Determinants of Public-Private-Partnership Performance: The Case of Pakistan

This thesis is submitted in fulfilment of the requirement for the degree of Doctor of Philosophy (Ph.D.) at James Cook University

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Research Outputs

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Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet the requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the material included in this thesis is original and is an intellectual product of the author of this thesis. Proper citation/ acknowledgment has been made to the work of other authors contained in this thesis.

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04 June 2019

Acknowledgments

In the name of Allah, Most Gracious, Most Merciful.
Proclaim! (or read!) in the name of thy Lord and Cherisher, Who created man, out of a (mere) clot of congealed blood. Proclaim! And thy Lord is Most Bountiful. He Who taught (the use of) the pen. Taught man that which he knew not (Al-'Alaq 96:1-5).

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Statement of Contributions of Others

Name of Assistance	Contribution	Names, Titles and Affiliation of Contributors
Supervision	Primary Supervisor	Dr Taha Chaiechi
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Abstract

Pakistan is the sixth most populous country in the world with a population of 207.77 million and growth rate of 2.40 percent per annum (Pakistan Bureau of Statistics, 2018). Continual increases in population growth and urbanisation are applying pressure on infrastructure services demand. Currently, the country is unable to finance infrastructure projects through traditional methods. Public finance – due to budget deficit. The provisions of Fiscal Responsibility and Debt Limitation (FRDL) Act 2005 limit federal fiscal deficit to 4 percent of gross domestic product (GDP) and the current budget deficit is 4 percent of GDP. Borrowing – is unavailable because, under lending restrictions in the FRDL Act 2005 public debt is restricted to 60 percent maximum of estimated GDP. Present public debt is 59.2 percent of GDP (Ministry of Finance, 2016). Issuance of international bonds – is not available due to their high susceptibility to event-risk factors. Access to capital markets is limited to only three stock exchanges and stock issuers are unable to use savings from remote areas. There is no availability of long-term lending facilities for infrastructure projects financing. Finally, the government cannot impose new taxes or increase tax rates due to weak economic conditions and political reasons.

Improvements in public infrastructure facilities have not kept pace with population growth and urbanisation. Consequently, the gap between infrastructure services demand and supply is widening. Financial constraint is the major barrier in infrastructure development alongside other problems such as a weak institutional framework, political instability and governance issues. Consequently, Pakistan ranks 115 out of 137 countries in the basic infrastructure category in Global Competitiveness Index 2017-18. Therefore, it is suspected that a large part of the population will not have access to infrastructure facilities in future, if appropriate measures are not taken now.

The present infrastructure demand-supply gap needs to be addressed on priority basis. New avenues to increase infrastructure investment may be found elsewhere, beyond the scope of public resources. Accordingly, Pakistani government needs to adopt innovative approaches to deal with financial constraints for infrastructure development by avoiding future debt traps. Empirical studies suggest that public-private partnerships (PPP) may be a valuable solution to the infrastructure challenge. Therefore, it is ascertained that PPP for infrastructure development is urgently needed in Pakistan and an exploration of the factors helping or impeding their implementation is justified.

However, there are a few impediments in PPP implementation in Pakistan. These includes lack of "ownership" of such projects at senior level management and a weak judicial system: there is a lack of fast track dispute-resolution mechanises. There is no PPP legislation and sector specific guidelines and standard model contracts. The financial system is weak such that long-term loans

for infrastructure development are unavailable. There is limited access to the capital market. Institutional structure is ineffective, especially regarding political instability and inconsistency in policy implementation. Finally, microeconomic polices are weak.

In the current literature, the majority of research focus, primarily within developed countries, has been put on PPP procurement, management and performance of PPP projects and service delivery. However, institutional capacity and the capacity of public and private sectors for implementing PPP projects has been largely ignored, with only a small number of researchers having identified the importance of institutional and public sector capacity for successful implementation of PPP projects. A comprehensive set of criteria and methodology for evaluating their capacity is missing. An extensive review of the available literature suggests that private sector capacity to implement PPP programs has not been assessed so far. Therefore, no previous analytical methodology and research technique was available to evaluate this aspect of PPP. As no studies have been carried out to determine the capacity of institutions, public and the private sector to implement PPP program in the context of Pakistan, this thesis therefore focuses on the determinants of PPP implementation.

In this thesis, time series and cross-sectional primary and secondary data covering 24 years from 1991 to 2014 was used. Primary data was collected through a survey questionnaire. Secondary data was collected through official websites and financial reports of the government of Pakistan and from the World Bank database. The suitability of questionnaire was verified by using factor analysis. Cronbach's alpha was used to test reliability and consistency among questionnaire variables. Time series property of the data and unit root non-stationarity of variables within panel framework was conducted by panel unit root tests. Panel cointegration tests were performed among the variables to avoid spurious regression by utilising Persyn and Wasteland tests.

The estimated model was built up within panel vector autoregression (PVAR) framework. The PVAR model was further extended to include qualitative policy variables to articulate the effects of quantitative and qualitative variables in infrastructure development of Pakistan. This model is generally known as panel vector auto regression with exogenous variables (PVAR – X). The panel regression model was estimated by ordinary least square (OLS) and generalised least square (GLS) methods. PVAR model was estimated by generalised method of moment (GMM). The post-estimation analysis was performed for checking: i) economic theory consistency and sign consistency; ii) statistical significance; iii) model adequacy; iv) goodness-of-fit tests; and v) classical testing framework was also applied (t-test, F-test, Lagrange multiplier (LM) and Wald testing approaches) for comparing growth parameter among panel and their interaction.

The estimation results showed that:

i) Institutions in Pakistan do not have the capacity for managing PPP program. The private sector not only lacks the capacity for participating and managing PPP projects but also are a barrier to infrastructure development;

ii) The public sector has an influence on PPP undertakings for infrastructure development but the sector cannot attract private sector investment due to lack of managerial, financial and monitoring capacity. Further, the public sector does not have the capacity for mitigating project-related risks.

iii) Other factors (barriers) for implementing PPP in Pakistan were also identified, which are: a) lack of good governance – administrative formalities and ambiguous rules and regulations; b) delays/deficiencies in project execution; c) public and private sectors do not have PPP related experience and qualification; and d) feasibility studies and projections for PPP projects are unrealistic.

This thesis contributes to both theoretical and practical aspects of PPP implementation in Pakistan. The findings provide valuable insights on how and why PPP model may or may not work effectively in different institutional settings. These contributions extend the theoretical literature related to PPP implementation, especially in developing economies, and provides policy guidance for the government to remove barriers for implementing and encouraging PPP undertakings in Pakistan. The findings provide guidelines for PPP implementation in Pakistan and the methodology used can be extended to other developing countries and/or multi-country studies for generating useful comparisons and revealing more useful information.

Keywords: Public private partnerships, Fiscal Responsibility and Debt Limitation Act 2005, panel vector autoregression, ordinary least square, generalised least square, Lagrange multiplier.

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List of Abbreviations and Acronyms

ADF	Augmented Dickey-Fuller
AIC	Akaike Information Criterion
APEC	Asia-Pacific Economic Cooperation
BLT	Build-Lease-and-Transfer
BOO	Build-Own-and-Operate
BOT	Build-Own-and-Transfer
BTO	Build-Transfer-and-Operate
CAGR	Compounded Annual Growth Rate
CSF	Critical Success Factor
DFBOT	Design, Finance, Build, Operate and Transfer
ECM	Error-Correction Mechanism
AIC	Akaike Information Criterion
GCI	Global Competitiveness Index
GFCF	Gross Fixed Capital Formation
ICT	Information and communication technology
IMU	Infrastructure Management Unit
IPDF	Infrastructure Project Development Facility
IPK	Institutionalist and Post-Keynesian
KICT	Karachi International Container Terminal
KM	Kilometer
KPT	Karachi Port Trust
KWH	Kilowatt-Hour
MDGs	Millennium Development Goals
MoF	Ministry of Finance
MW	Mega Watt
NC	Neoclassical
NK	Neo-Keynesian
NTI	Neoclassical Theory of Investment
OECD	The Organisation for Economic Co-operation and Development
PVAR	Panel vector Auto Regression
PFI	Private Finance Initiative

PICT	Pakistan International Container Terminal
PK	Post-Keynesian
PPIB	Private Power & Infrastructure Board
PPP, P3,3P	Public-Private Partnerships
PPPIRC	Public-Private-Partnership in Infrastructure Resource Centre
PSC	Public Sector Competitor
PSDP	Public Sector Development Program
ROO	Rehabilitate-Own-and-Operate
ROT	Rehabilitate-Operate-and-Transfer
Rs	Rupees
T&D	Transmission and Distribution
UNECE	United Nations Economic Commission for Europe
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
VGF	Viability Gap Funding
VoF	Value for Money
WEF	World Economic Forum

Glossary of Technical Terms

Animal Spirits	This term was used by the British economist, John Maynard Keynes, to explain financial and buying decisions in conditions of uncertainty. In Keynes' 1936 publication, *The General Theory of Employment, Interest and Money*, "animal spirits" describe the human emotion that drives consumer confidence.
Business Cycle	The business cycle is also known as the trade cycle or economic cycle. It is the upward and downward movement of GDP and unemployment in its long-term trend (Alan, 2006). Business cycles are usually measured by considering the growth rate of real GDP.
Circular Debt	Circular debt is a kind of debt where all members are both a creditor and a debtor. Every individual owes to someone and the net final creditor in the chain is indebted to the first creditor. At the end balance of all debts between individuals is zero (Nikbakht, 2006).
Credit Rating	An independent assessment of the likelihood of credit default of an enterprise or undertaking by a credit rating agency. A credit rating is assigned and this plays an important role in the pricing of the rated enterprise's securities (Regan, 2010).
Crowding in	An economic principle in which private investment increases as debt-financed government spending increases. This is caused by government spending boosting the demand for goods, which in turn increases private demand for new output sources, such as factories. This is in contrast to crowding out.
Crowding out	The principle that high levels of public sector activity in the economy (such as increased public expenditure) have an adverse impact on private sector demand. This can also apply to markets where Keynesian style budget deficits increase Treasury activity in the capital market, which increases interest rates and so "crowds out" private activity such as capital raisings, investment and expenditures.
Enabling Environment	A supportive policy, legal, institutional, macro-economic, infrastructural and bureaucratic environment. Businesses have difficulty functioning when their trading activities are hampered by excessive bureaucracy. When the judicial system does not function well and laws are not well drafted, this can distort

	and reduce the efficiency of the market, increase the costs of doing business and retard the development of a competitive private sector. Traders and others are generally reluctant to make investments in an uncertain policy climate, such as those that restrict imports and exports or internal produce movement.
Ex-Ante	The term is derived from the Latin for "before the event" and refers to future events, such as future returns (expected return of an investment portfolio) or prospects of a company. For example, an ex-ante analysis is done when an investment company values a stock ex-ante and then compares the predicted results to the actual movement of the stock's price.
Expansionary Monetary policy	Monetary policy is the process by which the monetary authority of a country, typically the central bank, controls the monetary base or cost of very short-term borrowing. It targets the inflation rate or interest rate to ensure price stability and general trust in the currency. Monetary policy is referred to as being either expansionary or contractionary. The expansionary monetary policy tool is used to stimulate the economy and maintain short-term interest rates at lower than usual rates to control unemployment and increase aggregate demand for all goods and services in an economy or to increase total supply of money more rapidly than usual. Expansionary monetary policy decreases the value of the currency relative to other currencies (the exchange rate). Contractionary monetary policy is the opposite of expansionary monetary policy. It is used to increase interest rates higher than usual, thus slowing the rate of growth in the money supply. Consequently, it slows short-term economic growth and lessens inflation. However, contractionary monetary policy leads to increased unemployment and depressed borrowing and spending by consumers and businesses, which can eventually result in an economic recession if implemented too vigorously.
Gross Fixed Capital Formation	Government/private expenditure on fixed assets, additions and replacements, and upgradation of existing fixed assets (excluding repairs and maintenance).
Incomplete Contract	A contract whereby some aspects of the future are not observable or capable of resolution at the time of the contract was entered into and writing-up the

	contract to address all future responsibilities is too costly, impractical or unachievable (Regan, 2010).
Public Sector Competitor	A public sector competitor (PSC) is an estimate of what the project would cost if traditional procurement methods were used while still meeting the performance standards expected from the private sector deal over the life of the contract. A PSC is normally used to determine whether private finance offers better value for money than traditional procurement.
Sovereign Debt	A central government's debt. This debt is issued by a national government in a foreign currency in order to finance the issuing country's growth and development. Sovereign debt is also called government debt, public debt and national debt.
Turnpike	Road with turnpike – in former times, a road that travellers were allowed to use only after paying a toll at the turnpike. Road barrier – a gate formerly used to bar the way on to a section of road or a bridge until a toll had been paid. Toll road – in the United States, a motorway on which a toll is charged. Drivers usually receive a ticket when they start their journey and pay a fee at the end that depends on the length of journey.
Unitary Charges	A payment refers to a fixed charge per unit of production under a long-term contract to supply a service. For example, under a PPP arrangement for a hospital, the private operator is required to furnish a minimum number of fully serviceable beds together with linen and support equipment to the hospital each day. The cost of providing and maintaining the beds is the responsibility of the contractor who is paid a quarterly unitary or availability charge based on bed availability.
User Charges	The imposition of fees and charges for the use of certain public goods and state-owned utilities. Examples include fees applied for admission to council car parks, highways, art galleries and national or state parks and flora/fauna reserves.
Value for Money	Value of money is generally defined as "the best possible outcome at the lowest possible price" (Linda, 2006). Value for money is the optimum combination of whole-life cost and quality (or fitness for purpose) to meet a user's requirement and does not always mean choosing the lowest cost bid. It should

not be chosen to secure a particular balance sheet treatment (HM Treasury 2004, p.3). The Partnerships Victoria (2001) approach to value for money is:

- Risk transfer – relieving government of the substantial, but often undervalued, cost of asset-based risks;
- Whole-of-life – whole-of-life costing, fully integrating under the responsibility of one party;
- Up-front – design and construction costs, with ongoing service delivery, operational, maintenance and refurbishment costs;
- Innovation – providing wider opportunity and incentive for innovative solutions for how service requirements can be delivered; and
- Asset utilisation – developing opportunities to generate revenue from use of the asset by third parties, which may reduce the cost that government would otherwise have to pay as a sole user.

Viability Gap Funding	Targeted subsidies provided by government for PPP projects that are economically and socially justified but financially unviable.

Personal Statement

I have had more than 17 years of diversified work experience in both private sector organisations and the public sector in various federal ministries at different positions in Pakistan. As a result of my experience, I realised that the country is unable to achieve its economic goals without well-established infrastructure. Financial constraint is the major impediment to infrastructure development, combined with other problems such as poor infrastructure planning, policy and management and the lack of research into alternative sources of infrastructure financing. This thesis is intended to provide both theoretical and policy-related contributions to inform future infrastructure funding decisions. In this context, the thesis focuses on how private sector participation in terms of PPP can be a part of the solution to infrastructure financing and management problems. However, inexperienced institutional frameworks and lack of public and private sector capability are major barriers to implement an efficient PPP programs. These challenges motivated me to develop expertise in the field of infrastructure development through private sector participation.

I have experience working with both the public and the private sector in Pakistan and over the years I have developed associations with public and private sector organisations. Therefore, I have access to bureaucracy, public sector record/reports and many private sector organisations in Pakistan for research purposes. This research is expected to provide in-depth an analysis of the determinants of PPP performance in Pakistan in order to promote its economic growth.

Chapter One: Introduction

1.1 Background

Pakistan's population grew by 1.954% in 2017, the highest population growth rate among South Asian countries (The World Bank, 2018) (Table 1.1 and Figure 1.1). Rapidly increasing population growth is putting pressure on infrastructure services. Consequently, the gap between infrastructure services demand and supply is widening continuously (Bjorvatn, 2000). Conversely, Pakistan's economic growth and development has remained unsustainable mainly because of insufficient physical and social connectivity and inappropriate use of economic growth software that drives the growth rate on a sustained basis. The software includes effective governance mechanisms, better organisation of institutions, efficient management of physical infrastructure, and human capital development in relation to globally successful experiences (Planning Commission, 2012).

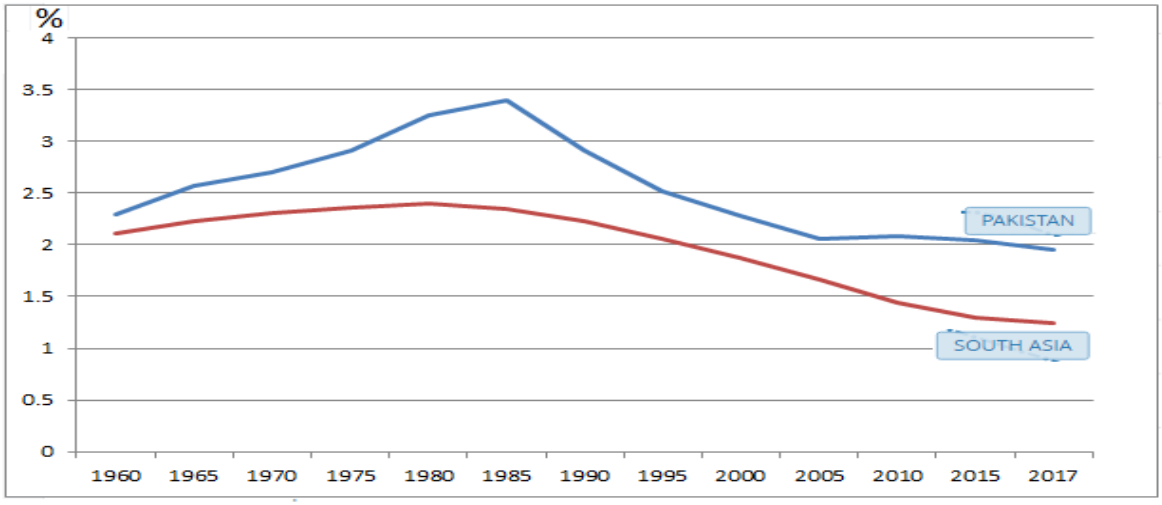
This thesis identifies the key determinants of PPP performance for developing physical infrastructure, including telecommunication, power and transport, with reference to Pakistan.

Table 1.1: Comparison of population growth rate (%) of Pakistan and South Asian countries 1960-2017

Year	Pakistan	Bhutan	Bangladesh	India	Nepal	Sri Lanka
1960	2.291	2.501	2.846	1.947	1.566	2.395
1965	2.577	2.846	3.101	2.074	1.715	2.376
1970	2.702	3.246	2.538	2.205	1.990	2.193
1975	2.912	3.205	2.014	2.321	2.165	1.858
1980	3.255	2.922	2.780	2.304	2.277	1.658
1985	3.397	2.923	2.683	2.254	2.278	1.422
1990	2.912	1.316	2.469	2.074	2.462	1.272
1995	2.522	-0.315	2.150	1.921	2.505	0.819
2000	2.276	2.807	1.958	1.774	1.849	0.603
2005	2.054	2.523	1.492	1.584	1.299	0.782
2010	2.080	1.828	1.120	1.367	1.049	0.612
2015	2.045	1.399	1.120	1.168	1.169	0.934
2017	1.954	1.227	1.049	1.127	1.106	1.130

Source: The World Bank Data (2018)

Figure 1.1: Comparison of population growth rates (%) of Pakistan and South Asia 1960-2017



Source: The World Bank Data (2018)

The basic physical and organisational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise is called infrastructure (Oxford Dictionary, 2018). Infrastructure is widely recognised as an integral part of economic growth in any economy (Lakshmanan, 2008; Zhang and Fan, 2004). It provides the core networks for all economic and social activities. A review of international empirical evidence points to a positive association between infrastructure investment and productive capacity, output growth, domestic and overseas trade, lower private costs, employment, incomes and living conditions of general public (Kevin, 2011; Paravaka and Ranjan, 2010; Naoyuki and Masaki, 2000).

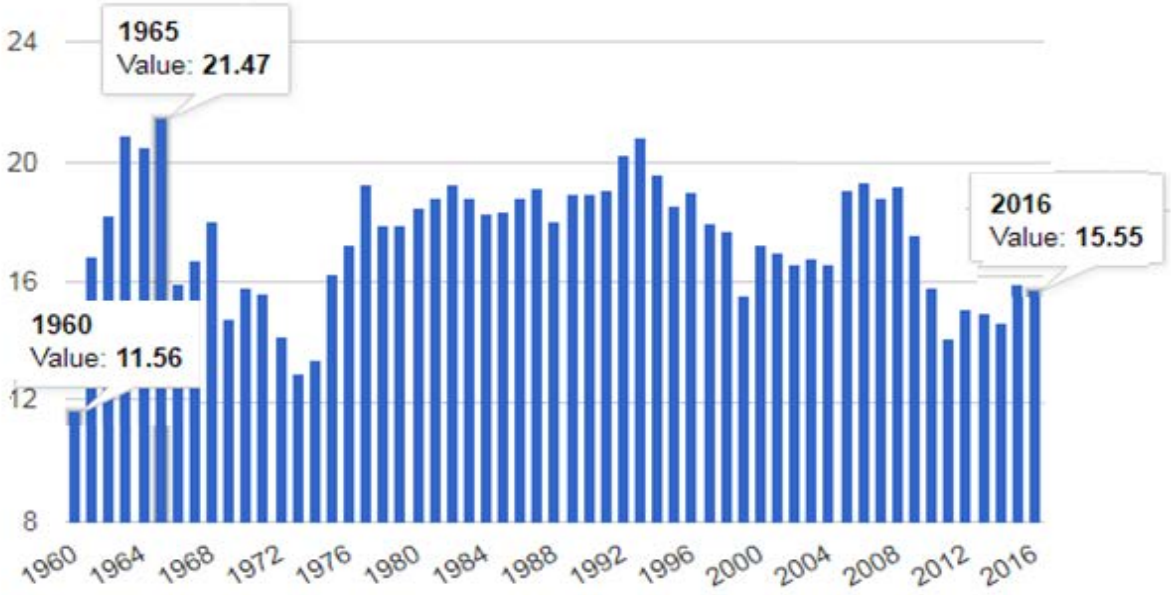
In Pakistan the gap between demand for and supply of infrastructure services is large and widening. Between 2010 and 2015 Pakistan's population increased by 8.83 percent while Development Expenditure (% of GDP) decreased to 2.3%. However, inadequate infrastructure facilities are observed to be one of the factors that have impeded Pakistan's attempts to achieve higher economic growth (Economic Survey of Pakistan, 1990 – 2015).

As noted above, Pakistan's need for infrastructure development has risen in recent decades due to increasing population and rapid urbanisation. On the other hand, gross fixed

capital formation[1](GFCF) in Pakistan was 15 percent of GDP in 2014 and 16 percent of GDP in 2016, which is the lowest in South Asia (World Bank Indicators, 2015 and 2017).

An increase in physical capital generates positive spillovers by providing better health, education and transportation, accumulating productive capacity to sustain a higher output by using modern research and techniques, and ultimately enhancing GDP growth. There is a two-way causality between GDP and investment (Maryam and Nazima, 2012). A comparison of infrastructure investment in Pakistan 1960-2016 is presented in Figure 1.2.

Figure 1.2:Infrastructure investment in Pakistan 1960 – 2016 by percentage of GDP



Source: The World Bank data (2018)

According to World Bank indicators 2018, the average value of infrastructure investment in Pakistan from 1960 to 2016 was 17.43 percent of GDP, with a minimum of 11.56 percent of GDP in 1960 and a maximum of 21.47 percent of GDP in 1965.

1.2 Pakistan: Infrastructure investment as a percentage of GDP

In Pakistan, infrastructure development has traditionally been carried out through public resources i.e. borrowing or taxpayer funded. The limited availability of public resources results in an inability to build sufficient infrastructure to meet growing demand (Table 1.2 provides an

[1] See Glossary of Technical Terms.

overview of Pakistan's budget deficits and debt). However, if the public sector is unable to fulfil this need, then private investment can be a useful option. Unfortunately, private sector participation in infrastructure development is also very limited.

Table 1.2: Pakistan's financial indicators (as percentage of GDP)

Year	Real GDP %	Budget Deficit % of GDP	Public Debt % of GDP
2006-07	5.5	4.1	55.5
2007-08	5.0	7.3	58.4
2008-09	0.4	5.2	60.0
2009-10	2.6	6.2	60.2
2010-11	3.6	6.5	59.3
2011-12	3.8	8.8	61.3
2012-13	3.7	8.2	64.0
2013-14	4.0	5.5	63.5
2014-15	4.1	5.3	63.3
2015-16	4.5	4.6	67.6
2016-17	5.3	5.8	67.2

Source: Adopted from Fiscal Policy Statement, Federal Budget, Ministry of Finance Pakistan

According to the Australian Department of Foreign Affairs and Trade (2014), the private sector drives growth and acts as an engine of growth by creating new jobs, and by paying taxes that finance services and investment. In developing countries, the private sector funds around 60 percent of all investments, provides more than 80 percent of government revenues and generates approximately 90 percent of jobs. The private sector also participates in the provision of essential infrastructure services, such as banking, transportation, telecommunications, health and education. According to the Ministry of Finance (2012), fixed investment by the private sector was 8.3 percent of GDP during the financial year 2012-13 out of a total fixed investment 13.1 percent of GDP, which is the lowest fixed investment by both the public sector and the private sector in South Asia (World Bank Database, 2016).

1.3 Current state of private investment in Pakistan

Overall Pakistan has not been successful in attracting private investment to develop infrastructure projects. The private sector's participation has remained limited to the telecommunications sector, power generation and container terminals at ports, which are highly commercial projects. (Details of private sector participation in infrastructure development in Pakistan and its comparison with South Asian countries are provided in Chapter Two.) The possible reasons for low private sector investment in infrastructure in Pakistan have been investigated and are stated to be as follows by the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) – PPP Network, 2010; Infrastructure Management Unit (IMU), Planning Commission of Pakistan (2007):

1.3.1 Weak institutional arrangements

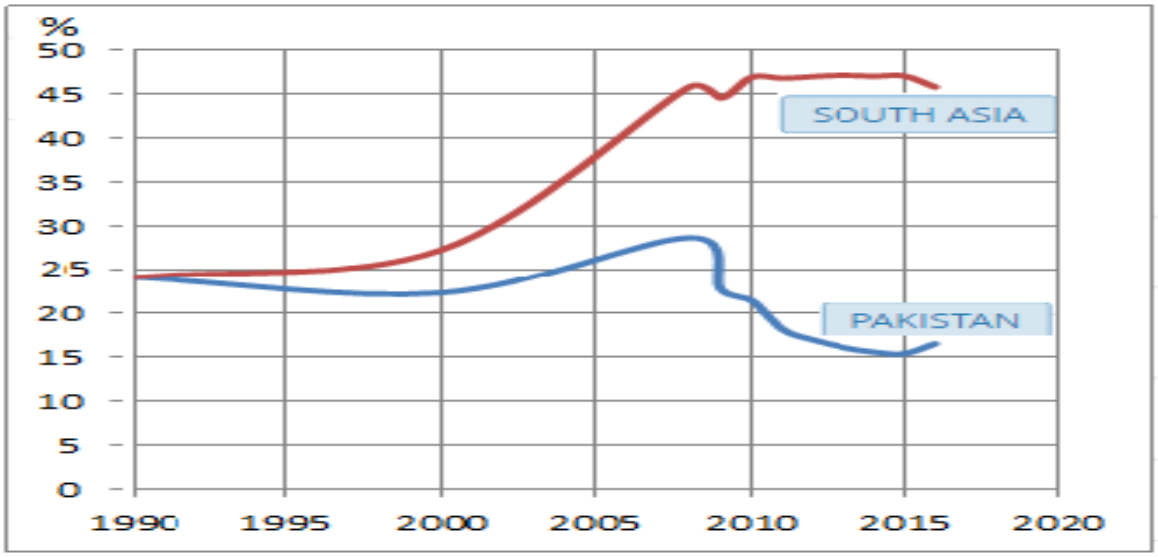
Debt financing for infrastructure projects is very limited/unavailable due to the long development period needed to construct and commission projects, during which there is little financial return. Infrastructure projects typically require long-term investment (10-20 years approximately). Therefore, traditional lending resources (commercial banks) do not offer long-term loans facilities for large infrastructure projects. Bank credit provided to the private sector in Pakistan during 1990 to 2017 reached its lowest point of 15.39 percent of GDP in 2015, which is also the lowest among South Asian countries (The Global Economy.com, The World Bank). Table 1.3 and Figure 1.3 provide a comparison of domestic credit to the private sector as percentage of GDP in Pakistan and South Asia during 1990-2017. Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of non-equity securities and trade credits and other accounts receivable, that establish a claim for repayment (The World Bank, 2018).

Table 1.3: Comparison of domestic credit to private sector (% of GDP) in South Asian countries 1990-2017

Year	Pakistan	Bangladesh	Bhutan	India	Nepal	Sri Lanka
1990	24.16	16.07	4.11	25.25	12.81	19.62
2000	22.34	21.78	8.85	28.72	30.67	28.83
2008	28.73	34.04	29.96	50.06	51.65	29.54
2009	22.72	36.19	32.42	48.78	59.18	25.74
2010	21.41	40.96	41.45	51.14	54.59	25.52
2011	18.13	42.47	46.81	51.29	52.95	35.01
2012	16.94	43.00	45.72	51.89	56.13	35.02
2013	16.12	41.79	45.64	52.39	58.03	34.75
2014	15.59	43.74	43.82	51.88	61.90	35.87
2015	15.39	44.41	45.19	51.90	64.75	41.60
2016	16.53	45.28	47.02	49.55	81.05	45.71
2017	17.03	47.58	---	---	81.16	---

Source: The World Bank Data (Retrieved on 27-08-2018)

Figure 1.3: Comparison of domestic credit to private sector (% of GDP) in South Asian countries 1990-2017



Source: The World Bank Data (Retrieved on 27-08-2018)

1.3.2 Lack of expertise

Pakistani government departments lack knowledge and prerequisites of project finance at an institutional level. A well-developed insurance sector can be an important long-term financial resource for infrastructure development, like other financial institutions such as banks. The insurance sector should facilitate investors by providing hedging facilities. A hedge is an investment position intended to offset potential risks or losses that may be incurred by an investor. Simply, a hedge is a risk management technique used to minimise any substantial losses or gains suffered by an individual or an organisation. Examples of hedging include forward exchange contracts for currencies and interest, money market operations for currencies and bets on elections or sporting events. However, the Pakistani insurance sector is dormant due to low levels of insurance density and penetration in the country. The domestic financial market (commercial and industrial banks), lending companies and the stock exchange are also not mature enough to finance infrastructure projects. The country's capital market (a financial market that provides long-term debt or where bonds and equity-backed securities are bought and sold) is limited and unable to encompass the country's overall infrastructure financing needs. In Pakistan, private investors are not familiar with infrastructure project financing and typically are short-term investors. They are more inclined towards projects that involve lower investment, have shorter construction and return periods, and are highly profitable. Examples of these include short-term stock market investors, real estate investors, gold and money market

investors. See, for example: (Edwards, 1998; Infrastructure Management Unit, 2007; Investopedia, 2018; Morewedge, Tang, & Larrick, 2018).

1.3.3 Lack of adequate regulatory framework

Too many bureaucratic formalities are involved in the public procurement process. The main bottlenecks are the complex and time-consuming procurement, approval, tendering and bidding processes, as well as conflicts of interest, the principal-agent problem and increasing risk of corruption. Complex rules and regulations together with official procedural requirements are known to cause delays in project completion and cost overruns (Klijn & Teisman, 2003). In addition, a lack of unidirectional policy frameworks and coordination at federal, provincial and municipal levels have impeded private-sector investment in infrastructure development in Pakistan (Infrastructure Management Unit, 2007). The existing procurement law does not have provisions for cancelling the procurement process if there are any irregularities. There is limited scope to make changes to the requirements once the contract has been signed, as it increases the project cost (Podriguez, 2018). Furthermore, the division of responsibilities between the contracting parties (public and the private sector) is unclear and ambiguous project-related risk mitigation mechanisms have discouraged private-sector participation in infrastructure development.

1.4 Justification for the Thesis

1.4.1 Pakistan's Current Infrastructure Status

Pakistan is the sixth most populous country in the world, with 188.9 million people (The World Bank, 2018). Projections suggest that it will become the fifth largest country with a population ranging between 230 and 260 million people by 2030 (Planning Commission, 2005). The country also has a relatively high level of urbanisation, with 37 percent of its population living in cities, and so is the most urbanised in South Asia (Ministry of Finance, 2011).

Rapid urbanisation is claimed to place burdens on inadequate infrastructure (Bjorvatn, 2000). The rapid increase in population and urbanisation has led to the gap between infrastructure services demand and supply widening. According to the Ministry of Finance (2011), existing road conditions are getting worse, the power supply and sewerage and sanitation systems are unreliable and potable water is often unavailable. A comparison of urbanisation across South Asian countries is presented in Table 1.4.

Table 1.4: Comparison of urbanisation across South Asian countries at 2015

Country	Population (Millions)	Surface area Thousand Sq. Km	Population density people per sq.km	Urban population % of total population
Pakistan	188.9	796.1	245	39
Bangladesh	161.0	147.6	1,237	34
Bhutan	0.8	38.4	20	39
India	1,311.1	3,287.3	441	33
Nepal	28.5	147.2	199	19
Sri Lanka	21.0	65.6	334	18

Source: World Bank Indicators 2017.

Pakistan's basic infrastructure, such as roads, railways, ports, airports, communication and power supply, is not equivalent to the standards prevalent in competitor countries. On a global scale Pakistan's infrastructure is also very poor. Its infrastructure ranking in the basic determinants of Global Competitiveness Index (GCI) in the year 2015-2016 is 117 out of 140 countries (Global Competitiveness Index 2015-16). Table 1.5 presents Pakistan's ranking in the basic determinants of GCI:

Table 1.5: Pakistan's ranking in the basic determinants of GCI

Period	Overall Rank	Infrastructure	Institutions	Health and Primary Education	Macroeconomic Stability
2009-10	101/133	89/133	104/133	113/133	114/133
2011-12	118/142	115/142	107/142	121/142	138/142
2015-16	126/140	117/140	119/140	127/140	128/140

Source: Adopted from the data collected from GCI 2009-10, 2011-12 and 2015-16

1.4.2 Scarcity of finance/loans

Lack of public financing and expertise is a major barrier to project execution around the globe, which prompted the government to seek foreign support and encourage the private sector to become involved in developing infrastructure (Business Monitor International, 2016).

In summary, the primary reasons for scarcity of finance/loans are: perception of country risk, lenders' fear and credibility of the host government, lack of predictability in government decisions, institutional capacity concerns, the enforceability of contracts, and the regulatory framework and its transparency (Smith, 2007).

Pakistan has particular challenges that limit its ability to develop its infrastructure facilities. As mentioned earlier, a lack of public resources causes budget deficits and high levels of public debt (refer to the summary of recent trends in Table 1.3). In addition, limited participation by the private sector in infrastructure development may also continue to impede infrastructure growth in Pakistan. On the other hand, identifying strategies to bridge the gap

between infrastructure service demand and supply is an enormous challenge the country has to deal with due to the importance of infrastructure development in the economy. New avenues to increase infrastructure investment may be found elsewhere. Empirical studies suggest that PPP may be a valuable solution to the infrastructure challenge; see, for example, (Adrias, 2010; Pereira & Andraz, 2005; Peter, 2010).

1.4.3 Brief introduction to PPP

PPP involve the public sector authority and private sectors working together to provide services. Under a PPP arrangement, the private sector performs a function on behalf of the public sector for a contracted time period, and assumes financial, technical and operational risk in the project. The private party's compensation is based on its performance (availability of service and quality of the service). A PPP allows each partner to concentrate on activities that best suit their skills. For the public sector that means focusing on developing policies and identifying service needs, while for the private sector the key is delivering those needs efficiently and effectively [at an affordable price] (IPDF, 2006).

PPP procurement is based on output specification. In PPP procurement, the government defines the required service and leaves the design and planning of the project to the private party. In this way optimal risk associated with the project from the project design stage through to operation and service delivery is transferred to the private party. In some circumstances design requirements may not be left entirely to the discretion of the private party and the public sector may specify some inputs (IPDF, 2006). The advantages and disadvantages of PPP will be discussed in detail in Chapter 3. The PPP model has been successfully adopted in many countries for various purposes including the provision of infrastructure services.

PPP programs have been successfully adopted in both developed and developing countries such as the United Kingdom, Canada, the United States of America, Australia, Japan, Netherlands and Hungary (European Commission Directorate-General Regional Policy, 2004; European PPP Expertise Centre, 2012). To overcome funding shortages, developing countries such as India, Mexico, Sri Lanka, Bangladesh and Nepal have also increasingly resorted to the PPP approach and have successfully implemented various PPP projects.

The PPP model is financially strong and technically sound, as well as having management efficiency, credibility and the goodwill of the partners (Bovis, 2015; Graeme, 2018; PPPIRC, 2018). Its successful implementation in many other countries suggests that it may be a suitable model for Pakistan to explore, to see whether it can help address the country's

infrastructure shortfall. Unfortunately, there do not appear to be any relevant studies on using the PPP model in the context of Pakistan's infrastructure development. This thesis examines Pakistan's capacity to use the PPP procurement model for infrastructure development and, if capacity is lacking, what the major impediments are.

1.5 Research questions and objectives

The research questions answered by this thesis concern the major impediments to PPP implementation in Pakistan and how they affect PPP implementation.

General Research Questions

- What is the current status of private participation in infrastructure investment in Pakistan? If this participation is not extensive, why not?
- Has the PPP model been used effectively in Pakistan to proactively involve the private sector in infrastructure development? If not, why not and what are the major obstacles?
- Are institutional impediments the most critical to the effective adoption of the PPP model for infrastructure development?
- What kind of institutional arrangements are needed and how can they be developed in Pakistan to boost PPP undertakings for infrastructure development?

A set of specific empirically testable research questions was developed in order to answer the general research questions.

Specific Research Questions

- Does institutional capacity (IC) have an effect on PPP implementation in Pakistan?
- Do the public and private sectors in Pakistan have the capacity to implement PPP programs?
- Do other factors have an effect on PPP implementation in Pakistan? If so, what are these factors and what is their relative impact?

The primary objective of this thesis is to identify the main obstacles to implementing PPP in Pakistan, focusing on institutional, public-sector and private-sector impediments along with other factors. The findings from this research will assist in identifying policy implications and policy adjustments that can be made to encourage greater adoption of PPP to develop infrastructure in Pakistan.

Research amis are to:

- Survey the current status of infrastructure development in Pakistan
- Evaluate contributions to infrastructure development by both the public and private sectors
- Examine the causes of the lack of implementation of PPP in Pakistan
- Develop a framework that helps to establish essential institutional arrangements conducive to PPP adoption
- Draw out implications for policy development for effective PPP implementation in Pakistan.

1.6 Methodology

The research underpinning this thesis used both quantitative and qualitative methods to achieve the research objectives. Quantitative techniques were used for investment analysis relative to PPP for the period 1991 to 2014. The quantitative/secondary data was collected from the websites and reports of government authorities and multilateral agencies. A survey questionnaire was used to collect qualitative/primary data from public and the private sectors to assess each sector's capacity to implement successful PPP program. Guidance from relevant studies conducted by researchers from both developed and developing countries has been taken to ensure the legitimacy of the information generated. The research methodology is described in detail in Chapter Four.

Factor analysis was used to verify the variability of the observed variables used in the questionnaire and reliability and consistency among questionnaire variables was tested by Cronbach's alpha. This thesis treated infrastructures (telecom, power and transport) as a panel and specified relationships as a panel data model. Thus, the specification of the model was via a panel vector auto regression (PVAR) model. The statistical properties of the panel variables were checked for stationarity of the variable by panel unit root tests. The PVAR model is useful because it captures both static and dynamic interdependence among panel variables of interest. PVAR with exogenous variables was used to combine the quantitative variables and the survey responses to articulate the effects of the variables (both quantitative and qualitative) in the infrastructural development within Pakistan. An overview of the research design and thesis contribution is provided in Table 1.6. The methodology is discussed in detail in Chapter Four.

Table 1.6: Overview of the research design and thesis contribution

Research aims	Research questions	Research gap	Research methodology	Analysis techniques	Contribution
• Survey the current status of infrastructure development in Pakistan • Evaluate contributions to infrastructure development by both the public and private sectors • Examine the causes of the lack of implementation of PPP in Pakistan • Develop a framework that helps to establish essential institutional arrangements conducive to PPP adoption • Draw out implications for policy development for effective PPP implementation in Pakistan	• Does institutional capacity (IC) have an effect on PPP implementation in Pakistan? • Do the public and the private sectors of Pakistan have the capacity to implement PPP programs? • Do other factors have an effect on PPP implementation in Pakistan? If so, what are these factors and what is their relative impact?	• There is a gap in literature determining institutional capacity, public sector capacity and the private sector capacity to implement PPP program in Pakistan • To our knowledge, private sector capacity to implement PPP programs has not been assessed so far. Therefore, no previous method and technique is available to evaluate this aspect of PPP • Some research has been done on the role of institutions and public sector capacity to develop infrastructure to achieve higher economic growth. However, its scope is limited and does not complete the causal direction.	• Factor analysis was used to verify the suitability of the questionnaire • Reliability and consistency among questionnaire variables were tested by Cronbach's alpha. The model in this thesis was built up within the panel vector autoregression framework allowing dynamics of investment and other quantitative independent variables. • The quantitative variables were all treated as endogenous and modelled as a Panel vector auto regression (PVAR) model • This model was further extended to include qualitative policy variables to articulate the effects of both variables (quantitative and qualitative) in the infrastructural development of Pakistan. This model is generally known as Panel vector auto regression with exogenous variables denoted as PVAR – X	• The panel regression model (1) is carried out by using ordinary least squares (OLS), generalised least squares (GLS) and maximum likelihood methods. • PVAR and PVAR – X are estimated using Generalised Method of Moment (GMM) estimation • Analyses are performed to check: • (i) theory consistency • (ii) statistical significance • (iii) model adequacy and • (iv) goodness-of-fit tests. • We also conducted Hausman (1978) & Breusch-Pagan (1980) tests for model selection (between fixed effects and random effects models) • The research problems are restated in terms of statistical hypotheses and are tested within the classical testing framework (e g. t, F, χ^2, LR, LM, Wald testing approaches)	• This study provides a comprehensive survey of major obstructions to undertaking PPP in Pakistan • This thesis is an attempt to construct a comprehensive framework to examine successful PPP implementation in Pakistan • This study also provides important information and inputs with government policy implications for removing barriers to PPP implementation and encouraging PPP undertakings in Pakistan for infrastructure development • Some research work has been done on the roles of institutions and public sector capacity to develop infrastructure to achieve higher economic growth. However, the scope is limited and does not complete the causal direction. The stages were elaborated into a unidirectional flow, which differentiates this research from the existing body of knowledge.

1.7 Econometrics to verify the results

The econometric models were estimated using the STATA program. They are discussed in detail in Chapter Six.

1.8 Organisation of the Thesis

This thesis is organised into seven chapters. The first chapter provides the background for the justification of the thesis, key facts relating to Pakistan's economy and comparisons of Pakistan to other South Asian countries. This chapter discusses the current infrastructure investment trends and methods used in Pakistan and the current status of private-sector investment in infrastructure development. The chapter also briefly identifies the possible reasons for low private-sector participation in infrastructure development in Pakistan. Justification for the thesis, research aims, research questions and research objectives and the methodology for the data analysis techniques used to address the research questions are also discussed in this chapter.

Chapter Two discusses the importance of infrastructure and provides a sector-wide overview of the current status of infrastructure in Pakistan. This chapter also reviews infrastructure investment planning, policies and trends in Pakistan. Causes of insufficient infrastructure facilities in Pakistan and infrastructure projects financing models are also discussed in this chapter, which serves as a background against which the remaining chapters of the thesis can be read.

Chapter Three provides a critical literature review that examines empirical data from previous studies dealing with the role of infrastructure, PPP and institutions in economic growth. This section is divided into four sub-sections:

- The role of infrastructure in economic growth;
- PPP – a solution;
- Role of institutions in economic growth; and
- Review of investment theories in context of investment in public infrastructure.

The gaps in current literature is also identified in this chapter.

Chapter Four consists of a discussion of the assorted theoretical and methodological approaches that have been used by various researchers for assessing institutional capacity, public and the private sector capacity in implementation of PPP programs for infrastructure development. In this chapter, research questions are translated into econometrically testable

hypotheses, other factors are discussed that have impacted on PPP implementation, the data used for analysis is discussed, as are research methodology and estimation approaches in detail.

Chapter Five presents a detailed discussion of primary data/qualitative data collection approaches used in the studies that were undertaken as part of the thesis, together with tabulation and representation of qualitative data in numerical values. This chapter discusses the study type selection, data sources, the design of the questionnaire, econometric equations and estimation techniques and the adoption of an estimation model. Preliminary results are also presented in this chapter.

Chapter Six presents findings from the data analyses and discusses the findings as they specifically relate to the research questions. This chapter also states the empirically testable research hypotheses and provides hypotheses test results for pinpointing the causes of obstructions of PPP implementation in Pakistan.

Chapter Seven summarises the key findings of the thesis and conclusions that can be drawn and underlines the significance and contributions of the study to policy makers and both the public and private sectors. This chapter discusses the implication of the findings, the limitations of the study and policy development. Recommendations for future research in the area are also made in this chapter.

Chapter Two: Current Status of Infrastructure in Pakistan

This chapter presents an overview of the current status of infrastructure development in Pakistan. The overview draws primarily on policy documents and international economic reports as there is little critical analysis of Pakistan's infrastructure strengths and weaknesses in the academic literature. Section 2.1 discusses common definitions and various interpretations of the term "infrastructure". Section 2.2 presents an overview of Pakistan's current infrastructure status with a discussion of historical trends and the increasing demands placed on infrastructure and services. Pakistan's infrastructure investment policies and trends are addressed in Section 2.3. Section 2.4 explores major causes of insufficient infrastructure in Pakistan and makes recommendations on how to boost Pakistan's infrastructure.

2.1 Defining infrastructure

The basic physical and organisational structures and facilities (e.g. buildings, roads, power supplies) needed for the operation of a society or enterprise is called infrastructure (Oxford Dictionary, 2018). Over time different researchers have defined infrastructure differently. Various researchers (see Lakshmanan, 2008; Jamaluddin et al., 2007 and INSTATE Pty. Ltd., 2001) refer to infrastructure as comprising two parts: the basic physical structure (roads, buildings, power etc.) and the organisational structure (institutions). Other researchers have distinguished between "hard" infrastructure i.e. large physical networks necessary for the functioning of the economy, and "soft" infrastructure i.e. institutions required to maintain the economy (Instate Pty. Ltd., 2001).

Other definitions of infrastructure are as follows:

Lakshmanan (2008) states that physical infrastructure covers telecommunication, power and transportation and through its spillover effects can increase employment, income and savings. It can also lead to higher living standards and eventually forward and backward linkages to facilitate growth. Infrastructure development spreads its positive effects across the economy. Social infrastructure includes water supply, sanitation, sewage disposal, education and health, as primary services that have a direct impact on the quality of life. Physical infrastructure and social infrastructure are interlinked, and both improve living standards and accelerate growth rate.

Jamaluddin et al. (2007) classify infrastructure as:

- Physical infrastructure: transport, power, communication and agro-specific infrastructure such as manufacturing of farm equipment, imports and exports of farm products
- Financial infrastructure: banking services and life insurance corporations
- Social infrastructure: health, education, medical care, aged care, nutrition, housing, water supply, sanitation, sewage collection and disposal, parks and sports facilities.

Instate Pty. Ltd. is an advisory practice that undertakes research and analysis as inputs for business managers and policy makers. Instate Pty. Ltd. (2001) asserts that the most critical infrastructure for economic development is that which relates:

- Directly or indirectly, to the movement of people and goods – the physical (hard) infrastructure such as the roads, the rail networks, the ports and power stations etc.
- To quality of life – the social (soft) infrastructure such as hospitals, health care facilities, social services, the art and the legal and regulatory systems etc.
- To the generation, storage and sharing of knowledge – the knowledge infrastructure (schools, colleges and universities, research bodies and libraries etc.).

This thesis focuses on three sectors of physical infrastructure, namely telecommunication, power and transport, with the objective of assessing their impact on the economic growth of Pakistan.

2.1.1 Infrastructure improves standard of living

Infrastructure development has positive and significant effects on output and the standard of living in the long-term (Peter et al. 2009). Additionally, improved infrastructure facilites have important impacts on household welfare (Mensah et.al, 2014). A review of the available literature has highlighted that infrastructure has a positive impact on economic growth [see, for example, Alfredo and Jorge (2013); Pravakar Sahoo and Ranjan Kumar Dash. (2013) and Minh (2012)]. Conversely, poor infrastructure reduces the profitability of the manufacturing sector (Bjorvatn, 2000). An inadequate infrastructure network may imply inefficiency in transportation of raw materials and possible increases in price. Therefore,

lack of infrastructure that connects growers, producers and consumers of final goods causes inefficiencies and competitiveness problems, which may impede economic growth (D´emurger, 2001). According to Aschauer (1993) there is a strong causal relationship between public capital investment and both productivity and output. Further, new research suggests that public infrastructure is also considered a factor of production along with factors of such as land, labour and capital.

2.1.2 Infrastructure has positive effects on business

Infrastructure affects production activities in developing countries (Yoshino and Nakahigashi, 2000). Infrastructure has positive effects in reducing production costs and contributing positively to aggregate output and productivity (Ecurra et al. 2005; Bjorvatn, 2000; Andrews and Swanson, 1995). According to Nourzad et al. (2014), public expenditures on infrastructure development increase the productivity of private investment by improving production conditions. Infrastructure not only has an impact on output but also attracts foreign direct investment (FDI). Several empirical studies have recognised that FDI is one the factors of economic growth and concluded that FDI contributes to the living standard of the host country by transfer of new technology (Nourzad et al. 2014).

2.2 Overview: ownership/control of Pakistani's infrastructure assets across each sector

As mentioned earlier, Pakistan is lagging behind in achieving its development goals mainly because of poor infrastructure facilities compared with South Asian countries (Table 2.1 refer). A better infrastructure increases productivity, income and consumption levels, which ultimately improves living standards (Kusharjantoa and Kim, 2011; Peter et al. 2009). According to Mensah et al.'s (2014) study, improved infrastructure increases business opportunities, improves public and private assets, increases household income and consumption, reduces vulnerability, improves food security, increases access to natural resources and eventually increases public wellbeing. Several empirical studies have shown that poor infrastructure in developing countries has negative effects on economic growth (see, for example, Lin and Doerte, 2012). Better strategies must be developed and put in place to address Pakistan's infrastructure challenge.

Table 2.1: Comparative Indicators of Infrastructure across South Asian Countries

Indicators	Pakistan		India		Bangladesh		Bhutan		Nepal		Sri Lanka	
	1990	2014	1990	2014	1990	2014	1990	2014	1990	2014	1990	2014
Population (millions)	103	185	508	1,295	106	169.1		765	18.8	28.2		20.8
Population growth (%)	2.9	2.1	2.1	1.2	2.5	1.2	1.2	1.4	2.5	1.2	1.2	0.9
Population density (people per sq.km)	---	240	---	436	---	1,222	---	20	---	197	---	331
Mobile cellular subscription (% of population)	---	73.3	0	74.5	0	80	0	82.1	0	81.9		103.2
Individuals using the internet (% of population)	---	14	---	18	---	10	---	34	---	15	---	26
Access to Electricity (% of total pop. Year 2012)	59.6	43.1	50.9	78.7	21.6	59.6	65.6	75.6	69.9	76.3	78.3	88.7
Access to improved water (% of total pop.)	---	91	70.5	94	68.1	87	72	100		92		96
Access to improved sanitation facilities (% of total pop.)	---	64	16.8	40	34.4	61	18.9	50	---	46	---	95
Telecom Density (% of Population) *	---	70.37	---	72.94	---	16	---	---	---	18	---	122
Road Density by Population (Road km/1,000 people) *	---	1.7	---	3.8	---	1.9	---	6.5	---	0.6	---	4.7
Life expectancy (Total years. Data 2012)	---	65.7	---	67.3	---	70.9	---	68.7	---	68.8	---	74.5

Source: Author (compiled from World Bank data, 2016; World Bank Indicators, 2015; *The World Bank Data, 2006)

Table 2.1 presents a brief comparison of basic infrastructure facilities available in South Asian countries. The comparison shows that the basic infrastructure facilities in Pakistan are inadequate and the country ranks lowest in South Asian countries. The country also ranks the lowest in life expectancy (total years). While, population growth trend of Pakistan in the year 2014 is the highest in the region.

The status of Pakistan's infrastructure can be determined through an analysis of key indicators. Tables 2.3 to 2.8 present sector specific comparative data including relevant indicators for the period 1960 to 2015, with the objective of understanding how changing conditions and demands on infrastructure have evolved over time. Pakistan's growing population continues to burden already strained infrastructure services.

2.2.1 Population and GDP Trends

As shown in Table 2.2, Pakistan has experienced a very large increase in population since 1960, with population density increasing from 75.3 people/sq.km in 1970 to 240.1 people/sq.km in 2015. Conversely, overall Pakistan's GDP has experienced a decline. Data shows a decrease from Rupees (Rs.) 7.16 (million) in 1960 to Rs.1.42 (million) in 1970 peaking at Rs.9.15 (million) in 2010 before declining to Rs.1.13 (million) in 2015. The annual average growth rate/compounded annual growth rate (CAGR)[2] from 1960 to 2015 of development expenditure as a percentage of GDP (0.29 percent) is lower than the population growth (2.62 percent).

Table 2.2: Population growth and GDP from 1960 to 2015

Indicators	1960	1970	1980	1990	2000	2010	2015
Population (million)	44.9	58.1	78.1	103	138	170	185
Population Density(people/sq.km)	56	75.3	101.3	139.3	179.4	22.6	240.1
Population Growth Rate %	2.3	2.7	3.3	2.9	2.3	2.1	2.1
GDP (Rs. in millions) ^	7.16	1.42	2.24	4.12	6.07	9.15	1.13
Development Expenditure (% of GDP)	---*	17.8	8.1	5.2	5.2	6.5	4.2

Source: compiled from Economic Survey of Pakistan, 1990-2015; FAO, 2015 and World Bank, 2016
*Data is not available ^ 1US$ = 121 Pak Rs. (as on 21/06/2018)

The substantial increase in population has placed additional demands on services and driven the need for greater infrastructure development. Many areas of Pakistan's infrastructure are affected by the rising population growth, as shown in Table 2.3, including

[2] Formula to calculate compound annual growth rate is: CAGR = (EV / BV)1/n - 1. Whereas, EV = Ending Value, BV = Base Value and n= Periods.

power, roads, railways, seaports, aviation and telecommunications. Comparative data in relation to these areas are presented in Tables 2.4. to 2.9.

2.2.2 Telecommunications

The telecommunication sector has progressed in the past five decades, especially in the most recent five-year period for which data is available (between 2010 and 2015). There has been an increase in telephone line connections (64.71 percent of the total population) with a CAGR of 7 percent, cellular subscriptions (73.4 percent of the total population) with a CAGR of 53 percent from 1990 to 2015, and broadband penetration (13.5 percent of the total population) with a CAGR of 79 percent from 2010 to 2015. However, as at 2015, 35.19 percent of the population still did not have a telephone line connection, 26.6 percent of the population did not have a mobile phone connection and 86.5 percent of the population had no access to internet facilities. A comparison of telecommunication access trends is presented in Table 2.3.

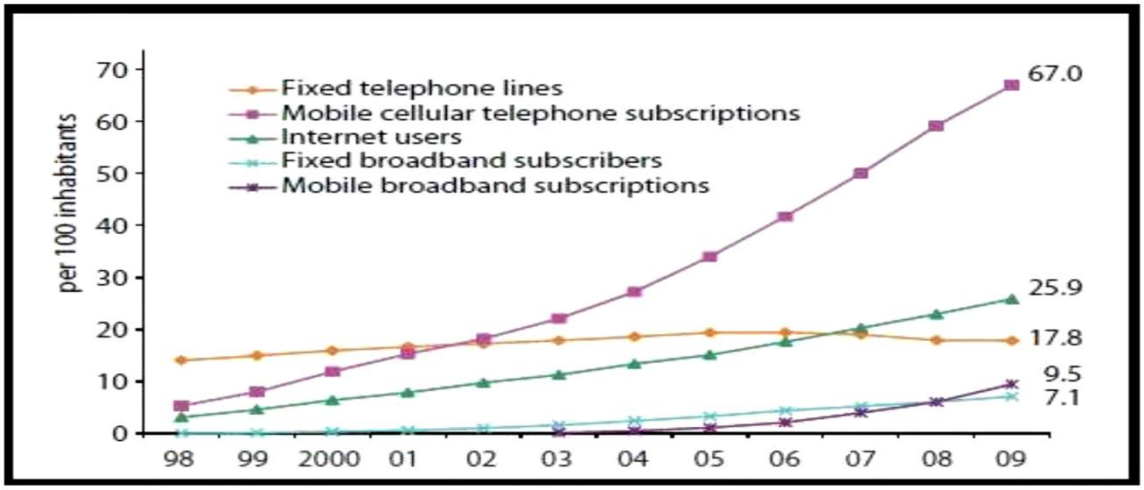
Table 2.3: Comparative data of telecommunication from 1960 to 2015

Indicators	1960	1970	1980	1990	2000	2010	2015
Telephone Lines (million No.)	0.1	0.2	0.6	1.2	3.3	3.4	5.6
Mobile Phones (per 100 people)	---*	---*	---*	.0018	0.2	57.3	73.4
Internet Connections (per 100 people)	---*	---*	---*	---*	---*	8	13.8

Source: Economic Survey of Pakistan, 1990-2015; FAO, 2015 and World Bank, 2016
*Service was not introduced in Pakistan

The use of information and communication technology (ICT) contributes to the economic growth of a country. Farhadi, Ismail, and Fooladi (2012) used a sample of 159 countries and categorised them in to four groups (high income, upper middle, lower middle and lower income) for the period 1998 to 2009. Their study revealed that: i) ICT has a positive and significant effect on economic growth; ii) the majority of the countries recognised the important effect of ICT on their economic growth; and iii) the more a country uses ICT, the greater is its economic growth. Global ICT development from 1998 to 2009 is presented in Figure 2.1.

Figure 2.1: Global ICT developments, 1998-2009



Source: Farhadi et al. (2012), page 1.

According to Atkinson and Stewart (2013) ICT helps economies to create high-paying jobs, drives productivity and GDP growth, helps build high-growth companies, creates new sectors and ways of doing business, and ICT is the key source of competitive advantage and drives innovation. However, Pakistan is far behind in providing ICT facilities to its citizens compared with the rest of the world. Pakistan ranked 124 and 112 out of 140 countries in 2016 for mobile telephone subscription and fixed-telephone line connections respectively in the World Economic Forum's Global Competitiveness report (World Economic Forum, 2016).

2.2.3 Power (Electricity) Access and Consumption

Table 2.4 shows that in 1990, 59.6 percent of Pakistan's population had access to electricity. Since then, Pakistan has improved the population's access to electricity significantly with a CAGR of 1.83 percent from 1960 to 2015. In 2015, 93.6 percent of the population had access to electricity, with the remaining 6.4 percent still deprived of it. In addition, the consumption of electricity kilowatt-hour (kWh per capita) increased by approximately threefold since 1980, putting greater pressure on already limited resources.

Table 2.4: Comparative access and consumption data for the power sector from 1960 to 2015

Indicators	1960	1970	1980	1990	2000	2010	2015
Access to Electricity (% of population)	---	---	---	59.6	79.5	91.4	93.6
Consumption (kWh per capita)	---	---	136.1	277.6	373.2	466.6	449.9

Source: Economic Survey of Pakistan, 1990-2015; FAO, 2015 and World Bank, 2016
Note: --- indicates data is not available

The CAGR of consumption (kWh per capita) was 3.63 percent from 1960 to 2015. Therefore, the high consumption of electricity has resulted in a supply-demand gap that has been evident for a number of years, resulting in frequent power outages. The Ministry of Water and Power (2011) acknowledges that there was an estimated power shortfall of 5,000MW during 2010-11. During 2015 the demand for electricity was 18,400MW, while supply was 14,400MW; resulting in a net deficit of 4000MW (Ministry of Water and Power, 2016). The electric supply is both insufficient and unreliable due to years of under investment, leading to insufficient capacity to meet demand and affecting transmission and distribution networks (BMI, 2012). In addition to the ongoing demand-supply gap, Pakistan's power services are also plagued with ageing transmission and distribution infrastructure and mismanagement such as transmission and distribution losses (Business Monitor International, 2016).

Pakistan's electricity generation installed capacity is 25,100MW in 2017. At present (2018), the country is generating 18,000MW. The average demand is 22,000MW and the shortfall is 5000-6000MW. The principal sources of electricity generation are: oil (35.2 percent), hydro (hydel) (29.9 percent), gas (29 percent), and nuclear, solar and imported (6 percent). Electricity demand is expected to rise by 4-5 percent during the next 10 years, by 1,500MW approximately. These are conservative estimates due to an unbalanced energy mix (power generation depends largely on crude oil rather than utilising other sources such as coal, hydel and wind energy), diminishing domestic fuel reserves, increasing circular debt[3] and transmission hold-ups. The country has almost exhausted its natural gas reserves. Supply of imported oil cannot be guaranteed due to oil price hikes that affect the budget and its constant supply. The country has the potential to meet these energy challenges through hydro-electric power, but there are environmental and political issues in building new dams,

[3] See Glossary of Technical Terms.

such as equal distribution of water among provinces for farming purposes and people being unwilling to evacuate their indigenous land for dams (Ministry of Water and Power, 2016).

Insufficient infrastructure may be a major or severe impediment to business expansion, with power being the most critical bottleneck. All kinds of manufacturing industries in Pakistan lose approximately 5-8 percent of their business as they do not fully utilise their production capacity due to power-related problems (Nataraj, 2007). On a global scale, Pakistan ranked only 129 out of 140 countries in 2016 for quality of electricity supply in the World Economic Forum's Global Competitiveness report (World Economic Forum, 2016).

Pakistan's power generation infrastructure is growing at a similar rate to its population growth. This means that, at the current rate, Pakistan will not be able to improve the electricity supply to its population, causing the supply-demand gap to persist unless significant development occurs in this sector.

2.2.4 Transport Infrastructure

Transport infrastructure includes roadways, railways, air services and seaports. These are discussed in the following sections.

2.2.4.1 Roadways Infrastructure

As a whole, the country has underperformed in developing new and paved roads since its independence in 1947. There has been a fourfold increase in roadway development from 70,500km in 1960 to 263,000km in total in 2015 with CAGR of 2.43 percent. However, development stagnated between 2010 and 2015 with only 3000km of road being developed in this period. The comparative data is shown in Table 2.5. During the financial year 2011/2012, the Pakistani Government temporarily shelved several projects in the transport sector because of public funding constraints (Business Monitor International, 2012).

Table 2.5: Comparative data for the road sector from 1960 to 2015

Indicators	1960	1970	1980	1990	2000	2010	2015
Roadways (thousand km)	70.5	74.1	123.8	279.3	255.3	260	263
Paved Road (km % over total roads)	---	---	---	54.0	56.0	72.6	70.2
Registered Vehicles (million No.)	---	0.4	0.8	2.1	4.5	7.8	15.1

Source: Economic Survey of Pakistan, 1990-2015; FAO, 2015 and World Bank, 2016

The significant rate of growth in the number of registered vehicles, along with slow road development rates, suggests that unless there is dramatic development in this area, the problems will increase and place heavy demands on an already strained system.

The present road infrastructure is not adequate to cater for the increased demand – there has been a sixfold increase in the number of registered vehicles since 1990. The CAGR of registered vehicles is 8.48 percent from 1960 to 2015. Due to insufficient development of road infrastructure, the increased number of vehicles has resulted in terrible traffic jams, pollution and road congestion. The quality of road infrastructure of Pakistan ranks 77 out of 140 countries in 2016 in the World Economic Forum's Global Competitiveness report (World Economic Forum, 2016). A series of images has been included to illustrate the severity of these issues.

Figure 2.2: Inadequate transport facilities

Source: Google Infrastructure Photos

Figure 2.3: Underdeveloped road infrastructure

Source: Google Infrastructure Photos

Figure 2.4: Inadequate railways transport facilities

Source: Google Infrastructure Photos

Figure 2.5: Miserable sewage system

Source: Google Infrastructure Photos

2.2.4.2 Railway Infrastructure

Pakistan's railway infrastructure has experienced an overall decline, with major deterioration in the quality of its rolling stock. In 1960, railways were operating with 42,836 passenger vehicles and 13,306 freight wagons however, by 2015, this had reduced to 4020 passenger vehicles and 729 freight wagons. Railways covered 8,817,000km of service lines in 1980, while in 2015 the distance was 7,791,000km i.e. 11.64 percent less service linear as a few loss-making routes were closed when compared with 1980 (Table 2.6).

Table 2.6: Comparative data for the railways sector from 1960 to 2015

Indicators	1960	1970	1980	1990	2000	2010	2015
Routes Cover (thousand km)	---	---	8,817	8,775	7,191	7,191	7,791
Locomotives (No.)	---	---	960	753	597	528	452
Passenger Vehicles Run (No.)	42,836	30,830	30,706	30,054	20,577	16,079	4,020
Freight Wagons Run (No.)	13,306	15,407	13,184	13,088	7,191	7,172	729

Source: Economic Survey of Pakistan, 1990-2015; FAO, 2015 and World Bank, 2016

In addition to internal management issues of Pakistan Railways, there are two main reasons for its decline. These are:

i) Construction of highways and motorways and establishment of road trucking businesses, especially the publicly owned National Logistic Cell. Railway lines are only laid down in the major cities and do not cover the most remote areas of the country. Furthermore, Pakistan Railways does not have feeder routes for bringing passengers and freight business to the main routes/rail stations.

ii) Pakistan Railways was not given importance equal to the road network. The CAGR of the railway network from 1960 to 2015 was negative, such as: routes covered (thousand km) -0.36 percent locomotives (No.) -2.12 percent passenger vehicles run (No.) -1.39 percent, and freight wagons run (No.) -7.25 percent. The quality of railway infrastructure of Pakistan ranks 60 out of 140 countries in 2016 in the World Economic Forum's Global Competitiveness report (World Economic Forum, 2016).

The main line of Pakistan's rail network extends from the northern regions of the country, in particular the cities of Haripur and Havelian, to two of the major seaports in the south at Karachi (Figure 2.2). Pakistan's rail network covers only a small part of the country, with a heavy reliance on road transport to connect the major trade centres. The rail network has obviously suffered from severe underinvestment. The limited availability of rail services impedes the country's ability to facilitate trade effectively. This is evidenced by the absence of a railway connection to the Gwadar port, which is the third largest international seaport in Pakistan and located at a cross junction of international sea shipping and oil trade routes (Business Monitor International, 2016).

Development of rail sector infrastructure would enable efficient (economical and reliable) transport of cargo to seaports, through a reduced reliance on road transport. The current degradation of the rail network could be detrimental to Pakistan's import and export goals. Further development in this area could see an increase in Pakistan's export trade and therefore improve the nation's GDP (Pakistan Railways, 2015).

Figure 2.6: Geographical map of Pakistan

2.2.4.3 Air Transport

Air traffic experienced both growth and decline growth between 1960 and 2015. Data show an increase in Pakistan's airline fleet from 23 planes in 1960 peaking at 45 in 2000 before declining to 34 planes in 2015 (Economic Survey of Pakistan, 1990-2015 (Table 2.7). The increase in airline fleet numbers has resulted in an increase in passenger carrying capacity, with a CAGR of 3.11 percent from 1960 to 2015. Importantly, there has been no real progress in building new airports with the exception of one international airport under construction in the capital city Islamabad, expected to be completed by the end of 2018.

Table 2.7: Comparative data for aviation from 1960 to 2015

Indicators	1960	1970	1980	1990	2000	2010	2015
Passengers Carried (thousand)	---	1336	3029	5180	5293	6588	5559
Airline Fleet	23	23	32	43	45	40	34
Route (thousand km)	46	87	218	255	317	424	389

Source: Economic Survey of Pakistan, 1990-2015; FAO, 2015 and World Bank, 2016

The quality of airport infrastructure is also deteriorating significantly, resulting in a low ranking over the past five years. The quality of air transport in Pakistan ranks 79 out of 140 countries in 2016 in the World Economic Forum's Global Competitiveness report (Business Monitor International, 2016; World Economic Forum, 2016).

The development of the new international airports should stimulate Pakistan's economy during the development and post-completion phases. Tourism to Pakistan, and the jobs it brings, has declined in part because many international airlines have discontinued their flights to Pakistan due to a lack of state-of-the-art airport facilities.

2.2.4.4 Seaports

The number of seaports has increased from one to three, with an 86 percent increase in cargo handling. However, Pakistan's port infrastructure is inadequate considering its focus on increasing imports and exports needs (Business Monitor International, 2016). Over time the number of publicly owned vessels has reduced from 53 ships to nine ships during 1960 and 2015 (Table 2.8). As mentioned earlier, the Gwadar port, which can act as an alternative route to Indian Ocean or South China Sea routes, has no railway connection. In relation to seaport infrastructure, Pakistan ranks 66 out of 140 countries in 2016 in the World Economic Forum's (WEF) Global Competitiveness (GC) report (World Economic Forum, 2016). While the increase in seaports has been positive in relation to Pakistan's import and export goals, it is apparent that there are many opportunities for expansion in this area. A rail connection to Gwadar would further increase the cargo handling capabilities of this port.

Table 2.8: Comparative data for seaports from 1960 to 2015

Indicators	1960	1970	1980	1990	2000	2010	2015
Seaports	1	1	1	2	3	3	3
Cargo Handled (000 tons)	7,169	9,587	14,657	18,709	23,761	41,420	54,379
Vessels	53	71	50	28	14	9	9

Source: Compiled from Economic Survey of Pakistan, 1990-2015; FAO, 2015 and World Bank, 2016

The geographical locations of Karachi Port, Muhammad Bin Qasim Port and Gwadar port are indicated in Figure 2.6: Geographical map of Pakistan.

2.2.5 Implications of Infrastructure Deficiencies

Pakistan has fought four wars with India and martial law regimes have been imposed four times, spread over almost all the decades since its independence in 1947. The major events in Pakistan since independence are summarised in Table 2.9. The development pattern of the period 1947 to 2015 has not been consistent. Some of the years experienced growth, while others saw a decline in certain areas. After two months of independence, Pakistan was at war with India, starting in 1947 and lasting for more than a year. Although there was a dictatorship during the 1950s and 1960s, Pakistan's economy flourished due to

increases in exports and an inflow of foreign aid and assistance. The country's economy showed a declining trend in 1970 due to political instability, war with India, oil price shocks, nationalisation policy (nationalisation of major industries) and civil war in East Pakistan, which ended in the emergence of the independent state of Bangladesh. Again, a military dictator enforced martial law and assumed control of the country.

During the 1980s, defence spending levels were increased, coupled with extensive involvement of the public sector in commercial activity, which discouraged and squeezed out private investment and ultimately adversely affected the country's growth. There was vicious political instability during the 1990s, which negatively affected the growth rate of the economy. Once again, a military dictator enforced undeclared martial law and seized control of the country from the elected Prime Minister. In the 2000s, an economic reform program was launched and a privatisation policy was implemented to sell publicly owned loss-making entities. However, terrorist activities and targeted killings, which deterred investors from investing in Pakistan, and a shortage of electricity and gas for the industrial sector, slowed down the rate of investment during 2008 and 2009. Due to a rapid decline in investment (public and private) the growth rate of the country became negative in the 2010s. The global financial turmoil foreign private inflows negatively affected the demand for Pakistani exports and foreign private inflows. However, investment and economic growth increased slightly in the lead-up to the election during the financial year 2011-12.

Table 2.9: Major events in Pakistan since independence at a glance

Period	Events
1947	Pakistan is located in the north-western regions of South Asia. Pakistan achieved independence and was declared a sovereign nation following the end of the British Raj on 14 August 1947.
1948	First war between India and Pakistan few months after independence. During this war, Pakistan losses were 6000 killed and 14,000 wounded. The war took place between 22 October 1947 and 1 January 1949. A formal ceasefire was declared at 23:59 on the night of 31 December 1948.
1950s	Pakistan's exports were boosted and maintained a high level of economic growth during the Korean war. The first military dictator of Pakistan, General Ayub Khan, enforced martial law and assumed control of the country on 8 October 1958 and ruled actively implemented economic management and reforms (Muhammad, 2014). This first martial law duration was 1958 to 1969.
1960s	The country maintained a high and rapid growth rate due to inflow of foreign aid and assistance. Pakistan had its second war with India in 1965, between April 1965 and September 1965. In this war, 5800 Pakistani soldiers were killed. The economic policy and second development plan was replaced by a nationalisation program by the then government. The second martial law period was introduced and enforced by General Yahya Khan in 1969 ran from 1969 to 1971.
1970s	The high growth rate seen in the 1960s could not continue during the 1970s due to a civil war in East Pakistan that ended in the emergence of the independent state of Bangladesh, oil price shock and a nationalisation policy (announced on 2 January 1972), which impacted on infrastructure development. Above all, the political instability after 1970-71 has been the major cause of deterioration in Pakistan. Pakistan had a third war with India in 1971. This war started on 3 December 1971 and ended on 16 December 1971. Pakistan suffered casualties of 8000 killed and 25,000 soldiers wounded. General Zia-ul-Haq military dictator of Pakistan enforced martial law and assumed control of the country on July 5 1977 and ended martial law on December 30 1985.
1980s	Since then the country has invested in high levels of defence spending, which took up a significant fraction of scarce revenues and adversely affected public savings otherwise meant for development purposes. However, significant involvement of government in commercial activity squeezed out private investment and adversely affected its growth.
1990s	The picture of the economy remained gloomy during the 1990s due to severe political instability. This instability negatively affected the growth rate of the economy. As a result, the growth rate fell from 6.2 percent in 1980s to 3.99 percent in the 1990s. On 28 May, 1998 Pakistan tested a nuclear bomb. Consequently, the country had to face financial hardships as a result of a reduction in financial assistance and sanctions from its international donors. In 1999 Pakistan had its fourth war with India. Pakistani losses were 453 killed and 665 wounded. This war took place between May and July 1999. In October 1999, General Perwaz Musharaf took control from the elected Prime Minister and assumed control of the country. The duration of Musharaf's undeclared martial law was 12 October 1999 to July 11 2002.
2000s	An economic reform program was launched in 2000, which included reforms in the banking and trade sectors, fiscal adjustment, privatisation of the energy sector, telecommunication sector and public sector industries such as cement factories, sugar mills and cooking oil factories. This played a vital role in the economic recovery of Pakistan. The rate of investment slowed during 2008 and 2009 due to terrorist activities and shortage of electricity and gas for the industrial sector.
2010s	After rapid decline in investments during 2008-10, the growth rate of public and the private investment and economic growth in Pakistan become negative. The global financial turmoil hampered foreign private inflows and reduced the demand for Pakistani exports due to the recession in countries of the Organisation for Economic Co-operation and Development (OECD). OECD was founded in 1961 and has 37-member countries, to stimulate economic progress and world trade. However, investment and the economic growth had slightly increased due to the election period in 2011-12

Source: Economic Survey of Pakistan 1990-2016; Economic Times 1965; S.M. Burke 1974; Parvez, 1997; Muhammad, 2014; Maryam and Nazima, 2013.

However, the average annual growth of overall infrastructure facilities has been lower than the population growth except in the telecommunication sector over the past five decades. The comparative data show (Table 2.11: Details of Five-Year Development Plan) that the development of public infrastructure in Pakistan has improved over the past 55 years, although at a slower rate than the population growth experienced (Economic Survey of Pakistan, 1990-2015).

Infrastructure facilities currently do not meet the increasing demand of the population. Pakistan's current maintenance requirements are not being met, resulting in an overall decline in the quality and performance of existing major infrastructure facilities. Consequently, the infrastructure deficit may be a major impediment in the economic growth of Pakistan. Pakistan ranks 98 out of 140 countries in 2016 for overall quality of infrastructure in 2016 in the WEF's GC report (World Economic Forum, 2016).

2.2.6 Summary

The World Bank (2012) states that public infrastructure in Pakistan has experienced low levels of improvement over the past 50 years. Current infrastructure facilities in Pakistan are not only inadequate, they could have a negative impact on economic growth. Infrastructure facilities are also insufficient to meet the increasing demands of a fast-growing population (an average annual growth rate of 2.62 percent). Table 2.2 highlights the limited development of basic infrastructure such as power and roadways in comparison to the population statistics for the country.

The rapid increase in population and urbanisation is challenging already inadequate infrastructure services. Pakistan's physical infrastructure needs major investments for new developments, maintenance, expansion and modernisation of existing facilities, particularly in remote and rural areas. While the average growth rate is appropriate in some areas, infrastructure services must continue to grow and improve with the needs of the population. The World Bank Indicators 2016 show that inadequate infrastructure services and bottlenecks in infrastructure development may have been a hindrance in economic growth in Pakistan. Table 2.9 provides a comparison of Pakistan's basic infrastructure with its neighbouring countries in the region with comparable geographic location, size or economic development.

A comparison of infrastructure across South Asian countries shows that:

- Pakistan is not only the second most populous country in the region, it also has the highest rate of population growth of up to 2.1 percent per annum with population density of 240 people per sq.km and a maximum urbanisation of 32 percent.
- The only sector where Pakistan is ahead of other comparative regional countries is access to electricity, with 93.6 percent of the population enjoying this facility. However, despite the high percentage of access there is a major power shortfall, as stated earlier. According to the World Bank (2012), electricity generation in Pakistan is substantially lower than in other South Asian countries except Bangladesh.
- The transport sector has seen a general upward trend in most South Asian countries. Provision of total paved roads in Pakistan has improved markedly, with the percentage rising to 72.6 percent of total roads in 2015, up from 54 percent to 65 percent in the 1980s (World Bank, 2012), while other countries in the region have consistently underperformed in this area. Respectively, Nepal and India have 53.9 percent and 53.8 percent of their total road length paved. In terms of road density per 100sq.km of land area, Pakistan ranks third (33 per 100sq.km of land area) in the region, with Sri Lanka at the top of the list with 173.9. The worst-case scenario is evident in railway density where Pakistan is the lowest in the region with 1.0 per 100sq.km of land area, while Sri Lanka ranks number one on the list with 2.2 per 100sq.km of land.
- Likewise, there has been a steady rise in the telecommunications sector across regional countries on the whole, however, Pakistan's telecommunications sector has yet to be developed. Sri Lanka ranks number one for telecommunication density (i.e., 122 percent of the population) followed by India with 72.94 percent and Pakistan with 70.3 percent of the population. Despite that, the provision of mobile cellular subscription is the lowest in the region. Internet services in Pakistan are not as developed as in comparative countries, only exceeding Bangladesh in the region.
- When comparing economic growth in the form of GDP, Pakistan is the second lowest in the region with 4.7 percent annual growth in GDP. Sri Lanka has the lowest growth with a growth rate of 4.5 percent annually and India has the highest GDP growth rate at 7.3 percent annually. Pakistan does

not have the same level of infrastructure services and support available to meet the increasing demands of a growing population as do countries such as India. A causal relationship could be established between infrastructure development and economic growth. GDP growth is greater in those South Asian countries that have a larger infrastructure supply. The statistics listed in Table 2.10 suggest that overall economic growth is possible in the region, provided that appropriate infrastructure and services are available. It will be challenging for Pakistan to achieve higher economic growth with inadequate and inefficient infrastructure facilities.

Infrastructure in Pakistan has improved over the past five decades; however, the improvement has been the slowest for the majority of public infrastructure sectors among the regional countries. This is a likely contributor to the low economic growth performance of the country, which has remained at or below the median growth rate of other countries in the world. In summary, the comparison presented above suggests that there is a substantial demand-supply gap in Pakistan's infrastructure when assessed against other South Asian countries (World Bank, 2012). The next section, Section 2.3, presents a sector-wide historical background of infrastructure investment policies and trends in Pakistan.

Table 2.10: Comparison of infrastructure across South Asian countries at 2015

Indicators	Pakistan	Bangladesh	Bhutan	India	Nepal	Sri Lanka
Total Population (Million)	188.2	160.4	0.8	1282.3	28.4	21.6
Population Growth (annual %)	2.1	1.2	1.4	1.2	1.2	0.9
Population density (people per sq.km)	240	1222	20	436	197	331
Urban Population (% of Total)	32.0	28.0	-	30.0	18.0	15.0
GDP Growth (annual %)	4.7	6.1	5.5	7..3	5..4	4.5
Paved Road (% total roads)	72.6	-	34.2	53.8	53.9	-
Road Density (per 100 sq. km of land area)	33.0	-	21.8	142.7	-	173.9
Railways Density (per 100 sq. km of land area)	1.0	1.9	-	2.0	-	2.2
Electricity (% of Population)	93.6	41.0	75.6	78.7	76.3	88.7
Telecom Density (% of Population)	70.37	16.0	-	72.94	18.0	122
Mobile cellular subscription (% of population)	73.3	80.0	82.1	74.5	81.9	103.2
Individuals using the internet (% of population)	14.0	10.0	34.0	18.0	15.0	26.0

Source: Author (compiled from the World Bank data, 2016. The World Bank Indicators, 2015-17 and Food Security Indicators, 2015)

2.3 Infrastructure investment planning, policies and trend in Pakistan

The main sources of information regarding infrastructure investment planning, sector-wide annual reports, policies and trends in Pakistan are:

- Ministry of Finance, Pakistan – Economic Surveys of Pakistan;
- National Planning Board and Planning Commission of Pakistan – Five-Year Development Plans;
- Ministry of Planning, Development and Reforms;
- Ministry of Information Technology – telecommunication sector;
- Ministry of Water and Power – power sector;
- Private Power Infrastructure Board (PPIB) – private investment in power sector;
- Ministry of Railways – railways sector;
- Ministry of Ports and Shipping – Karachi Port, Muhammad Bin Qasim Port and Gawadar Port for seaport sector;
- Pakistan International Airline – air transport; and
- National Highways Authority – roadways transport sector.

Immediately after Pakistan achieved independence in 1947, development plans focused primarily on achieving high national income levels. The major objectives of these plans, developed by the Planning Commission of Pakistan, were to: raise national income and per capita income; increase production in agriculture and industrial sectors; improve living standards; create employment opportunities; and increase economic development. However, priority was given to the agricultural and industrial sectors.

The first development plan 1955-1960 was announced by the Planning Commission of Pakistan late in 1957. The plan had certain handicaps and limitations such as: (i) the plan did not receive full support until 1957; (ii) the financial resources of the plan fell short of expectations; and (iii) total non-development expenditures exceeded its revenue receipts by Pak Rs. 280 million. During the early period after independence, development expenditures were regarded as the foundation for rapid progress in the future. Plans explicitly confirmed that some sectors of the economy, such as the transport sector (including railways and aviation), would be progressed more rapidly than others, to achieve higher growth (1st Five-Year Plan 1955-1960, National Planning Board, Government of Pakistan).

In view of the anticipated 9 percent increase in population, an increase in national income of 20 percent was targeted during 1960-65. In terms of projected sector-wide expenditure distribution, private-sector expenditure was fixed at 54 percent, public sector at 30 percent and autonomous corporations (semi-public sector) at 16 percent.

As mentioned earlier, all development plans were revised in 1966 due to Pakistan's war with India and the worst economic conditions that Pakistan had experienced. There was a great investment shift from consumer goods to capital goods industry in the development plan of 1965-70. Therefore, 58 percent was allocated to the public sector for development plans and the remaining 42 percent was targeted for the private sector. A total of 66 percent of the total development plan was projected to finance from local sources (public investment) and the remaining 34 percent through external sources (foreign aid and assistance).

During 1983-88, the economy had grown at the projected average of 6.5 percent and would have exceeded the target if not for severe droughts in 1986-87. In the early 1990s, greater emphasis than ever before was given to increased private investment in all sectors of the economy. Therefore, the private-to-public ratio of investment was expected to rise from 42:58 in 1988 to 48:52 in 1993. The sequence of five-year development plans and the periods to which they relate are presented in Table 2.11.

Table 2.11: Details of Five-Year Development Plan

Plan	Period
1st Five-year Plan	1955-1960
2nd Five-year Plan	1960-1965
3rd Five-year Plan	1965-1970
4th Five-year Plan	1970-1975
5th Five-year Plan	1978-1983
6th Five-year Plan	1983-1988
7th Five-year Plan	1988-1993
8th Five-year Plan	1993-1998
9th Five-year Plan	1997-2002
10th Five-year Plan	2010-2015
11th Five-year Plan	2013-2018

During 1993-98, it was planned to increase GNP by 8.1 percent, reduce population growth up to 2.6 percent by 2000 and maximise utilisation of available investment resources through technological changes. During 1993-94, policies of privatisation, deregulation and market friendly environment were reinforced. A new concept of PPP was also introduced to increase the private sector's role in achieving higher growth. The medium-term development

framework (2005-10) of the Planning Commission of Pakistan emphasised upgrading physical infrastructure for accelerating output growth. Therefore, telecommunications, power and transport sectors were identified for the private sector participation through privatisation and private partnerships for achieving Millennium Development Goals.

In 2014, the Ministry of Planning, Development and Reforms proposed enhancing private sector participation to improve and develop better infrastructure facilities under a PPP modality through comprehensive policy reforms. As a result, a few rental power generation projects[4] were developed through private investment. The Ministry of Planning, Development and Reform (2014) also proposed that a Bureau of Infrastructure Development (BID) be established to coordinate and oversee private sector participation in infrastructure development. The BID was intended to serve as a focal point to facilitate the project approval process and manage project financial arrangements (Ministry of Planning, Development and Reform, 2014).

All development plans and polices were focused on solving the major problems of the economy such as low investment and low productivity, heavy reliance on imported energy, and low spending in social sectors including health and education. To present an appropriate discussion on existing policies, it is necessary to understand the historical background of Pakistan's infrastructure trends and investment policies, the demand for infrastructure facilities in the past, and how they have developed with the changing demands of Pakistan's population. Further, we need to establish whether infrastructure requirements were fully met, and if not, identify why not. As noted in Section 2.1, this study focuses on three sectors of physical infrastructure: telecommunications, power and transport. A breakdown of each sector's infrastructure investment policy is presented in the following sections:

[4] Rental power generation plants are set up to meet short-term and emergency requirements of a country and are typically commissioned within 4-6 months based on available technology. The rental periods are normally 5-7 years depending on the country's need. Primarily, the concept was introduced in Pakistan in 2007 when two projects were awarded to GE and PPR, both from the USA, for 150MW and 136MW each. Rental power plants have now been set up in many countries such as the USA, UK, India, Bangladesh, Kuwait, Sri Lanka, Turkey, UAE, Saudi Arabia, Iraq and Palestine. (Murtaza Mohsin, 2009).

2.3.1 Telecommunications

Pakistan's telecommunications network was greatly improved after independence. The country did not inherit any international telecommunications system in 1947. At that time, overseas telephone calls were only possible via Bombay (India, now known as Mumbai). The country had 12,500 telephone connections in 1947, which increased to 37,000 in 1955. However, the number of telephone connections was planned to increase to 75,000 by 1960. A further substantial increase in telephone connections to 195,000 connections was planned by 1970 (1-3 Five-Year Development Plans).

A large increase in communication traffic was experienced during 1978-1983, when the system could not keep pace with the increasing demand, resulting in over-loading in the telecommunications sector. Therefore, it was planned to clear the backlog in demand and the expansion of telephone facilities to rural and underdeveloped areas. A target was set to provide nationwide dialling facilities for 107 towns and cities by 1988 (6th Five-Year Development Plan).

Telephone connection density was proposed to increase to 20.6 per 1000 population by June 1993, compared with a density of 6.7 in June 1988. However, trunk call traffic was estimated to increase at a rate of 14 percent per annum by 1998. Therefore, improving, upgrading and extending Carrier Telephone Industries, Pakistan, to a telecommunication training centre and manufacturer of telecom products, accessories and local network and international gateway exchange through the installation of modern digital technology was proposed to cope with the increase demand in the sector. Engaging the private sector in the production of telecommunication equipment and Pakistan Telephone Corporation operations was also planned.

Despite the proposed reform, telecommunications services were still beset by mounting pressure to meet the rising demand for services and the extension of facilities to remote and rural areas where they did not previously exist. The government also recognised that there was room for improvement in the quality of service through adoption of modern technology and operating procedures. Subsequently, the Ministry of Planning, Development and Reform (2015) promulgated a strategy for developing the Information Technology (IT) sector under the Public Sector Development Program (PSDP) 2014-15. The key goals of this strategy were:

- International fibre bandwidth to be increased to develop e-commerce in the country
- Wireless broadband networks to be extended to provide high speed internet access for local use
- IT infrastructure to be improved to attract foreign IT companies to undertake business in joint venture arrangements with domestic IT companies
- Data centres across the network to be created for growth of digital content to increase economic activities, provision of improved social services and expansion of local research
- Software Technology Parks to be set up to provide centres for value-added activities such as increase in the use of IT and development of computer software and applications
- Scholarships to be granted to 400 students to develop human resources through a National ICT Scholarship Program
- A strategy for the sustainability of E-Government to be made to boost usage of government online services, enhance efficiency and transparency in governance.

2.3.2 Power

In 1960 the electric power policy set by the Ministry of Water and Power aimed to achieve two major objectives by 1965. First, to meet the domestic and industrial demand for electricity, the installed electric power capacity was to be increased from 905,500KW to 1,414,000KW[5]. Second, the Ministry aimed to provide abundant electric power at affordable rates, to accelerate and strengthen agricultural and industrial development. In the next phase of development (1965-1970) electric generation capacity was planned to increase to 2,270MW by extending existing power generation plants and constructing new ones. Third, new transmission lines will be built and extended to serve additional generated electricity and electrification of rural areas.

[5] 1 Mega-Watt = 1,000 Kilo-Watt

Consequently, electric generation capacity increased 20-fold between 1947 and 1970, from 130MW to 2590MW. Despite these improvements, the majority of the population still had no access to electricity, with only 1.7 million out of a total population of 132.3 million in 1970 registered as electricity consumers. Therefore, in the 4th development plan 1970-1975 generation, transmission and distribution of electricity throughout the country were given top priority (4th Five-Year Development Plan).

In July 1982, the maximum demand for electricity was recorded as 3050MW but this was not met by the available power generation capacity, leading to power load-shedding (a temporary reduction in a supply of electricity as a method of reducing the demand on the generator). Consequently, it was then proposed to increase the installed electric generation capacity up to 6849MW by 1988. These power generation targets had still not been met by 1993. Only 2018MW was installed against the planned addition to increase installed power generation capacity to 3795MW. This resulted in only 53 percent of the target being achieved. The main reasons for the shortfall were that the execution of a number of power generation projects was delayed. In 1993 the demand was projected to 9570MW. Therefore, the installed capacity was again targeted to increase to 13,112MW by the end of 1993.

Once again, 9.6 percent of the target had not been achieved due to resource constraints and physical implementation delays. Besides these problems, private sector power projects were also delayed due to overly optimistic and unachievable initial estimates of completion timeframes and financing arrangements for the projects. During 1993-98, the privatisation of the power sector was planned alongside the development of new power projects through private investment to increase the power generation capacity and utilisation of financial and managerial skills of the private sector.

According to AJC Consulting[6] (2015), the Government of Pakistan has developed and implemented four power policies through the Private Power & Infrastructure Board (PPIB). To invite private investment in the country's electricity generation sector, PPIB announced:

- The first Policy for Private Power Generation Projects in 1994
- The second Policy for Hydropower Generation Projects in 1995
- The third Policy for Private Power Generation Projects in 1998

[6] AJC Consulting provides management consultancy services to a variety of business sectors.

- The fourth Policy for Private Power Generation Projects in 2002

Public sector power projects such as the Kot Addu Power Project[7] were selected for strategic sale through the Privatisation Commission, Pakistan, and subsequently the Kot Addu Power Project was converted into the Independent Power Project (IPP). The Government of Pakistan decided that the proceeds of the sale of divested assets of power sector should be reinvested in the power sector for "hydel" (hydro-electricity) projects. As a whole, 28 IPPs availed themselves of the Power Policies announced by the Pakistan Government. The details of power plants that started operation since 2015 are given in Table 2.12.

Table 2.12: IPPs power projects announced by the Government of Pakistan

Power Policy	Dependable Capacity	No. of Projects	Technology
1994	2898MW	14	63% Oil Based 27% Gas Based
1995	84MW	1	42% Oil Based
2002	2782MW	13	58% Gas Based
Total	7564MW	28	

Source: AJC Consulting (2015)

By 2014, the ongoing power shortfalls had caused significant negative impacts on societal and economic wellbeing in Pakistan, with an estimated 4-7 percent loss to the country's GDP (Ministry of Planning, Development and Reform 2015).

Pakistan Vision 2025 is a living document. To standardise targets with new national and global necessities, the Vision document will be reviewed and updated once every three years (Planning Commission of Pakisatan, 2013). Vision 2025 was released in 2013 by Pakistan's Ministry of Planning, Development and Reform as a guideline and roadmap for the way forward. It is also a policy document for the country to strengthen its development foundation and enable international development goals to be achieved within their respective time frames. The government recognised the energy sector as one of the seven pillars of the economy, and therefore introduced a policy aimed at eliminating the ongoing electric

[7] The Kot Addu Power Company (KAPCO) was incorporated in 1996 and in April, 2000, it was incorporated as a public limited company. KAPCO has 15 generating units (multi fuel-fired power plant: gas, furnace oil and diesel) with a nameplate capacity of 1600MW. KAPCO is the single largest Independent Power Producer (IPP) in the country. It sells the electricity it produces to a single customer, the Water and Power Development Authority (Wapda), Pakistan, under a Power Purchase Agreement (PPA). The current PPA is valid to 2021. KAPCO is setting up a 660MW coal-based power project with a projected cost of US$1 billion (Dilawar Hussain, 2018).

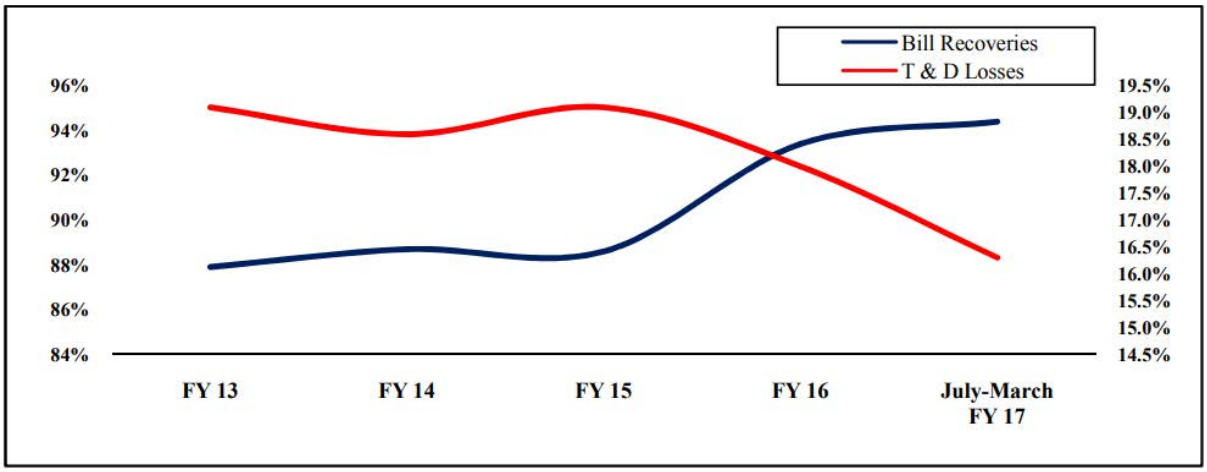
demand-supply gap by adding up 25,000MW of generation capacity by 2025. Power transmission and distribution losses in Pakistan are over 25 percent, around three times higher compared with China and OECD countries. Thus, the vision also emphasises minimising wasteful losses through investing in transmission and distribution infrastructure, enforcing controls over inefficient recovery systems including recovery of overdue payments and electricity theft to maximise distribution efficiency and double power generation to more than 45,000MW to provide uninterrupted and affordable electricity (Ministry of Planning, Development and Reform, 2015).

The Ministry of Water and Power (2013), under its National Power Policy 2013 Pakistan, set these key targets:

- Increase in power generation capacity – decrease demand-supply gap from 4500-5000MW to 0 by 2017
- Affordability of power generation cost – decrease cost of generation from 12c/unit to 10c/unit by 2017
- Efficiency – decrease transmission and distribution losses from 23-25 percent to 16 percent by 2017
- Financial viability – increase collection/recovery from 85 percent to 95 percent by 2017
- Good governance – decrease decision-making processing time from long to short durations

The National Power Policy 2013 Pakistan addresses the key challenges to the power sector in achieving the long-term vision of the power sector. However, two critical issues are addressed on a priority basis: inefficient recovery systems and effective control over transmission and distribution (T&D) losses. The recovery of electricity charges from the end consumers rose from 87 percent to 94.40 percent during 2013-2017 (Figure 2.3). This is the highest recovery during the past 10 years. T&D losses declined to 16.3 percent during the same period. Both issues are being addressed effectively but still need improvement.

Figure 2.7: Bill recoveries and loss reduction (%)



Source: Economic Survey of Pakistan 2016-17

Since 2015, 21 power generation plants have been developed with a total capacity of 2631MW as shown in Table 2.13.

Table 2.13: List of Power Plants that have Started Operation since 2015

2015			2016			2017		
Plant Name	Fuel Type	Installed Capacity (MW)	Plant Name	Fuel Type	Installed Capacity (MW)	Plant Name	Fuel Type	Installed Capacity (MW)
RYKML	Bagasse	30	Apollo Solar	Solar	100	Fatima	Coal/Bagasse	120
FWEL-I	Wind	50	Best Green Solar	Solar	100	Hamza	Bagasse	15
Quaid Azam	Solar	100	Crest Energy Solar	Solar	100	Bhiki	Gas	760
Nandipur	Furnace Oil	425	Younus	Wind	50	Dawood Wind	Wind	50
Sapphire	Wind	50	Metro	Wind	50	Sachal Wind	Wind	50
Chiniot	Bagasse	62	Tapal	Wind	30			
			Master	Wind	50			
			Tenaga	Wind	50			
			Gul Ahmed	Wind	50			
			Chashnupp-III	Nuclear	340			
Total		717			919			995

Source: Economic Survey of Pakistan, 2016-17

2.3.3 Transport

After independence, production in some sectors increased considerably and generated heavy demand for transport services and facilities. An estimated increase of 23 percent in railways passenger-miles, 33 percent in freight ton-miles and 25 percent in cargo handling in the port was experienced in the years following independence (1947). The Planning Commission[8] (1960) reported that demand for road transport had increased about 40 percent during 1960-1965. By contrast, providing the required investment to cover the increasing demand of transportation facilities in full was not possible. Therefore, a small amount was allocated in relation to the rising transportation needs (2nd Five-Year Development Plan).

Currently, the transport sector contributes approximately 10 percent to the Pakistani GDP and more than 6 percent of employment is linked to this sector. Pakistan's Vision 2025 aims to achieve a reduction in transportation costs and high-speed connectivity (from farm to market) between rural areas and markets and urban centres. The Vision 2025 policy also targets the transport network between economic hubs such as Karachi seaport, Muhammad bin Qasim port and Gawadar seaport and high-capacity transportation corridors connecting major regional trading partners. The Vision 2025 has set targets for the transport sector to raise road-density levels. The transport sector policy also outlines strategies to increase roadways, railways and airport density. Therefore, a multi-modal transport system will be established in light of Transport Strategy 2014-15 (Ministry of Planning, Development and Reform, 2015). The transport policy focuses on:

- Rehabilitating and upgrading the existing transport infrastructure
- Enhancing the role of private sector participation and institutional capacity building for transport sector development
- Using modern technology, procedures and processes by research and development to increase sector efficiency.

[8] The Planning Commission is a financial and public policy development institution of the Government of Pakistan. The Commission comes under the Ministry of Planning, Development and Reforms. It undertakes research and state policy development initiatives for the growth of national economy and the expansion of the public and state infrastructure, in collaboration with the Ministry of Finance.

2.3.3.1.1 Road sector

The 2nd Five-Year Development Plan emphasised road sector improvement. Therefore, it was planned to construct and improve 3875km of roads by 1960. In 1960 the country had 70,500km of paved roads. It was planned to improve existing roads of 250km by 1965, and to develop paved roads of 12,750km by 1970, with the construction of new roads of 1310km and improvement of existing roads of 3500km by 1975. Consequently, by 1988 the country had 113,000km of paved roads with an average density of 0.16km per square km of area, which was about one-third of the generally accepted standard for developing countries with similar topography and level of economic development. A deficiency of 247,000km of roads was calculated. Besides this shortfall, structural deficiencies of existing roads of about 6000km were identified. In 1983, construction of 5800km of new roads and improvement of 7860km of existing roads was proposed by 1988. In addition, a rural road construction program for the construction of 40,000km of road was planned to be launched by 1988.

In 1993, the average road density of Pakistan was 0.21km/sq.km, far less than the generally accepted standard of 0.5km/sq.km for developing countries with similar topography (Ministry of Planning, Development and Reform, 2015). This prompted a proposal to give the highest priority to improve and upgrade the existing road network to fill the gap and optimally utilise the system for speedy economic growth by 1998. Pakistan's Vision 2025 targets raising road density to 0.45km/sq.km by increasing the existing road national network from around 260,000km to 358,000km (Ministry of Planning, Development and Reform, 2015).

2.3.3.2 Railways sector

During 1960-1965, railways continued to develop and replace rolling stock, rehabilitate equipment and tracks and modernise railways signalling systems. Specific objectives were set to increase passenger traffic by 20% (6400 million) and freight miles by 40% (5260 million ton-miles) during the same period. Rehabilitating and upgrading railways had been ongoing since independence. In 1978, further targets were set as to: upgrade railways tracks, rehabilitate 74 broken locomotives and order 105 new locomotives, manufacture 400 new carriages and replace 248 existing carriages and acquire 152 new traffic carriages by 1983.

The rail sector had only partially achieved its major targets by 1988 in terms of renewing 555km of rail tracks and 740km of sleepers, rehabilitating 42 locomotives and acquiring 90 new locomotives. Targets were exceeded for passenger carriages, manufacturing 525 passenger coaches and 130 bogie hopper trucks, in addition to work on the telecommunication system and signalling project being completed. In 1988, a target was set to manufacture a further 300 passenger carriages, 200 wagons and freight wagons and to renew 650km of rail track by 1993. A number of uneconomic lines were selected for closure, to minimise losses on railways operations during 1993-1998.

2.3.3.3 Air transport sector

At the time of independence, Pakistan's airline had a new comprehensive development plan under consideration. However, no final decision had been taken while preparing the first Five-Year Development Plan for 1955-1960. However, the purchase of nine aircraft, including two long-distance and seven medium distance aircraft, had been included in the 1st Five-Year Development Plan. In 1960, it was estimated that the national airline would carry about 52 million ton-miles of long-distance freight traffic per year and the service would extend to the Middle East and Europe by 1965. In addition, skills, up-to-date knowledge and know-how capabilities were to be built up for the manufacture of light aircraft for charter operations, agricultural pest control, flight training and feeder aircraft operations to the level of short take-off and landing aircraft by 1975.

In 1983, it was recognised that the inadequate infrastructure was a major deficiency in the air transport sector and passenger and freight handling capacity of all major airports. This sector needed improvement and expansion to fulfil long-term air traffic requirements. The proposed development program for 1983-1988 was:

- To develop new terminal buildings and facilities as commercial ventures in the cities of Karachi, Lahore and Islamabad
- To augment physical infrastructure of all airports to meet future traffic requirements
- In case of emergencies, Nawab Shah Airport was to be used as an alternative airport to Karachi (see Figure 2.2)
- New airports to be constructed at Chilas and Hunza division (see Figure 2.2)
- To ensure operational safety, high priority was given to improving and augmenting air navigation and communication systems.

In addition to the air shuttle services, feeder services from central business centres to airports were planned to be introduced in association with the private sector.

1n 1993, the airline sector projected an annual compound increase of 5.11 percent and 3.3 percent for passenger and freight traffic respectively. However, it was targeted to increase passenger carrying by 7.3 percent and freight transportation capacity by 2.8 percent. Outdated planes in the fleet would be phased out completely and aircraft would be leased rather than purchased outright. Private sector participation in airline would be encouraged during 1993-1998. Therefore, 5.8 per cent of shares in Pakistan International Airlines were divested through the stock exchange in July 2004 (Ministry of Privatisation and Investment, 2018).

The key objective of Pakistan's Vision 2025 relating to the aviation sector is to increase cargo and passenger infrastructure at important airports to meet the delivery needs of a modern global supply chain (Ministry of Planning, Development and Reform, 2015).

2.3.3.4 Seaports sector

Pakistan has six seaports. The geographical structure and length of these ports is presented in Table 2.14, while Figure 2.2 refers to the geographical locations. The Karachi Port Trust (KPT) operates two container terminals, namely Karachi International Container Terminal (KICT) and Pakistan International Container Terminal (PICT) and Silos Terminal. All three terminals are operated as a single integrated facility. KICT and PICT are among the most advanced container terminals, equipped with state-of-the-art facilities (KPT, 2018).

Table 2.14: Detail of Seaports in Pakistan

Name of the Port	Opened Date	Port Area	Geographical Location
Karachi Port	1857	11km	Karachi, Sindh
Port Muhammad Bin Qasim	1980	49km^2	Karachi, Sindh
Gwadar Deep Sea Port	2001	4,500 acres	Gwadar, Balochistan
Port Ormara	1970	30.9km	Gwadar, Balochistan
Jiwani Port	1949	1.2km^2	Gwadar, Balochistan
Port Pasni	2008	1.2km^2	Maran Coastline, Balochistan

Rehabilitation of old commercial berths and the construction of new berths at Karachi seaport on an ongoing, regular basis were planned from 1962 to 1970. In 1965, it was proposed to increase storage capacity for food grain up to 5.5 million tons and handling of petroleum products from 1 million to 2 million tons at Karachi by 1970. Major expansions of port facilities were also proposed, including reclamation and development of a new wharf, oil berth and replacement and purchase of craft and equipment during 1962-1970.

Traffic through the ports increased about 15.5 percent during 1969-1970 and it was estimated that the traffic would increase from 15.8 to 29.5 million tons in 1974-1975, however, the facilities at that point were inadequate. Therefore, short-term measures were proposed such as improvement in cargo handling and clearance and diversion of maximum imported cargo to other ports. It was also proposed to develop additional port facilities, either as a second port or expansion of Karachi Port as a long-term measure.

The port facilities were considerably improved between 1978 and 1983. Based on the cargo traffic movement in 1983, cargo traffic was projected to increase at a rate of 7 percent per annum over the next five years (by 1988). Consequently, it was planned to use the optimum capacities of both Karachi Port and Port Qasim in addition to creating a National Port Authority to manage both ports including a mini-port (the third port) at Gwadar. In 1988, it was planned to develop seaport infrastructure, railways and road transport facilities including encouraging the private sector to participate in cargo handling and transportation of containers to enable efficient container movement.

Seaport traffic was projected to increase at a rate of 3.6 percent per annum from 1993 to 1998. The port facilities would be supported and augmented with intermodal infrastructure to ensure maximum utilisation of container movement. Therefore, railways would be geared towards container movement. Further, the private sector would be encouraged to participate in the expansion of port infrastructure including cargo handling, construction of a container and oil terminal at Port Qasim and construction of a deep-sea port at Gwadar by 1998. The present seaport infrastructure requires significant investment to upgrade cargo handling facilities. Therefore, under Vision 2025 it is proposed that seaport facilities be upgraded to meet global efficiency and cargo-handling standards and shipping services (Ministry of Planning, Development and Reform, 2015). However, in late 2015, the port was officially leased to China for 43 years, until 2059. Gwadar Port became formally operational on 14 November 2016 (Dawn.com, 2016). A total of 80.4 metric tons of cargo (imports plus exports) was handled during financial year 2016-17 (Economic Survey, 2017-18).

In summary, the infrastructure investment pattern in Pakistan has shown considerable fluctuation and decline over time. Public sector infrastructure allocations was 12.3 percent in 1970s, 4 percent in the 1980s and 3 percent in the 1990s (Looney, 1997). The plans for physical infrastructure development in Pakistan have never been achieved according to their planned targets, thus increasing the infrastructure demand versus supply

gap. However, Pakistan's economy progressed between 1960 and 1965. Although it was ruled by a military regime, the country was successful in gaining foreign aid and international financial assistance. The causes and reasons of inadequate physical infrastructure facilities in Pakistan are identified in the next section 2.4.

2.4 Causes of insufficient infrastructure facilities in Pakistan

The principal causes for ongoing inadequate infrastructure facilities in Pakistan may be studied in two phases:

- Lack of managerial capacity and skilled human resources
- Lack of financial resources and budgetary constraints

2.4.1 Lack of managerial capacity and skilled human resources

Since independence, a persistent problem with Pakistan's economy has been low productivity and the inability to achieve self-sustainability due to reliance on imports rather than domestic industries. The country has also suffered a shortage of equipment, material and skilled human resources, and this has hindered implementation of development plans (National Planning Board, 1957).

Between 1 July 1965 and 30 June 1966, all sectors of the economy increased. The targeted development plans were achieved as the actual growth rate surpassed the projected growth rate. GNP recorded a growth of 30 percent compared with the proposed rate of 24 percent in the development plan 1965-70 and per capita income grew by 15 percent compared with the projected 12 percent over the planning period (National Planning Board, 1960, 1965).

However, during 1970-75 the performance of all sectors of the economy fell far behind projections. There was a substantial decline in the growth rate particularly, in large scale industry, due to the third war with India that started on 3 December 1971 and ended on 16 December 1971 with the emergence of the independent state of Bangladesh (formerly East Pakistan) (Planning Commission of Pakisatan, 1970).

All plans for 1970-75 were abandoned after the separation of Bangladesh (East Pakistan), and only annual plans were prepared. During 1971-72, the annual growth rate had declined by 6.8 percent due to the war with India, strict credit policies and the East Pakistan crisis that led to the formation of Bangladesh (Five-Year Development Plan (1978-1983). The social sector, including housing, health and education, was not given due attention in

planning during the same period. In 1977, the military took over the government, martial law was imposed and civilian government policies were suspended. The military, rather than government departments, drafted the development plan for the next five years (1978-1983). The development plan was implemented in very difficult and unfavourable conditions due to a rapid increase in imports and a fast decrease in foreign exchange reserves. Consequently, no major new projects were planned and priority was given to completing ongoing projects only. During the military regime, the private sector played a limited role in infrastructure development (Planning Commission of Pakisatan, 1970, 1988).

The major issue in implementing infrastructure development plans during the period of martial law was the inadequate capacity of public-sector organisations to execute plans and implement projects. Lack of management and adequate capacity resulted in time and cost overruns of the projects. Consequently, some projects of an operational nature were affected. Project execution lagged far behind the schedule, so the expected benefits from the projects could not be realised in time. Therefore, experienced and qualified professionals were needed at a managerial level in the project executing organisations to ensure proper implementation and achievement of planned objectives (Ministry of Planning Development and Reform, 2015).

2.4.2 Lack of financial resources and budgetary constraints

Developing countries such as Pakistan finance public infrastructure projects through various resources such as tax revenues, bilateral and multilateral lenders and private investment. Despite borrowing from domestic commercial banks, government security bonds and international financial institutions such as the International Monetary Fund, the World Bank and the Asian Development Bank, Pakistan also depends on external financial assistance to cover its budget deficit. During the financial year 2009-10, external assistance was lower than the expected level, which led to sharp cutbacks in expenditure for the PSDP (Ministry of Finance, 2011). According to credit rating[9] agency Moody's (2012), Pakistan's broad policy framework has not been robust enough to ensure support from donors and creditors or to effectively contain macroeconomic imbalances that have arisen since the global financial crisis in 2008.

[9] See Glossary of Technical Terms.

As mentioned in Chapter One, during the past two decades demand for infrastructure services has increased dramatically in Pakistan due to the substantial increase in population (as detailed in Table 2.1) and urbanisation. Infrastructure projects in Pakistan have in the past been established, owned and managed by the public sector. The role of the private sector has been limited and generally restricted to subcontracting at the construction stage (Nataraj, 2007). Therefore, projects are typically financed through taxes or borrowing from domestic commercial banks and/or also from international financial institutions. Conversely, the government is no longer able to finance infrastructure projects from public funds due to budgetary constraints. Other contributing factors include lack of investments, weak economic conditions and the high cost of debt servicing, substantial defence and security expenditures and smaller/unexpected foreign aid inflows.

Pakistan needs well-developed, efficient and sustainable infrastructure to achieve a higher growth rate. The current economic position does not allow the country to employ traditional infrastructure financing methods, i.e. public funds, because of financial constraints including high levels of public debt, a lower credit rating, high expenditures and lower revenues (total tax collection). Data on Pakistan's public debt is presented in Table 2.15 and its debt credit rating as reported by the credit rating agencies is presented in Table 2.16. The Credit Rating Tiers is presented in Appendix-I. Today, governments all over the world are seeking alternative means, beyond those used traditionally, to finance public infrastructure projects. Accordingly, the Government of Pakistan may consider adopting a more innovative approach to infrastructure development funding to deal with financial constraints for economic revival and to avoid future debt traps.

Table 2.15: Public Debt as percentage of GDP

Public Debt	2010	2011	2012	2013	2014	2015	2016
Domestic Debt	31.3	32.9	38.1	42.5	43.6	44.5	41.5
External Debt	29.3	26.0	25.2	21.4	20.2	18.9	17.7
Total Public Debt	60.6	58.9	63.3	64.0	63.8	63.5	59.2

Source: Fiscal Policy Statement, Ministry of Finance (2015-16)

Table 2.16: Debt credit rating of Pakistan

Year	Moody's		Standard & Poor's	
	Rating	Outlook	Rating	Outlook
2008	B3	Negative	CCC+	Negative
2009	B3	Stable	B-	Stable
2012	Caa2	Negative	---*	---*
2014	Caa2	Stable	---*	---*
2015	Caa2	Positive	B-	Stable
2016	---*	---*	B	Stable
2018	B3	Negative	---*	---*

Source: Trading Economics (2018). * Data is not available.

Empirical studies such as the Fiscal Policy Statement and Economic Surveys suggest that investment in infrastructure is largely stagnant in Pakistan for reasons including:

- Heavy spending on defence and boarder security and the war against terrorism;
- Small investment from private sector in infrastructure development;
- Lack of capacity to plan and procure projects with private investment within present institutional structure;
- Gap between economic viability and financial viability of infrastructure projects;
- Lack of long-term fixed rate financing facilities for infrastructure projects; and
- Limitations of the capital markets.

2.5 Infrastructure projects financing models

Conventionally, infrastructure projects are financed by the public sector through taxes and by lending from multilateral financial institutions and donors on concessional terms. However, in many low-income countries, infrastructure projects cannot be financed through tax revenues because of smaller net revenue, inefficient tax administration and weak growth (Lin and Doerte, 2012). The government is unlikely to impose additional taxes or increase tax rates and net tax due to potentially harmful impacts on an already weak economy, together with the likely political impact of measures that are unlikely to be popular.

2.5.1 Possible options for Pakistan to finance infrastructure facilities

In view of the current economic situation, the possible options for Pakistan to finance infrastructure facilities could be:

- Public funding through revenue collection (taxes)

- Lending from international financial institutions
- Capital market
- Infrastructure financing facilities
- Issuance of international bonds
- Private sector participation

2.5.1.1 Public funding through revenue collection (taxes)

The fiscal performance review of Pakistan from various Economic Surveys of Pakistan from 1991 to 2017 revealed that overall performance of key macroeconomic indicators such as total revenue collection, total expenditures, public debt and fiscal deficit has been deviating from fiscal targets for decades. For instance, during the financial year 2011, both revenues and expenditures have missed targets, leading to a budget deficit. Gross revenue collection was 12.1 percent lower (tax collection fell 6.4 percent and non-tax collections were 23.6 percent below the target), while total expenditures (current and development) were 2.4 percent higher than the budgetary estimates. PSDP spending was 24 percent lower than the target. The budget deficit has been around 4-6 percent of GDP during the past two decades, while the budget deficit during the financial year 2011-12 was 4 percent of GDP[10] (Ministry of Finance, 2012). Conversely, as noted above, the government cannot increase its revenues by imposing additional taxes, or increase tax rates and net tax, due to adverse effects on the weak economy and for political reasons (Ministry of Finance, 2012).

2.5.1.2 Lending from international financial institutions

Under the FRDL Act 2005[11], the country cannot borrow more than 60 percent of GDP. However, during the financial year 2011, the country's public debt reached at its highest limits i.e. 59.3 percent of GDP. The total public debt in terms of revenue had increased 64 percent in 2013. The lending option from international financial institutions is not workable for the time being. Secondly, the country's credit rating is low and may not be

[10] FRDL Act, 2005 amended in 2016 as part of the Financial Bill. FRDL limits the federal fiscal deficit excluding foreign grants to 4 percent of gross domestic product during the three years, beginning from the financial year 2017-18, and maintaining it at a maximum of 3.5 percent of gross domestic product thereafter (Ministry of Finance, 2016).

[11] FRDL Act 2005 ensures that within a period of two financial years, beginning from the financial year 2016-17, the total public debt shall be reduced to 60 percent of the estimated gross domestic product (Ministry of Finance, 2016).

strong enough to convince international financial institutions (creditors) to lend money to Pakistan (Ministry of Finance, 2011).

2.5.1.3 Capital market

The country's capital market is very limited, with only three stock exchanges, one in each of the main cities (Karachi, Lahore and Islamabad). Therefore, the limited capital market network is unable to encompass the country's total savings and, in particular, attract investors from small cities and remote areas.

2.5.1.4 Infrastructure financing facilities

Governments use specialised financing facilities to offer financial support and encourage private funding for provision of infrastructure services (Klingebiel, Ruster, & World Bank, 2000). Infrastructure projects typically require long-term investment (10-20 years). However, traditional lending resources (commercial banks) do not offer long-term loans facilities for large infrastructure projects.

2.5.1.5 Issuance of international bonds

This option may not attract international investors as credit rating agencies have assessed that the country's susceptibility to event risk is high due to uncertainty of returns, exchange rate exposure and higher transaction costs. According to Standard and Poor's August, 2009[12]assessment, Pakistan's credit rating is B-. This means the country is more vulnerable to adverse business, financial and economic conditions but currently has the capacity to meet financial commitments. However, Moody's Investors Service has declared in its annual report in February 2012 that Pakistan's credit rating is B3, which reflects the country's low economic, institutional and government financial strengths, and its high susceptibility to event risk. Moody's assessment is based on four factors: economic strength – which is characterised as "low"; institutional strength – "low"; government financial strength – "low"; and susceptibility to event risk – "high". Details of various credit rating tiers and credit rating definitions by major credit rating agencies are placed in Appendix-I and Appendix-II respectively (Moody's, 2012).

[12] Ratings from "AA" to "CCC" may be modified by the addition of a plus (+) or minus (-) sign to show relative standing within the major rating categories. Negative means that a rating may be lowered.

Moody's (2012) further explains that Pakistan's "low" economic strength reflects the weak economic growth trend since the 2008 global financial crisis, a trend that has also been constrained by policy framework weakness and structural weaknesses. Macroeconomic imbalances caused a high level of inflation and pressures on the government's payments position in the second half of 2011. The second factor, Pakistan's "low" institutional strength, is partly a reflection of the fractious character of politics. The third factor, "low" government financial strength, reflects the presence of a high debt burden and large refinancing requirements.

2.5.1.6 Private sector participation

Social and economic infrastructure contributes immensely to all economic activities, improves living standards and human welfare and also has considerable potential for reducing poverty directly. Many countries have employed several different financing methods for infrastructure development but they are still short of the required infrastructure facilities (Adeniyi, Aje, & Ogunsemi, 2011).

Presently, concurrent budgetary stringencies and demand for improvement in public facilities have persuaded governments to involve the private sector for provision of public infrastructure facilities, to harness private investments and achieve better value for money[13] (Grimsey & Lewis, 2004). Procurement of public infrastructure by getting the private sector to design, finance, build, operate and maintain it for a contract period is a well-established practice in Europe, the US and Australia (Cheung, Chan, & Kajewski, 2012). Cheung, Chan, and Kajewski (2009) referring to Walker et al. (1995) suggested three reasons for participation of private sector in infrastructure development: i) the private sector saves project costs in planning, design and construction, relieves administrative burdens and avoids bureaucratic formalities; ii) the private sector can provide better service to the public sector and maintain balance risk-return structure; and iii) the private sector can mitigate the financial burden of the government. The key reasons several governments have joined hands with the private sector are to have access to finance, use of modern technologies, managerial proficiency and good entrepreneurial spirit (Adeniyi et al., 2011).

[13] See Glossary of Technical Terms.

The success of private sector participation in the provision of public infrastructure typically lies in the commitment and competence of the public management, government guarantee for project implementation, favourable economic conditions, stable political and social environments, selection of an appropriate concessionaires and availability of financial markets (Cheung et al., 2012). Adeniyi et al. (2011) noted that a transparent and sound regulatory framework is necessary for private-sector participation in infrastructure development, including respect for contract agreements, protection from expropriation, quick and satisfactory dispute settlement and legitimate recovery of costs and profit proportional to the project-related risks undertaken. Samii, Van, and Bhattacharya (2002) have identified that the private and public sectors must have a symmetry in commitment and objectives, intensive communication and good working relations for successful participation of the private sector in infrastructure development.

Regan, Smith, and Love (2009) point to the advantages of private participation in infrastructure development over traditional procurement methods as: i) improved public services and qualitative user outcomes; ii) reduced procurement costs and improved value for money outcomes; iii) delivery of projects on budget and on time; iv) improved project management – integration of design and construction processes and full lifecycle costing; and v) introduction of innovation and new technologies. Private sector participation in infrastructure development brings new investment opportunities and increased efficiency in project delivery (Van Ham & Koppenjan, 2001).

2.5.2 Infrastructure project financing structure in Pakistan

Overall infrastructure investment of Pakistan primarily relies on public sector development plans. Foreign direct investment and private sector participation in infrastructure development are other sources of fixed capital formation.

2.5.2.1 Public Sector Development Program

The PSDP and the Annual Development Program (for federal and provincial governments) are developed at federal level by the Planning Commission, Ministry of Planning, Development and Reforms. These are the main mechanisms for implementing public-sector economic plans as well as the major source of public sector investment in Pakistan. Public funds are allocated through the PSDP to develop infrastructure, and to fund poverty alleviation programs through generating employment opportunities. The aim is to

achieve Millennium Development Goals[14] as well as economic growth. For the financial year 2012-13, the overall size of the PSDP was set at Rs. 873 billion (including Rs.360 billion for federal PSDP and Rs.513 billion for the provincial development program), which is equal to 3.7 percent of the GPD compared with 3.6 percent of GDP in the revised estimates for 2011-12 and 2.6 percent in 2010-11 (Ministry of Finance, 2012).

Despite borrowing, Pakistan also depends on external financial assistance to cover its budget deficit. In the financial year 2010-11, external assistance was lower than expected, which led to sharp cutbacks in expenditure for the PSDP. In addition to the PSDP, other development expenditure (such as grants, subsidies, relief and income support programs) has also been kept at around Rs.154 billion in the budget 2012-13 (MoF, 2012). Sector-wide distribution and utilisation of the federal PSDP for the financial year 2011-12 and 2012-13 is presented in Table 2.17.

Table 2.17: Broad Sectoral Allocations of Federal PSDP 2011-12 and 2012-13 (Rs Billion)

Sector	2012-13 Allocation	% Share	2011-12 Allocation	% Share
Water	48	13	37	13
Energy	65	18	55	18
Railways	23	6	15	5
Roads	57	16	50	17
Education	20	6	19	6
Health and Population	24	7	22	7
Others	123	34	102	34
Total (Federal)	360	100	300	100

Source: Adopted from Annual Plan 2011-12, Planning Commission of Pakistan,
Note. US$ 1 = Pak Rs. 86.020 as at July, 2011 and in July, 2012 US$ 1 = Pak Rs. 94.378).

According to the PSDP allocation, infrastructure projects (energy, water resources and highways/motorways/ports and railways) were given priority and allocated 53 percent of federal PSDP in both financial years 2011-12 and 2012-13. A midyear review of PSDP 2011-12 was held in January 2012 to review the progress of PSDP funded projects. Subsequently, adjustments were made within ongoing projects and funds were diverted from slow-moving projects to fast-track projects.

[14] The MDGs officially ended in 2015, but the MDGs acceleration framework was to continue until 2018.

2.5.2.2 Private sector participation in infrastructure in Pakistan

Over the past five decades, public infrastructure in Pakistan has made some progress. However, the rate of improvement has been slowest for the majority of public infrastructure sectors compared with other similar countries, due to the weak economic growth performance of the country. Furthermore, infrastructure improvement has been insufficient to improve the infrastructure conditions of Pakistani citizens (Norman & Tomoko, 2012).

According to Business Monitor International (2016) Pakistan's construction sector is facing hardships due to lack of protection for property owners, limited government spending and a worsening security situation, which continues to deter private investment and particularly foreign investors. Although the country has the potential for substantial infrastructure growth, it has suffered from years of underinvestment. A number of infrastructure projects are currently planned/in the pipeline in Pakistan. Many projects are receiving funding from regional bodies such as the Asian Development Bank. Pakistan also receives infrastructure investment from China. Power infrastructure is the focus of investment as the country attempts to address its electricity generation shortfall. The power sector has numerous issues such as a high level of circular debt from the public and private sectors[15]. In short, currently all infrastructure sectors are suffering from a high deficit (Business Monitor International, 2016).

Generally, infrastructure projects in Pakistan are financed through public investment. According to the Public-Private Infrastructure Advisory Facility (PPIAF) and World Bank's database, 64 infrastructure projects with a total investment of US$28,553 million[16] were developed with private-sector participation during the period 1990 to 2011. Of these, a maximum of 50 projects were developed in the energy sector with US$10,933 million, while the telecom sector was successful in attracting the highest investment of US$16,262 million for six projects. However, the water sector was neglected by the private sector and received no investment. A brief overview of the status of yearly and sector-wide infrastructure projects with private-sector participation is provided in Table 2.15.

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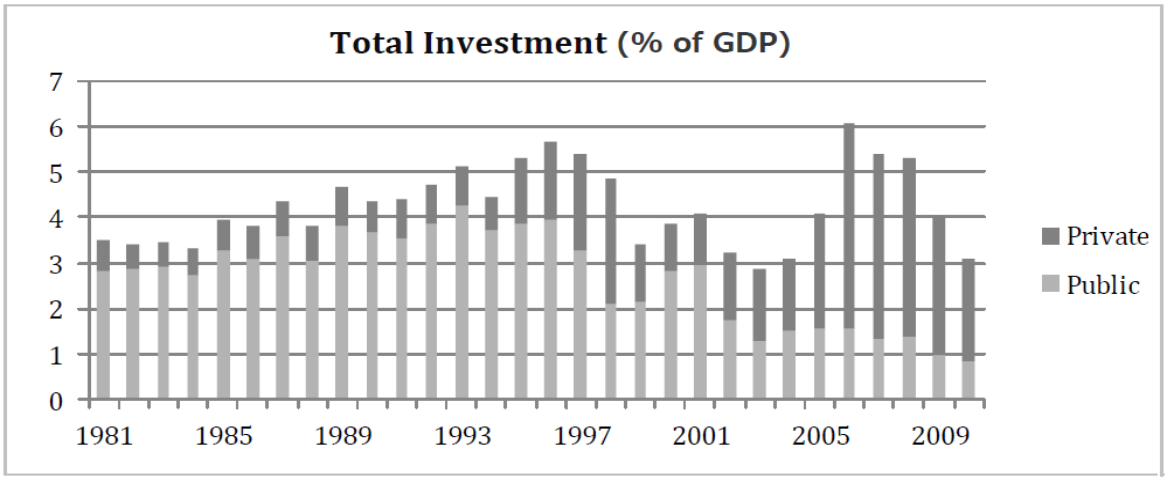
[15] The Independent Power Producers (IPPs) in Pakistan most operate oil-fired or coal-fired plants. The Pakistani government provides them the fuel for which the IPPs need to pay. Public owned electricity boards procure power from the IPPs and distribute it to the general public. Eventually, they charge the public and need to pay the IPPs. Often, the electricity boards are unable to pay the IPPs for the power procured and in turn, IPPs are unable to pay the Government for the fuel supplied (Gourishankar, 2017)

[16] AUS$1 = US$1.35 (on 23/06/2018. Oanda Currency Converter. https://www.oanda.com/currency/converter)

The trend in infrastructure investment in Pakistan from 1981 to 2010 as a percentage of GDP is shown in Figure 2.4. The investment trend illustrates that private investment has exceeded public investment in the most recent decade. However, private sector investment in Pakistan is still the lowest compared with its neighbouring countries.

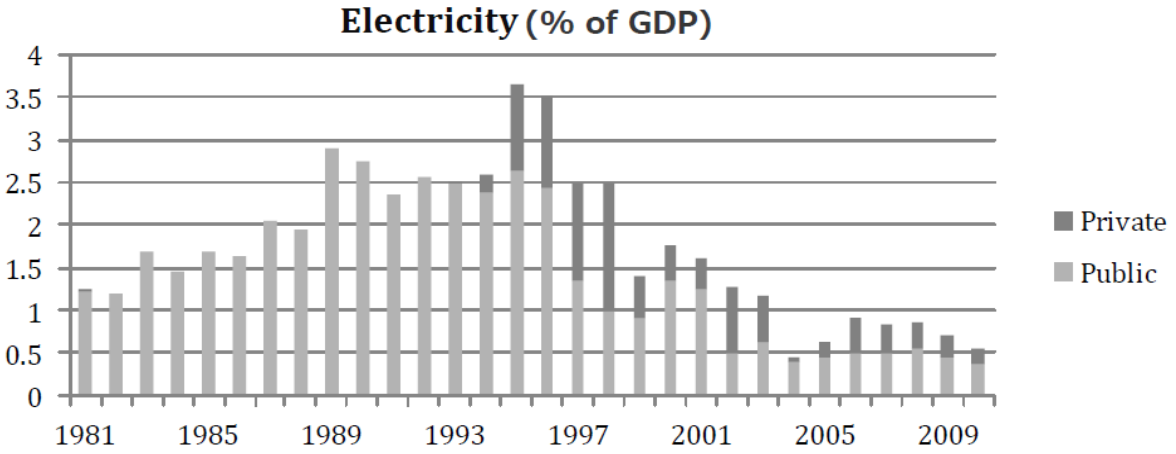
Figure 2.8: Total infrastructure investment (public and private) from 1981 to 2009 as percent of GDP



Source: Business Monitor International (2016)

The trend in Pakistan's investment (public and private) in the electricity sector shows that public investment has been a dominant force over the past three decades and is still a primary source of investment. In the 1980s, investment in the electricity sector was completely dependent on the public sector, which steadily rose above 2.5 percent of GDP. The level of public investment in the power sector (electricity generation) dropped in 1997 and has declined to less than 0.5 percent of GDP in the 2000s due to government's strategic plan of 1992 for restructuring the power sector that called for privatisation of electric power. Subsequently, private investment experienced a sharp increase totalling roughly 1 percent of GDP in 1995, but the boom lasted only for the following few years. Over the past decade, private investment reached about 0.5 percent of GDP and continued to decrease to about 0.2 percent of GDP in 2010 (Figure 2.5).

Figure 2.9: Electricity sector investment (public and private) from 1981 to 2009 as percent of GDP

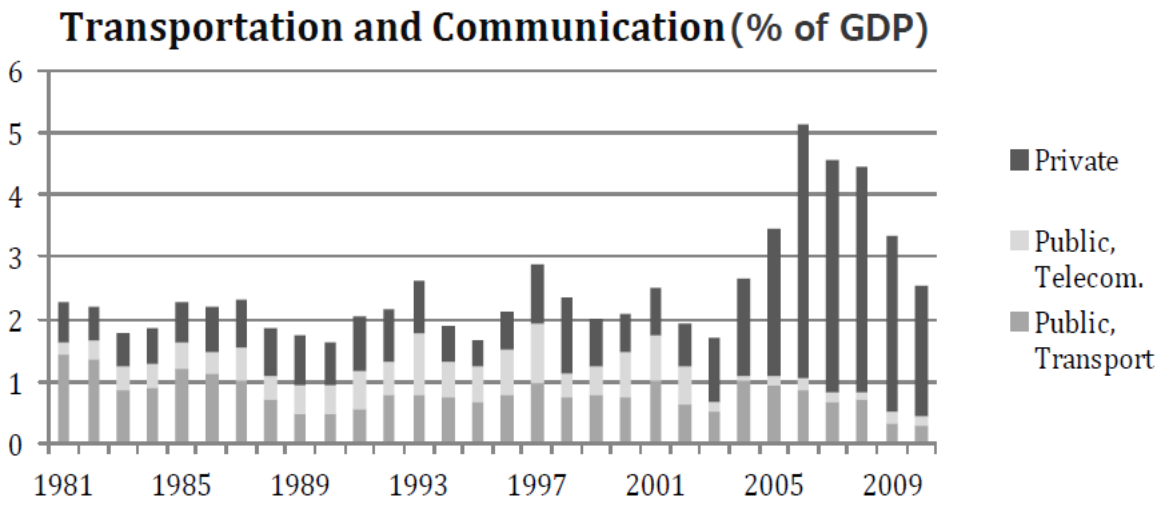


Source: Business Monitor International (2016)

Private investment in transportation and telecommunication is aggregated, while public investment can be disaggregated between the two sectors due to the availability of data. Public investment in the transport sector consistently declined in the 1980s and stagnated during the 1990s. In 2004, public investment in the transport sector rose slightly, but it again decreased over recent years and hit the lowest record of less than 0.3 percent of GDP in 2010.

Overall, public investment in the telecommunications sector is on a declining trend. In 1980s public investment increased and maintained its level in the 1990s. However, it has declined significantly since 2003. In contrast to the declining trend in public investment, private investment in transport and telecommunication rose considerably after 2002. In the 1980s and 1990s, private investment in the two sectors amounted to less than or close to 1 percent of GDP but jumped to 4 percent in 2006. The increase in private investment was caused by the increasing participation of private sector in the telecommunication services (see Figure 2.6).

Figure 2.10: Transportation and communication sector investment (public and private) from 1981 to 2009 as percent of GDP



Source: Business Monitor International (2016)

2.5.2.3 Private sector participation in infrastructure development across South Asia (1991-2011)

In the South Asia region, during the period 1990 to 2011, India led with the development of 556 infrastructure projects with the private sector investing a total of US$255,169 million. Pakistan developed 64 infrastructure projects with investment of US$28,546 million during the same period. Details of infrastructure projects with private sector participation in South Asia are shown in Table 2.18 and Private Participation in Infrastructure Development by Region from 1990 to 2011 is shown in Table 2.19.

Table 2.18: Private Sector Participation in Infrastructure in Pakistan from 1990 to 2011 (US$ million)

Year	Energy Sector		Telecom Sector		Transport		Water Sector		Total	
	No. of Projects	Total Investment	No. of Projects	Total Investment	No. of Projects	Total Investment	No. of Projects	Total Investment	No. of Projects	Total Investment
1990	-	-	2	20	-	-	-	-	2	20
1991	-	-	-	20	-	-	-	-	-	20
1992	2	7	-	20	-	-	-	-	2	27
1993	-	-	-	20	-	-	-	-	-	20
1994	1	1,631	2	502	-	-	-	-	3	2,134
1995	12	1,779	-	21	2	200	-	-	14	2,000
1996	8	2,365	-	18	-	-	-	-	8	2,384
1997	1	154	-	31	1	119	-	-	2	304
1998	-	-	-	6	-	-	-	-	-	6
1999	-	-	-	-	-	-	-	-	-	-
2000	-	-	-	77	-	-	-	-	-	77
2001	-	-	-	60	-	-	-	-	-	60
2002	-	-	-	170	1	32	-	-	1	202
2003	-	-	-	240	-	-	-	-	-	240
2004	1	30	2	1,683	-	17	-	-	3	1,731
2005	1	346	-	4,364	-	64	-	-	1	4,775
2006	2	298	-	2,473	1	40	-	-	3	2,811
2007	5	1,197	-	2,741	1	581	-	-	6	4,519
2008	5	1,084	-	2,255	2	303	-	-	7	3,643
2009	11	1,376	-	1,266	-	-	-	-	11	2,643
2010	-	166	-	271	-	-	-	-	-	437
2011	1	500	-	-	-	-	-	-	1	500
Grand Total	50	10,933	6	16,262	8	1,356	-	-	64	28,553

Source: Author (data extracted from Public-Private Infrastructure Advisory Facility and The World Bank Database, April, 2012)

Table 2.19: Private Participation in Infrastructure Development by Region from 1990 to 2011 (US$ million)

Region	Energy Sector		Telecom Sector		Transport		Water Sector		Total	
	No. of Projects	Total Investment	No. of Projects	Total Investment	No. of Projects	Total Investment	No. of Projects	Total Investment	No. of Projects	Total Investment
Bangladesh	21	1,397	12	6,099	5	-	-	-	38	7,496
India	220	117,420	37	81,196	287	56,198	12	355	556	255,169
Nepal	5	273	3	135	-	-	1	-	9	408
Pakistan	50	10,933	6	16,258	8	1,355	-	-	64	28,546
Sri Lanka	13	448	7	2,602	1	240	-	-	21	3,290
Grand Total	309	130,471	65	106,290	301	57,793	13	355	688	294,909

Source: Author (data extracted from Public-Private Infrastructure Advisory Facility and World Bank Database, April, 2012)
US$ 1 = 121 Pak Rs., AUS$ 1 = 89.90 Pak Rs. and AUS$ 1 = 1.35 US$ (as on 23/06/2018.
Oanda Currency Converter. https://www.oanda.com/currency/converter)

2.6 The way forward

This chapter has provided an overview of the current status of infrastructure development in Pakistan and a comparison with infrastructure across South Asian countries. The status of infrastructure development including infrastructure investment, planning, policies and trends in Pakistan has been explored. This chapter also has discussed infrastructure project financing structure in Pakistan comprising private-sector participation in infrastructure in Pakistan and across South Asian countries. Major events in Pakistan since the country's independence in 1947 were examined. This chapter also reviewed the causes of insufficient infrastructure facilities by examining the key indicators of the economy.

The chapter concludes that infrastructure in Pakistan has improved over the years but improvement has been slowest in the majority of public infrastructure sectors compared with countries in the region. This slow development of Pakistani infrastructure has several reasons, including lack of public financing and a declining trend in infrastructure investments. Therefore, this situation probably contributes to the low economic growth performance of the country.

Public-private partnerships may be the best option for Pakistan to improve and develop infrastructure facilities in the present situation, as discussed in Chapter One. These schemes are sometimes referred to as PPP, P3 or 3P. A literature review of the benefits and drawbacks of PPP is provided in Chapter Three.

Chapter Three: Literature Review

This chapter provides a critical review of the existing literature concerning the topic of public-private partnerships (PPP). An overview of the evolution of PPP is given in Section 3.1. Section 3.2 presents an analysis of studies related to PPP evaluation. Evaluation of PPP including advantages/benefits, disadvantages/weaknesses and their contribution to economic growth is discussed in Section 3.3. Section 3.4 presents the key elements and barriers/issues in implementation of a successful PPP program. The role of institutions and private-sector participation in infrastructure development is presented in Section 3.5. Section 3.6 provides a review of investment theories. The scope of the literature review and conclusions from its analysis are presented in Section 3.7 and 3.8 respectively. Section 3.9 highlights various gaps in the existing literature that require research attention.

3.1 Evolution of public-private partnerships

In the modern age, PPP for infrastructure development has become an important development option for governments around the world (Aschauer, 2000b; Grimsey & Lewis, 2007a; Pereira & Andraz, 2005). Despite the fact that PPP has become popular and is being implemented by governments, its definition, historical origins, and net benefits are still debated (Grimsey & Lewis, 2017; Pereira & Andraz, 2005). PPP might be an effective solution to contemporary financial constraints and budgetary imbalances, and offer value for money, if no other infrastructure investment model is viable. However, the exact nature of PPP must be made clear. It is also important to ascertain the evolutionary process in the provision of public infrastructure on PPP modality. Therefore, it is necessary to examine the origins of PPP and to establish a moderate but comprehensive definition.

3.2 Origin of PPP

Private-sector participation in infrastructure development is not a new concept. History indicates that there has always been some degree of public sector and private sector cooperation over the centuries (Hodge & Greve 2009; Wettenhall, 2003). For example, in the 17th century, the private sector contributed to the development of the transport sector (construction of roads and canals) in Europe and the United States (UNESCAP, 2007). In the 19th century, consortia of private parties built many American railways. (Grimsey & Lewis, 2004) cited earlier work of Briggs (1959) and Court (1962) that the mid-19th century is considered the grand era of private-sector involvement in infrastructure development, encompassing the boom period of

British railway construction in the late 1840s. Consequently, construction of railways gave rise to economic activity as the majority of the total population were engaged in railway construction activities in that phase. In 1853 railways were first introduced to the Indian subcontinent through private investment initiatives (UNESCAP, 2007).

Today, PPP have become attractive to governments all over the world as an off-budget mechanism for providing infrastructure services, as this model may not require any immediate cash investment by government agencies. As briefly described in Chapter One, PPP are commercial transactions/contracts between the public and the private sector in which they jointly develop projects and deliver services and share project-related resources, costs and risks. Under a PPP contract, organisations from the private sector perform functions on behalf of the public sector. The private sector may acquire the use of public property for its own commercial purposes, and receive benefits, charges or fees from the users or the customers for the services provided to them (IPDF, 2007).

An early form of PPP is the ancient concept of tolled roads, which have been used since Romans times. Toll money collected from road users was used to maintain roads and bridges. Britain also passed legislation in 1555, The Highways Act 1555 [17], to ensure maintenance of roads. According to that statute, local parishes were responsible for repairing the roads in their own areas. For that reason, unpaid and unskilled surveyors were appointed in each parish. The parishioners were called on to contribute services to the repair of the roads in that parish. Rich people were obliged to send horses, carts and ploughs, while others had to work for six consecutive days each year under the surveyor's authority. This compulsory labour system was abolished in 1835 in Britain, while a similar system in the United States operated into the 20th century in some rural areas. This system proved to be ineffective and inefficient because the local community had neither the capabilities nor resources and most importantly did not have the motivation to carry out road maintenance. Therefore, deteriorated road conditions and fast-growing traffic flow led to the development of the next phase i.e. turnpikes[18] (Grimsey & Lewis, 2007a).

[17] The *Highways Act 1555* was the first statute of Highways (an act for amending of highways). It was an Act of the Parliament of England passed in 1555 and later extended as the *Highways Act 1563* (Tanner, 1922, p. 498).

[18] See Glossary of Technical Terms.

3.2.1.1 Turnpike

The name "Turnpike" derived from the hinged barrier (spiked spear or English "Pike") that was fixed across roads and blocked passage until swung open for toll payers. Turnpike is another term for a toll road. The turnpike[19] is a road partly or wholly paid for by fees collected from the users at tollgates. Turnpikes are the foundation of contemporary infrastructure building, operation and transfer systems (Albalate, 2014).

3.2.1.2 British turnpikes

The tollgates in England were first authorised by law in 1364. Grimsey and Lewis (2004) cite earlier work by Cossons (1934) who stated that the first turnpike was established in 1663 to raise funds for the repair and improvement of the roads. The British Turnpikes Act granted permission to place three tollgates to collect the tolls at a specified rate on vehicles and livestock passing on a particular section of road over a period of 21 years. It was expected that within this period the debt for construction of the road would be paid off, and the road would then reopen free of charge. In this way, the customary formula of transferring the cost of road maintenance from the public to the users was established by early in the 18th century.

The first so-called "turnpike trusts" were established in 1706-07 to improve the section of the London-Holyhead highway between Fornhill and Stony Stratford. By 1840 there were about 1000 turnpike trusts Acts in force, promoted by town councils, manufacturers, merchants, landowners and farmers, including those responsible for maintaining at least a part of the road in question. The Trustees of the turnpike trusts were granted power to raise capital, generally at 4-5 percent, to develop new roads or improve old ones in a particular locality. The responsibility for maintenance and construction of the roads was given to appointed surveyors,

[19] Road with turnpike – in former times, a road that travellers were allowed to use only after paying a toll at the turnpike. Road barrier – a gate formerly used to bar the way on to a section of road or a bridge until a toll had been paid. Toll road – a motorway on which a toll is charged. Drivers usually receive a ticket when they start their journey and pay a fee at the end that depends on the length of journey. Electronic tickets – tolls are automatically calculated as a vehicle passes under a tolling point. Presently, there are many options available for toll payment. For example, in Australia, payment can be paid online, by phone or visiting a participating retailer. Pass products are available from the toll payment providers for occasional use. However, opening of an account may suit regular users. Toll road payment may be paid in advance before travel, registration of licence plate of the vehicle or setting up an account (video account, tag account and business account). When an account holder, tag holder and registered licence plate vehicle passes under the tolling point, the payment provider records an image of the number plate or detects a tag and deducts the toll amount from the registered vehicle account. If toll payment is not paid before travel or paid within three days of travel, the vehicle's registered owner will receive an unpaid toll notice from the toll road's payment provider. The notice will include toll payment instructions and may include additional fees.

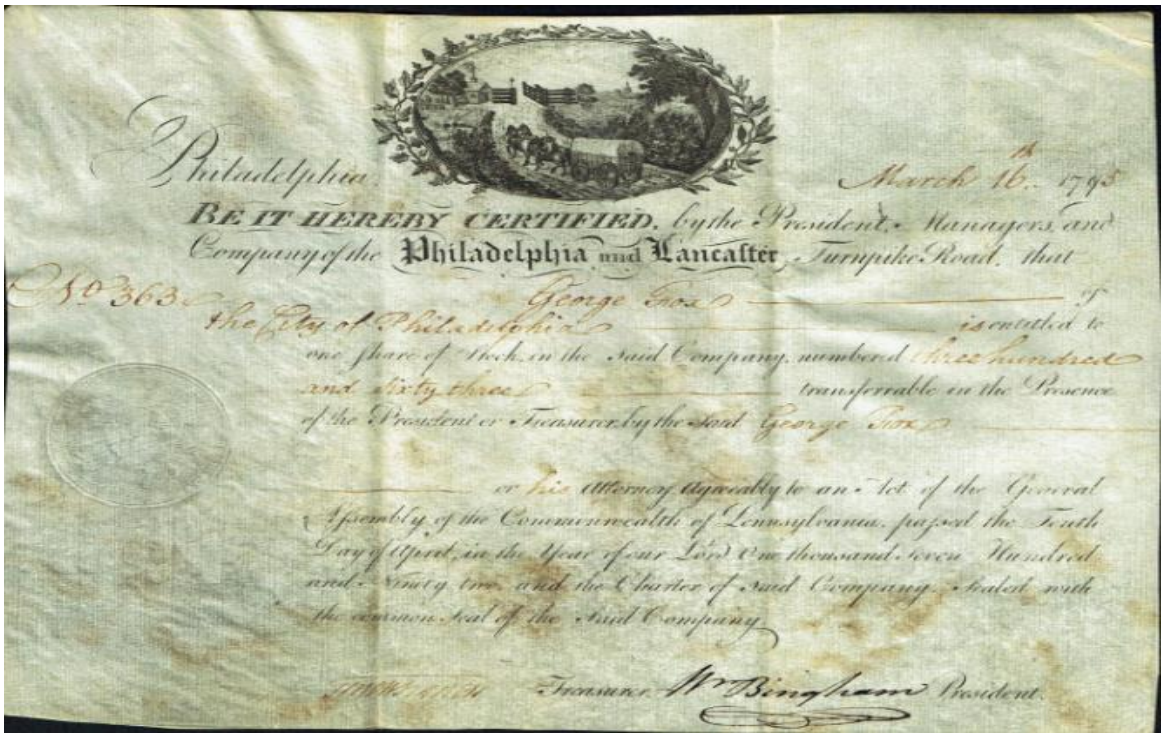
who were usually involved in supervising the operations of a number of turnpikes. Construction techniques were left to the discretion of the local engineers. The collection of the toll was franchised to "farmers" who paid a fixed amount to the trust in return for toll collection right on particular gates on the turnpike (an early example of subcontracting or outsourcing). After 1773, toll farming leases were auctioned, initially to local businessmen and ultimately to larger groups, which might buy leases to a number of turnpikes (Grimsey & Lewis, 2007a).

3.2.1.3 The United States turnpikes

The first turnpike road in the US was formed by a Virginian Act in 1785 and by 1840s a total of about 1600 turnpike companies were active/licensed. The first major toll road in the United States was the "Philadelphia" and "Lancaster Turnpike", built in the 1790s, within Pennsylvania, connecting Philadelphia and Lancaster.

It links Lancaster, Pennsylvania, and Philadelphia at 34th Street, with a total length of 62 miles (99.8km.). A copy of the contract of the Philadelphia and Lancaster Turnpike Road is at Figure 3.1 and an image is at Figure 3.2 (U.S. Department of Transportation Federal Highway Administration, 2018).

Figure 3.1: Copy of contract of Philadelphia and Lancaster Turnpike Road


Philadelphia March 16th 1795
BE IT HEREBY CERTIFIED, by the President, Managers and Company of the Philadelphia and Lancaster Turnpike Road, that
No 363 George Fox of the City of Philadelphia is entitled to one share of Stock in the said Company, numbered three hundred and sixty three transferrable in the Presence of the President or Treasurer by the said George Fox or his Attorney agreeably to an Act of the General Assembly of the Commonwealth of Pennsylvania, passed the Tenth Day of April, in the Year of our Lord One thousand seven Hundred and Ninety two, and the Charter of said Company, Sealed with the Common Seal of the said Company
Witness [illegible] Treasurer Wm Bingham President

Source: (U.S. Department of Transportation Federal Highway Administration, 2018)

Figure 3.2: Image of Philadelphia and Lancaster Turnpike Road

Source: (U.S. Department of Transportation Federal Highway Administration, 2018)

In the first half of the 19th century, there were more private toll roads than public roads (Estache, 2000). However, not everyone paid the toll. Massachusetts legislation exempted people going to churches, those on military duty and those doing business within the toll-gated town in New York. Toll gates were placed at 10-mile intervals, to allow locals on short journeys to travel freely. Towns and citizens were expecting economic spillovers into their locality due to the improved transport and communication systems. Indeed, the economic prosperity of the towns was linked to the success of the turnpikes. In the United States, turnpikes were leased for 99 years and ownership was expected to revert to the states (Estache, 2000).

In the second half of the 19th century, France introduced extensive concession schemes to finance its infrastructure networks. Water, electricity, railways and tramway networks were designed, financed and operated by private operators under long-term concession contracts. Under these concessions, infrastructure assets were returned to the public authority at the end of the contract. As a consequence of the 1929 financial crisis that heralded the start of the Great Depression (lasting from 1929-1930) and World War II (1939-1945), numerous concessions were nationalised and returned to the state. Thereafter, major infrastructure projects were launched on a public funding basis through public works contracts (European PPP Expertise Centre, 2012).

Subsequently, public services and infrastructure in France split into two separate systems: the PPP-based private concession system known as “delegation de service public” (outsourcing of public facilities) and the “dirigiste system of gestion directe” (interfering

system of direct management), where the infrastructure or service is built and/or operated directly through state-owned entities. However, most concessions were taken over by the government when private companies got into financial crisis as the tolls charged were regulated and price increases were lower than the inflation rate (European PPP Expertise Centre, 2012).

3.3 Current situation

Over the past three decades, public investment in infrastructure has reduced in many countries because of deficit budgeting. For example, government budgets aim for more spending on infrastructure than revenue available to pay for the spending. Consequently, many governments have sought to adopt new ways of delivering infrastructure facilities through private-sector partnerships. At present, three countries, namely Australia, Canada and the United Kingdom, have extensive experience in providing infrastructure services in collaboration with the private sector. Since the start of the 2000s, a number of Western countries and emerging economies in Asia, the Middle East and Eastern Europe have introduced extensive legislation for private-sector participation in public infrastructure development. Conversely, the private sector recognised the financial benefits of funding, constructing and operating infrastructure assets, whether in the form of long-term concession contracts or permanent ownership (Alfen, 2010).

Private concessions never completely disappeared in France and still exist in various contractual forms, especially in the municipal services sector. Since the end of the 1990s, the PPP procurement method in France has made a strong comeback in relation to the design, financing and operation of infrastructure projects. Almost all French public services are open to concession schemes at the local level under “delegation de gestion contracts” (management delegation contracts). In the UK, a private finance initiative (PFI) was first introduced in 1992 by the Conservative Government led by John Major. This was the first systematic program focused on encouraging PPP. The program aimed at reducing public-sector borrowing requirements. Later, in 1997, the UK Labour government led by Tony Blair expanded the PFI program with an emphasis on achieving “value for money (VoF)”[20], primarily through appropriate risk allocation between public and private partners (Allen, 2001).

[20] See Glossary of Technical Terms.

By 25 June 2018, PPP had delivered 700 UK infrastructure projects with a total of £56 billion of private-sector capital investment. The PPP infrastructure projects included new schools, hospitals, roads, housing, prisons, and military equipment and accommodation (Government Digital Service UK, 2018).

3.3.1.1 PPP structure and models

There are many forms of PPP. The contract between the public-sector authority and the private party defines the nature of the partnership between the parties. This partnership can take many different forms and range from a fairly simple contractual agreement, such as supplying a specific service (e.g. garbage collection), to complex arrangements such as the construction, operation, maintenance, finance and provision of an infrastructure service e.g. construction of a new airport (IPDF, 2007). In a PPP, the public and private sectors join forces to design, finance, build, manage or maintain infrastructure projects. The exact nature of the PPP depends upon the allocation of risks and responsibilities. Some of the common structures in PPP (Regan, 2009; UNESCAP, 2007) [21]are:

- Service Contracts Outsourcing/contracting out
- Management Contracts
    - Supply or Service Contract
    - Maintenance Management
    - Operational Management
    - Lease
- Standard International Build-Own-and-Transfer (BOT) variants:
    - Build-Own-and-Transfer (BOT)
    - Build-Lease-and-Transfer (BLT)
    - Build-Own-and-Operate (BOO)
        - Licensing:
            - ✓ Quantity Licensing
            - ✓ Quality Licensing

[21] The United Nations Economic and Social Commission for Asia and the Pacific (USESCAP) was established in 1947 with its headquarters in Bangkok, Thailand. USESCAP is the regional development division of the United Nations for the Asia-Pacific region. USESCAP is made up of 53-member states and nine associate members. USESCAP promotes rigorous analysis and peer learning in the areas of work. It translates its findings into policy dialogues and recommendations and provides good development practices, knowledge sharing and technical assistance to member States in the implementation of its recommendations.

- Build-Transfer-and-Operate (BTO)
- Rehabilitate-Operate-and-Transfer (ROT)
- Rehabilitate-Own-and-Operate (ROO)
- Design, Finance, Build, Operate and Transfer (DFBOT)
- Concession
- Franchise

- Private Finance Initiative (PFI)
  - Annuity Model

Brief descriptions of the common structures in PPP are given below:

- **Service contracts outsourcing/contracting out:** under this method the authority retains ownership and control of all assets and property. The private party performs a specific service, within specific specifications for a relatively short period of time. The duration of these contracts is from one to three years. This method reduces the procurement cost and overstaffing, and improves service delivery, introduces new technology and improves productivity especially in the industrial sector.
- **Management contracts:** generally, transfer more risks and responsibility to the private party than a service contract. They can be implemented in a short time and are the least complex in nature. The private partner is not expected to invest in facility improvement but may be responsible for routine maintenance. Efficiency gains may be limited. All risks are borne by the public partner. Management contracts are mainly used for existing infrastructure assets and are usually awarded for three to five years.
  - **Supply or service contract:** involve the supply of equipment, raw material, power, energy and labour and are typical examples of this method. Only non-core activities of an organisation such as catering, medical, luggage handling, security and transport services can be undertaken by the private partner. The duration of these contractual arrangements is one to three years.
  - **Maintenance management:** sometimes the private vendor/supplier can also be engaged for maintenance of assets procured by them. Assets management contracts are popular with the transport sector. These are usually awarded for three to five years.
  - **Operational management:** these are also common in the transport sector for providing non-transport elements of transport operations, such as the ticketing

and reservation systems for public transport. Length of these agreements is from three to five years.

- **Lease:** under this contractual management the private-sector service provider becomes the asset manager of the existing publicly owned facility or acquires land for its own exploitation. The leaser/operator collects the authorised tariff from the users and earns profits generated by improved efficiency. The private party generally is not expected to invest in facility improvement. The main benefits of this type of lease are that: it can be implemented within a short span of time; and a reasonable private investment is possible under long-term agreements. However, weaknesses include: almost all risks are borne by the public sector; and the lease offers little incentive for the private sector to invest. These types of contracts are generally used for existing infrastructure assets. Leases require considerable regulatory oversight. A lease contract can be anywhere between five to 15 years.

- **Standard international build-own-and-transfer (BOT) variants:** these are contractual arrangements whereby the private party undertakes the financing/construction of a given infrastructure service and its operation/maintenance as per output specification and service levels prescribed by the private party. The private party usually transfers the facility to the public authority at the end of the fixed term. The duration of BOT model contracts is 15 to 30 years. The common variants of these type of PPP scheme are:
  - **Build-own-and-transfer (BOT):** the private party operates the facility over a fixed period during which it is permitted to charge facility users appropriate tolls, fees, rentals and charges not exceeding those proposed in its bid to cover its investments, operating and maintenance expenses in the project.
  - **Build-lease-and-transfer (BLT):** under this contractual arrangement the private party returns the facility to the authority. This is done through a lease arrangement for a fixed period.
  - **Build-own-and-operate (BOO):** the private party builds the facility under a contractual arrangement with the authority and recovers its investments and operational/maintenance costs by collecting tolls, rent, fees and charges from the users. Licensing may be considered a variant of the BOO model of private participation.

- **Licensing:** the government grants licences to a private party to provide services such as fixed line and mobile telephony, internet service, television and radio broadcast, public transport and catering services on the railways and airlines. It allows competitive pressure in the market by allowing multiple operators. There are two type of licensing:
  - ✓ **Quantity licensing** by setting limits through quantity licensing, the government is able to ensure reasonable competition between service providers and adjust supply between one area and other.
  - ✓ **Quality licensing:** this does not place any restriction on the number of providers or the amount of service produced but specifies the quality of service that needs to be provided. The government may get a fee and a small share of the revenue earned by the private sector under the licensing arrangement.

- **Build-transfer-and-operate (BTO):** the private party constructs the facility under traditional procurement methods, transfers its title to the authority and operates the facility to specified standards on the authority's behalf under agreed terms.
- **Rehabilitate-operate-and-transfer (ROT):** the existing facility is turned over to the private partner to renovate, remodel, refurbish or rehabilitate and operate/maintain for a franchise period. At the expiry date the ownership of the facility is returned to the public authority.
- **Rehabilitate-own-and-operate (ROO):** the existing facility is turned over to the private partner to renovate/rehabilitate and operate/maintain in perpetuity, provided the operator does not violate specified franchised terms.
- **Design, finance, build, operate and transfer (DFBOT):** here the authority defines the service required and invites tenders for the complete design, finance and construction of an infrastructure facility by a private party. The private party operates the facility to specified standards on behalf of the authority and returns the asset to the authority on expiry of the agreement.
- **Concession:** the private party takes over operation/maintenance including rehabilitation/upgrade/capital investment and enhancement of an existing facility from the authority for a concession period. The private party pays a concession fee to the authority. The authority may also contractually require its

partner to share with it a portion of the profits. Although this traditional model is straightforward to implement, all risks are borne by the authority, and the project may attract only low private investment and limited innovation. Typical concession periods range between five and 50 years.

- **Franchise:** under a franchise arrangement the concessionaire provides services that are fully specified by the franchising authority and takes on all commercial risks. This form of private-sector participation is historically popular in providing urban bus and rail services. The length of these agreements is from three to seven years.

- **Private finance initiative (PFI):** a PFI model is similar to the Build-Own-and-Operate model in that the private sector partner builds, owns and operates a facility. However, the public sector purchases the services from the private sector through a long-term agreement. A PFI project, therefore, creates direct financial obligations for the government (the private partner is paid regularly from public money, purely based on its performance during the contract period. Payments to the private partner are deducted/reduced if performance targets are missed). In the PFI model, asset ownership at the end of the contract period may or may not be transferred to the public sector. The duration of PFI is 10 to 30 years. The PFI model also has many variants:
  - **Annuity model:** under this arrangement a selected private bidder is awarded a contract to develop a section of the highway and maintain it over the whole contract period. The private bidder is compensated with fixed semi-annual payments for their investments in the project. In this arrangement the concessionaire does not need to bear the commercial risks involved with the project operation. The PFI model has been used for developing social infrastructure such as schools and hospital buildings.

3.4 Definition and characteristics of PPP

Presently, there is no single universal definition of PPP (Lakshmanan, 2008). The meaning of PPP is different at national and international levels, and even when comparing different national infrastructure sectors (Alfen, 2010). A review of the literature indicates that there are as many definitions and meanings of PPP as corresponding publications or practical contexts in which the term is used. Several definitions are provided below:

- A PPP is a joint venture between the public and private sector. The expertise and

resources of both the public and private sectors are supplemented to provide services to the public at the best value for money over the contract period of the partnership (Adrias, 2010).

- Jingfeng, Yajun, J., and Qiming (2009) refer to a definition provided by the Canadian Council for PPP (2001), that a PPP is a cooperative venture between the public and private sectors, built on the expertise of each partner that best meets clearly defined public needs through the appropriate allocation of resources, risks and rewards.
- PPP are forms of cooperation between the public and private sectors for the funding, construction, renovation, management or maintenance of infrastructure or the provision of a service (Regan, 2009).
- The Planning Commission of India in its Guidelines for Financial Support to Public Private Partnerships in Infrastructure (2006:8) defines "Public Private Partnership Project means a project based on a contract or concession agreement, between a Government or statutory entity on the one side and a private-sector company on the other side, for delivering an infrastructure service on payment of user charges[22]".
- According to the United Nations Economic Commission for Europe (UNECE) (2008: 1) PPP that aim at financing, designing, implementing and operating public sector facilities and services have three main characteristics, namely: a) long-term service provisions (sometimes up to 30 years); b) transfer of risks to the private sector; and c) different forms of long-term contracts drawn up between legal entities and public authorities.

  The United Nations refers to PPP as "innovative methods used by the public sector to contract with the private sector who bring their capital and their ability to deliver projects on time and to budget, while the public sector retains the responsibility to provide these services to the public in a way that benefits the public and delivers economic development and improvement in the quality of life" (UNECE, 2008:1).
- The World Bank, Financial and Private Sector Development Vice Presidency (2006:1) describes PPP as "long-term arrangements in which the governments purchases services under a contract either directly or by subsidising supplies to consumers. In other PPP models, the government bears substantial risks – for example, by guaranteeing revenue or returns – on projects that sell directly to consumers".

[22] See Glossary of Technical Terms.

Common features of the above-mentioned definitions are illustrated in Table 3.1.

Table 3.1: Common features of PPP definitions

Researcher/Author	Joint venture/ Contract between public and the private sector	Expertise and resources sharing between partners	Value for Money	Risk sharing between partners	Cooperation for provision of infrastructure services
Adrias, 2010	✓	✓	✓		✓
Yuan et al., 2009	✓	✓		✓	✓
Regan, 2009	✓				✓
Planning Commission of India, 2006	✓				✓
UNECE, 2008	✓			✓	✓
The World Bank, 2006	✓			✓	✓

3.5 Evaluation of PPP

3.5.1 Advantages/benefits/value of PPP

Grimsey and Lewis (2004) spelled out the two basic motivations for governments to engage the private sector in the provision of public infrastructure services. Firstly, PPP can lead to an upsurge in infrastructure investment and augment fixed-capital formation without putting a burden on public funds. Secondly, PPP utilise the private sector's managerial and financial skills to achieve better value for money. Martin (2007) identifies private investors as being able to bring better financial and managerial discipline in the project company. This results in better and more sustainable project delivery than conventional government-financed projects. Further, Ugboaja (2010) referred to the Southern African Development Community's PPP protocols to illustrate the key strategically important factors for engaging the private sector in delivering public services. These are:

- The poor performance of publicly owned enterprises – PPP can ensure public services are economical, affordable, effective and efficient.
- Non-financial benefits – Partnership with a private investor also offers non-financial benefits in terms of better management style and cost recovery, while the public authority has a degree of control over the project.
- Joint-venture capabilities – the private sector has capabilities to enable potentially successful involvement in joint ventures with related benefits such as the sharing of risks associated with any specific project.
- Constraints on traditional source of infrastructure funds – Partnerships with the private

sector seen as a useful tool in bridging the gap between public investment and limited budgets.

Private investment for infrastructure development can reduce government budgetary constraints (see, for example, Public-Private-Partnership in Infrastructure Resource Center); (Cheung et al., 2012; IPDF, 2007; Jamali, 2004; OECD, 2010; PPPIRC, 2018; Satish, 2009). However, Alfen (2010) warns that absolute reliance on the private sector for infrastructure development cannot produce the expected results. Conversely, entire dependence on the public sector is also not a viable option for achieving the desired outcomes. Therefore, PPP have become popular globally as an alternative procurement option for the public sector and a good investment opportunity for private investors (MoF Lithuania, 2018). Empirical studies suggest that the PPP procurement method is considered most attractive in terms of its positive factors. The Confederation of British Industry[23] (2007) states that PPP have more functions and characteristics than merely being used to supplement public sector infrastructure investment through private-sector participation. The key advantages/benefits/value of PPP are presented in Table 3.2.

[23] The Confederation of British Industry works with policymakers for delivering a healthy environment for businesses, jobs creation and driving economic growth and prosperity.

Table 3.2: Advantages/benefits/value of PPP

Advantages/benefits/ value of PPP	Main results	Author (Year)
Value for money	PPP endeavour to ensure best value for money by minimising project costs and improving performance by improving quality of the service, and ensure availability and affordability of the service. PPP ensure public services are economical, affordable, effective and efficient. PPP ensures the best interest of stakeholders of PPP project.	(Alfen, 2010; Herpen, 2002; OECD, 2010; Rosenau, 1999)
Single point of responsibility	There is a single point of responsibility for the design, finance, construction and service delivery (DFCS) in the PPP procurement method.	(Hodge & Greve, 2009; Paul, 2003; Peter, 2010)
Price Certainty	PPP offer greater price certainty. As the price of the project services is determined for the future on the basis of current economic conditions and future projections.	(IPDF, 2007; Jin & Zhang, 2011)
Buildability	The contractor is responsible for DFCS. The contractor endeavours that the project is more likely to be "buildable" than is the case under other procurement methods.	(Bovis, 2015; OECD, 2010)
Risk sharing	PPP assign risk based on the resources and abilities of the partners. All project-related risks are shared between the contracting partners according to their capacities and abilities.	(Johnston & Kouzmin, 2010; Peter, 2010; Ugboaja, 2010)
Within Budget and Speedy Completion of Project	PPP deliver projects efficiently and effectively (better and early project delivery and effective of use resources).	(; A. & J., 1995; Cheung et al., 2012; Graeme, 2018; Jingfeng et al., 2009; Spackman, 2002)
Lower government borrowing	PPP generally provide public services cheaply and quickly and can reduce pressure on government budgets.	(Gordon, 1992; Graeme, 2018; Martin, 2007; Spackman, 2002)
Introduction of Innovation & use of modern technology	PPP are a way of introducing innovation and modern technology in infrastructure development through private investment.	(PPPIRC, 2018)
Asset management implementation	A PPP project is maintained for the full life of the project. It involves replacement, upgrading and repairs in order to gain the benefits from the PPP project throughout its entire life.	(Adrias, 2010; IPDF, 2007; Jin & Zhang, 2011; MoF Lithuania, 2018)
Ongoing performance standards	The PPP procurement model considers performance. Payments may be deducted and/or stopped if services are not delivered according to contractual requirements and predefined service standards.	(IPDF, 2007; Regan, 2009)
Output based specification	Under PPP procurement, the public sector focuses on the output specification and benefits from the start of the project.	(Ahlstrom, 2010; Dawson, 2006; Ugboaja, 2010)
Improved service quality and higher standard of living	The countries with a large number of PPP projects generally enjoy better infrastructure. As a result, their populations enjoy a higher standard of living, better prices and increased levels of productivity through innovation and use of modern technology.	(Andrews & Swanson, 1995; EIU, 2012; Koppenjan & Bert, 2009)
PPP encourages private sector investment	Public investment crowds in private investment and has strong and positive effects on output. Also, increases in public sector investment in infrastructure development increase the revenue of private investment.	(Aschauer, 1989; Mares et al., 2002; Pereira & Roca-Sagales, 2001; PPPIRC, 2018)
Avoid large up-front capital expenditure	PPP is a procurement method that avoids large public up-front capital expenditure on infrastructure development.	(Adeniyi et al., 2011; Cheung et al., 2012; PPPIRC, 2018)
Non-financial benefits	PPP have various non-financial benefits in terms of better managerial efficiency and cost recovery, rigorous risk analysis/allocation, new and innovative approach and capability of assets operation and maintenance.	(Martin, 2007; OEDC, 2010; Regan, 2008; Ugboaja, 2010)

Researchers point out that PPP models have substantial benefits/advantages in services delivery, which are not achieved via the traditional public infrastructure investment model (Podriguez, 2018; Regan, 2008). Regan further states that the traditional procurement models are based on lowest-cost evaluations, which are the worst performing models of the state procurement options. Peter (2010) concludes that PPP is the best method of procurement especially to deliver large, complex and expensive projects, achieving significant savings in both time and cost. However, Regan (2008) cautions that it is a difficult task to compare different procurement methods over different time frames and measurement criteria and that evidence exists of better procurement outcomes with methods that employ a full or partial output specification.

3.5.2 Weaknesses/disadvantages of PPP

Apart from the advantages and benefits of PPP, there are also negative aspects in PPP procurement methods, as presented in Table 3.3.

Table 3.3: Disadvantages/weaknesses of PPP

Disadvantages/ Weaknesses of PPP	Main results	Author (Year)
Unrealistic feasibility studies	Generally, PPP projects are over-commercialised such as over estimations in feasibility studies, which make PPP procurement less attractive especially for the private sector.	(Adeniyi et al., 2011; Adrias, 2010; Alberto Nucciarelli, 2010)
Failure of PPP project	The failure of any PPP project will be mean that a project's development and implementation will revert back to the government. Should this occur, the costs may be a burden on the public budget.	(Li, Akintoye, Edwards, & Hardcastle, 2005)
Higher transaction cost	PPP project preparation costs are higher than the conventional procurement methods as projects are unique in nature and have a long-term relationship between contracting parties. PPP project preparation requires more time, effort and additional experts' services, as its contracts are complex in nature.	(Podriguez, 2018; Rosenau, 1999)
Higher project monitors cost	PPP projects need far more government oversight to monitor the desired outcome and to protect the public interest.	(Herpen, 2002; Li et al., 2005; Rosenau, 1999)
Higher capital cost	PPP projects also result in higher capital cost because of private financing. Generally, lending to the private sector is approximately 1% to 2% higher than the public sector.	(OEDC, 2010; Paul, 2007; PPPIRC, 2018)
Long-term PPP contract	PPP infrastructure projects have a long gestation period, with little financial returns. Long-term PPP contracts increase uncertainty and risks in contractual relationships due to the incomplete nature of long-term contracts, compared with short-lived traditional procurement models.	(Adeniyi et al., 2011; Fombad, 2015; Hua & Karen, 2012; Podriguez, 2018)
Project design quality	PPP "design and build" are not the appropriate procurement method where design quality has a high priority.	(Herpen, 2002)
Culture Gap	There is a cultural gap between partners i.e. public and the private party, which may result in loss of confidence between partners. The primary motive of the private sector is profit-making. Conversely, the public sector's priority is social attractiveness.	(Adrias, 2010; Alberto Nucciarelli, 2010; Johnston & Kouzmin, 2010)
Inflexibility	PPP contracts are inflexible as there is a limited scope for the employer to make changes to its requirements once the employer's requirements and contractor's proposals have been agreed otherwise the cost consequences may be prohibitive.	(Grimsey & Lewis, 2007b; Herpen, 2002; Podriguez, 2018)
Inefficiencies	Long-term operating contracts can lead to inefficiencies due to lack of competition and contestability.	(Herpen, 2002)

Disadvantages/ Weaknesses of PPP	Main results	Author (Year)
Performance monitoring system	The performance of a PPP project is difficult due to a number of reasons such as an incomplete contract[24] does not give the desired output, and limited capabilities and understanding among monitoring staff (of public and the private sector).	(PPPIRC, 2018; Rosenau, 1999)
Creation of monopoly situation	Awarding a PPP contract to a private company may create a monopoly situation or creation of a situation of unfair competition or market access. This may impact on project cost and ability to introduce innovation into service delivery.	(European Commission Directorate-General Regional Policy, 2003)
Early problems with PPP Projects	In the early 1990s, many PPP infrastructure projects were procured for higher costs than standard public procurement models. Furthermore, the private sector demanded and received higher rates of return on project financing than the government's bond rate, even though most or all income risks were borne by the public sector. In Australia, initially procurement of PPP projects was inferior to the traditional public procurement model based on the competitively tendered construction of publicly owned assets. In the beginning, project procurement decisions were purely taken on low-cost basis, while ignoring innovation and use of high technological features of the services.	(Regan, Smith, & Love, 2011)
Different management orientation	As expected, partners of a PPP project may have significant differences in management orientation for different types of networks. For instance, non-profit networks are always community-oriented, and governmental networks are generally bureaucratic-oriented, while private commercial networks are almost always entrepreneurial-oriented.	(Hua & Karen, 2012)

[24] See Glossary of Technical Terms.

The literature review has identified the following controversial aspects of PPP procurement methods:

- Public investment in infrastructure is unlikely to have a perceptibly positive effect on economic growth if projects are developed based on political not economic reasons, which also crowds out private investment (Alsalam, Beider, Gramp, & Webre, 1998)
- The performance of a PPP project, for example the availability of services according to a pre-agreed standard, can be monitored through predetermined criteria. However, practical understanding of effective monitoring processes and the capacity of the monitoring staff of both public and the private sector to perform monitoring tasks effectively and consistently is limited (Rosenau, 1999).
- The value for money from a specific PPP can be calculated using a public-sector competitor[25] (PSC) apparatus (public sector estimation about the project prior to calling for bids) but a PSC may portray a false picture. A PSC is based on a theoretical estimation, which is usually different from the real situation/estimation (Alfen, 2010; Herpen, 2002; OEDC, 2010; Rosenau, 1999).
- PPP encourage private-sector investment and provide "level playing fields" (equal opportunities) for all potential investors by using open bidding processes. However, simultaneously, this may create a monopolistic situation by awarding a PPP contract to a private company and/or delegating exclusive rights to a private investor for performing a specific function or delivering a particular service (Andrews & Swanson, 1995; EIU, 2012; Erenburg, 1994; European Commission Directorate-General Regional Policy, 2003; Koppenjan & Bert, 2009; Pereira & Andraz, 2005). There may be substantial conflicting interests between the partners as the public sector aims to provide social and economic benefits to the community, while the private sector's sole motive is primarily to protect its investment and earn profits out of PPP projects (Johnston & Kouzmin, 2010).

3.5.3 Contribution of PPP to economic growth

PPP improve infrastructure facilities and play important roles in enhancing economic growth (Ugboaja, 2010). Kolzow (1994) suggests that PPP may blend the common interests

[25] See Glossary of Technical Terms.

of public and private organisations through some structure (like project risk and profit sharing) to increase infrastructure investment for achieving common objectives (economic growth) of the community. Private sector participation and private financing (domestic and foreign) in infrastructure are claimed to be essential for countries' sustainable economic growth (Tennant, Kirton, & Abdulkadri, 2011). Barro and Sala-i-Martin (2001) confirm that joint public and private investment has a positive impact on growth. PPP create more job opportunities, reduce investment costs/expenditures for the government and subsequently increase the economic growth rate (Lin & Doemeland, 2012). A number of studies in Britain and Australia in recent years point to significant benefits in health, education and justice user outcomes from services delivered by PPP models that are not being achieved with the traditional model (Regan, 2008). The aforesaid advantages/benefits of PPP directly or indirectly contribute to economic growth. The ways PPP may contribute to economic growth are discussed below:

3.5.3.1 New sources of capital investment

Jingfeng et al. (2009) consider that PPP in infrastructure development act as engines of growth. PPP provide new sources of investment capital for required infrastructure projects, free up government resources and fuel growth through innovation and technology, provided the right factors are in place. These factors are: the number of PPP projects, value for money and a suitable PPP procurement model, combined with supportive policies. Strategy& (2008)[26] states PPP may improve public satisfaction in terms of convenience and quality of public services at affordable prices.

3.5.3.2 Use of private-sector skills and investment

PPP maximise the use of private-sector skills (IPDF, 2007). According to Kolzow (1994) and Strategy& (2008), PPP bring private investment to the market while creating long-term employment, increasing efficiency and productivity, reducing costs, generating more wealth and a higher standard of living and strengthening the economy.

[26] PricewaterhouseCoopers (PwC) is a multinational professional services network. PwC's consulting team "Strategy&" was formed on March 31 2014, when Booz & Company combined with PwC to establish a new kind of consulting team and to offer strategy-through-execution services.

3.5.3.3 Increase public capital stock

PPP help in building infrastructure. Increases in public infrastructure capital reduces private sector costs (Berndt, 1992). Public infrastructure also contributes to the economy across various dimensions, for instance, in inter-industry input-output linkages. For example, transport projects may create linkages with real estate, steel industry and civil construction. Also, the private sector indirectly benefits from lower operation costs upon completion of these projects (Chan, Wang, & Ke, 2009). Andrews and Swanson (1995) and Aschauer (1989b) also confirm that an increase in the public stock of capital increases return to private capital, which crowds in private capital accumulation. Albala-Bertrand and Mamatzakis (2004) assessed the movement in the level of infrastructure investment on cost structure, private investment and productivity in Chile. They found that investment in infrastructure reduced production costs within the economy, which generated positive flow-on effects to productivity. In addition, infrastructure capital formation asserts a positive cost-share effect on private capital. Paul (2003) and Munnell (1990) assert that public capital has a significantly positive impact on private sector productivity. However, Bjorvatn (2000) revealed that in transition and developing economies, poor infrastructure reduces the profitability of the manufacturing sector and might inhibit industrialisation.

3.5.3.4 Reduce public borrowings

PPP reduce government sovereign debt/borrowings[27] (government debt, public debt and national debt) and associated risks, drive the creation of local long-term capital markets, utilise efficiencies of the private sector in running public services and stabilise economic growth, creating more employment opportunities and certainty (job security) (Jin & Zhang, 2011; Kolzow, 1994). On the other hand, the deadweight costs of public debt and taxation reduce returns to the private sector which, in turn, limits growth. Conrad (1997) found that if the investment is paid by taxation, then the optimal level of investment is lower than any another financing method.

[27] See Glossary of Technical Terms.

3.5.3.5 Increase living standards

Ugboaja (2010) Ugboaja (2010) asserts that countries with a large number of PPP projects generally have better infrastructure. As a result, these countries enjoy a higher standard of living, better prices and increased levels of productivity through innovation and use of new technology. Aschauer (2000a) considers public infrastructure to be a factor of production. A decline in public capital decreases productivity, whereas Ahlstrom (2010) and Dawson (2006) assert that innovation, such as achieved through successful PPP, produces new goods and services, increases productivity, creates job opportunities, and increases per capita income, thus improving living standards and ultimately generating economic growth.

As discussed earlier, the PPP procurement method helps in infrastructure development. Numerous studies have demonstrated that infrastructure investment has a positive and permanent effect on economic growth. Infrastructure investment impacts mainly on the supply side of the economy by improving economic efficiency, resource allocation and productivity (Sanchez-Robles, 1998). The endogenous growth model of Barro (1990) showed that increases in government spending on infrastructure for the home country result in higher growth rates and improvement in the terms of trade (Ghosh & Mourmouras, 2002).

3.6 Implementation of PPP

3.6.1 Essential ingredients to carry out PPP

Researchers around the globe appear keen to explore the basic ingredients for developing a successful PPP program (see, for example, Chan et al., 2009; Jooste & Raymond, 2009; Nisar, 2011; Regan et al., 2009; UNESCAP, 2010). Numerous studies have been done on the subject so far in developing countries, for instance, Bangladesh, China, India, Indonesia, Kazakhstan, Mongolia, Nepal, Philippines, Thailand, Vietnam and 19 Latin American and Caribbean countries (EIU, 2012). Therefore, it is difficult for the authorities to understand which findings are and are not applicable to the context of any developing country. There are no tailor-made PPP contracts that fit all PPP projects. Ismail (2013) investigated PPP critical success factors (CSF) in Malaysia and discovered that PPP have the unique characteristics of a particular country. Therefore, adopting the success factors of other countries may not provide the complete list of CSFs for PPP implementation in Malaysia. In PPP, the project functions transferred to the private party may vary from contract to contract. Project-related risks and responsibilities are typically allocated to the partners according to

their skills and capabilities. However, in all cases the private party shares significant risks, management responsibilities and accountability for project performance (PPP Knowledge Lab, 2018).

The focus of this thesis is on identifying the main impediments and how they affect PPP implementation in Pakistan, with a view to establishing policy guidelines that will encourage greater adoption of PPP for infrastructure investment. A few cases are illustrated in Table 3.4, 3.5 and Figure 3.3. The Multi Investment Fund of the Inter-American Development Bank has highlighted the key elements of PPP program implementation in Mexico in Table 3.4 (Vieitez-Martinez, 2008). Table 3.5 provides a summary the key challenges in Mexican PPP program.

Table 3.4: Key elements for PPP program implementation in Mexico

Element	Description
Cost-benefit analysis (Value for Money)	An analysis to determine the added value of a project developed through PPP, compared with the best available public investment alternative.
Budgetary impact (Affordability)	Financial impact analysis of the future payments on the budget of the agency involved over time, and its long-term sustainability.
Legal Feasibility	Review of regularity of the PPP program, its service contract and other legal acts within the legal framework of the entity or unit responsible.
Provision of PPP law	Provision of sector specific laws; Law of budget – accountancy and federal public expenditure and its regulation; Rule for private participation – rules for the implementation of private sector contracts; Guidelines – guidelines and complementary methodologies issued by the public authorities.

Source: (Vieitez-Martinez, 2008)

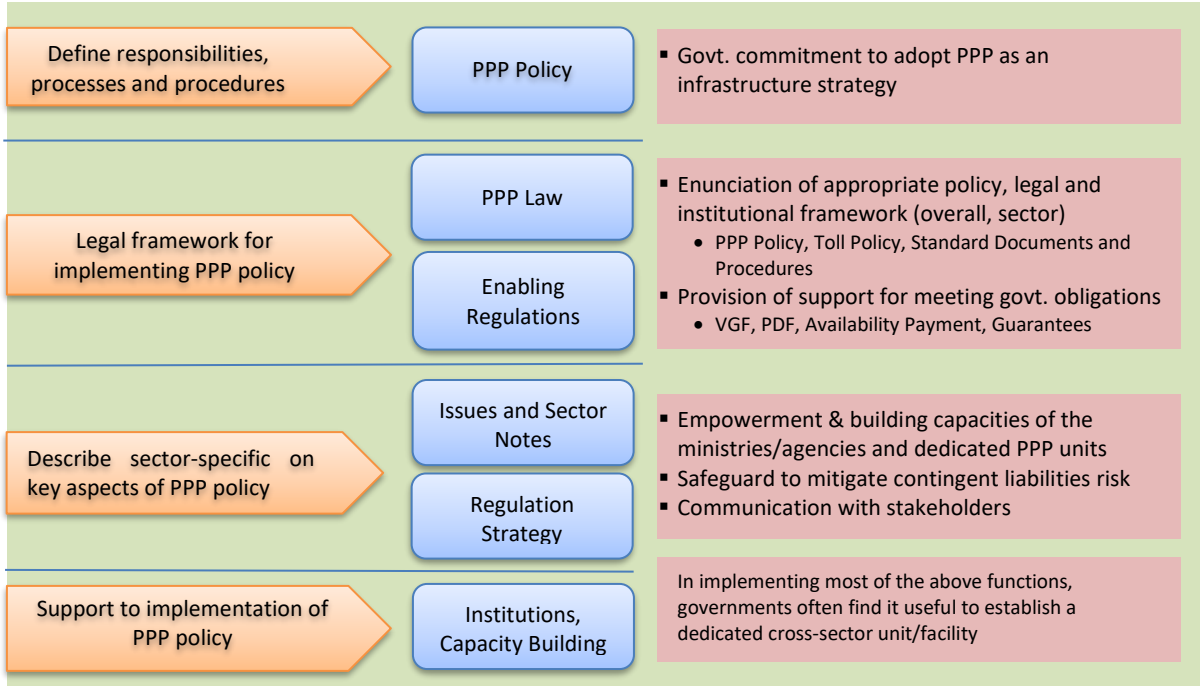
Table 3.5: Key challenges for PPP program implementation in Mexico

Element	Description
Feasibility study	Most toll road projects sent into default due to incorrect traffic and revenue forecasts
Tariff adjustments	Inflexible tariff adjustments (tariff is not linked to the inflation index)
Cost overruns and delays	In most cases construction began without securing the project land. Resistance from environmentalists and community groups resulted in delays and even rerouting a few projects.

Source: (Vieitez-Martinez, 2008)

The South Asia Sustainable Development Department of the World Bank reviewed the PPP experience in South Asia. specifically focusing on PPP in India, and found the key elements for creating an enabling an environment for PPP (See Figure. 3.3) (Tadimalla, 2010).

Figure 3.3: Key elements in creating a PPP enabling environment focusing on India



Source: (Tadimalla, 2010)

Furthermore, the literature review has pointed out that the success factors of PPP projects can vary in different infrastructure sectors and jurisdictions. However, there is a need to identify common factors irrespective of geographical location (Cheung et al., 2012). The following section classifies the findings of previous researchers regarding implementing a successful PPP program.

3.6.1.1 Public policy

Public policy provides precise guidelines regarding necessary action to be taken by the administrative authority of a country or individual state regarding a number of issues, in a manner consistent with the overarching law and institutional practices in place. Public policy is developed under the auspices of the national constitutional laws and regulations and cannot propose any actions that contravene the existing legal framework (Norwich University Public Administration, 2014). As previously noted, governments are facing growing demands to find alternative ways to finance infrastructure projects. Where publicly funded financial resources are scarce, governments may have to decide to focus on formulating public policies as the best option for funding needed infrastructure (Mona, Jean-Francois, & Etienne, 2006). Empirical studies suggest PPP can be effective in supplementing government resources and contribute to

growth in the presence of supportive policies and well-established institutional framework (Strategy&, 2008).

3.6.1.1.1 PPP guidelines

The success of a PPP scheme depends on clear PPP guidelines, and public policy (Cheung et al., 2012; Ugboaja, 2010). The availability of other guidance materials is a prerequisite for the successful implementation of a PPP. These may include material such as PPP standard documents, infrastructure sector specific guidance, PPP standard model contracts (templates) and PPP project preparation guidelines.

3.6.1.1.2 Public policy

Koppenjan and Bert (2009) note that public administration, policies, laws and institutions are the key drivers of private sector participation in infrastructure services provision. Ugboaja (2010) asserts that lack of a comprehensive PPP policy is a threat to a PPP project.

3.6.1.1.3 The investment policy

Investment policies frameworks should not focus only on attracting investment but also have defined objectives for any specific PPP project. The review of literature suggested that effective and efficient institutions have a positive impact on the investment climate, infrastructure development and economic growth. Javier and Carmen (2011) found that well-developed institutions have positive relationships with public infrastructure for achieving income growth and poverty reduction, whereas institutional weakness is a poverty trap. Therefore, the economy can take full advantage of infrastructure investment (including private investment) in the presence of the efficient institutional structure. Regan (2004) noted that established infrastructure, government institutions and regional development policies can create a favourable environment to attract public and private investment. Regional growth and investment returns are greater when the government has consistent policies and provides complementary institutional frameworks such as political stability, rule of law, an independent judicial system and well-established and regulated capital markets. Well-functioning institutions together with policy reforms and public sector initiatives in infrastructure investment may increase private investment and the certainty of profit and reduce private costs.

3.6.1.1.4 Private sector participation

Public organisations charged with executing PPP infrastructure projects should have clear policies for developing and implementing these projects, together with an enabling environment28 for private sector participation in the project's development.

3.6.1.2 Required institutional framework

Institutions have both formal and informal features. Formal institutions are a set of explicit, detailed, coded rules that are applied within defined limits, while informal institutions are a set of social conventions, customs, norms and prevalent social rules that are widely followed in a given society. Broadly, institutions provide a systematic framework that reduces uncertainty, establishes property rights and "the rules of the game", and provides the choices available to individuals and groups (Jose, 2004; Durham, 2004). Here are a few definitions of institutions:

- The World Bank (2009) states that institutions provide public facilities including health care, education, social and economic justice, property rights, rule of law and provision of investment-friendly climate.
- Institutions create incentives that favour cooperative solutions in which cumulative experiences and collective learning are best utilised and thereby minimise transaction costs (North, 1997).
- Institutions have clear objectives and clarity of purpose, create interactions between formal and informal institutions and bring them together, help reduce transaction costs, demonstrate adaptiveness to external and internal conditions/environment, have appropriate scale with respect to their size and scope and can ensure compliance to rules and objectives (Gandhi et. al, 2009).

North (1994) suggests that institutions such as governments[29] set "the rules of the game", the humanly devised constraints (rules and regulations) that structure human interaction (dealings and communication). These constraints are made up of formal constraints (such as rules, laws, constitutions), informal constraints (such as norms of behaviour, conventions, self-

[28] See Glossary of Technical Terms.

[29] The term "institution" refers to the rules of the game, whereas "organization" refers to players of the game.

imposed codes of conduct such as those set by professional bodies), and their enforcement characteristics. The term "organisation" denotes a group of individuals bound by some common purpose to achieve objectives. Organisations include political bodies (political parties, regulatory agencies), economic bodies (firms, trade unions), social bodies (churches, clubs), and educational bodies (schools, universities) (North, 1990). Broadly, institutions provide a systematic framework that reduces uncertainty, establishes property rights and "the rules of the game", and provides the choices available to individuals and groups (Durham, 2004).

Empirical studies have shown that institutional development is the foundation of economic growth. Institutional development provides a conducive business environment in the economy in terms of protection of property rights and certainty of returns. The World Bank (2009) suggests that the basis for the growth of any country depends on: i) the attitude of public officials; and ii) the role of institutions in providing public facilities including health care, education, social and economic justice, property rights, rule of law and provision of an investment-friendly climate. A stable macroeconomic environment, generalised access to the world economy, protection of individual property rights and spending in public infrastructure provide benefits for all. Institutions affect economic performance because of their effects on transaction costs and productivity (Albert and Wouter, 2011). However, the effects of policies and institutional structure vary from country to country depending on each country's phase of development (Romain et al., 2011).

However, this study indicates that a common understanding of the relative roles of formal institutions, political bodies and economic bodies is necessary for PPP program implementation. Cheung et al. (2012) identify favourable legal frameworks, institutional structures, stable macroeconomic conditions and administrative set-ups as essential components for a successful PPP program. Jamali (2004) also found an effective and efficient institutional structure (legal and regulatory frameworks) is an essential element of successful public partnerships with the private sector. Dani Rodrik (2002) argued that institutions affect growth. The examples of empirical relationships between institutions, investment and growth are:

i. free market institutions have a positive effect on growth;
ii. economic liberalism affects growth and investment;
iii. political stability may stimulate investment;

However, a successful PPP program requires an effective institutional framework that includes those institutions that are involved in PPP projects and have the capacity to implement a PPP program.

Li et al. (2005) conducted a study in the UK and found that the lack of an institutional framework is a significant constraint on the adoption of a successful PPP model. According to UNESCAP (2010), an institutional framework supportive of a PPP should have appropriate governing rules and clearly defined regulations, an independent accountable PPP unit/board, an enabling environment for private sector participation, effective monitoring systems, and the capability to select appropriate PPP projects and transparent bidding processes. This framework includes:

- PPP project management and supervision – a prudent administration is essential for successful PPP program implementation. For instance, there must be annual planning and budgeting for PPP projects and periodic monitoring to review the progress of PPP projects (Adeniyi et al., 2011).
- PPP facilitating/coordinating agency – an agency should be established at government level with primary responsibility for promoting, facilitating and coordinating PPP projects (Vieitez-Martinez, 2005). A further step is proposed by the IPDF (2007), which suggested establishing a PPP unit within all government agencies (including federal, provincial and municipal level) to develop projects based on PPP principles.

Institutional capacity means the readiness of public institutions (which involve the development of infrastructure) to carry out infrastructure projects using PPP models. For instance, capacity may incorporate the following:

- Institutional framework: quality of institutional design, the PPP contract and expropriation risk (Economist Intelligence Unit, 2009);
- Operational maturity: experience and qualification, public capacity to plan and oversee PPP projects (Economist Intelligence Unit, 2009);
- Supportive legal and regulatory framework: Judicial independence, dispute-resolution mechanisms, consistency and quality of PPP regulations and fairness/openness of bids and contract changes (Economist Intelligence Unit, 2009);
- Accountability: whereby officials are answerable to the entity from which they derive their authority, work is conducted according to agreed rules and standards and reported fairly and accurately (De, 2010);

- Transparency: low cost, understandable, and relevant information is made available to citizens to promote effective accountability, and clarity about laws, regulations, and policies (De, 2010);
- Enabling an investment climate and availability of financial facilities (provision of government services for improved business performance, political distortion and social attitudes towards private-sector participation and capital market, private infrastructure finance) (Economist Intelligence Unit, 2009; World Economic Forum, 2011);
- Strength of stakeholders' ownership towards the development goals (The World Bank Institution, 2011);

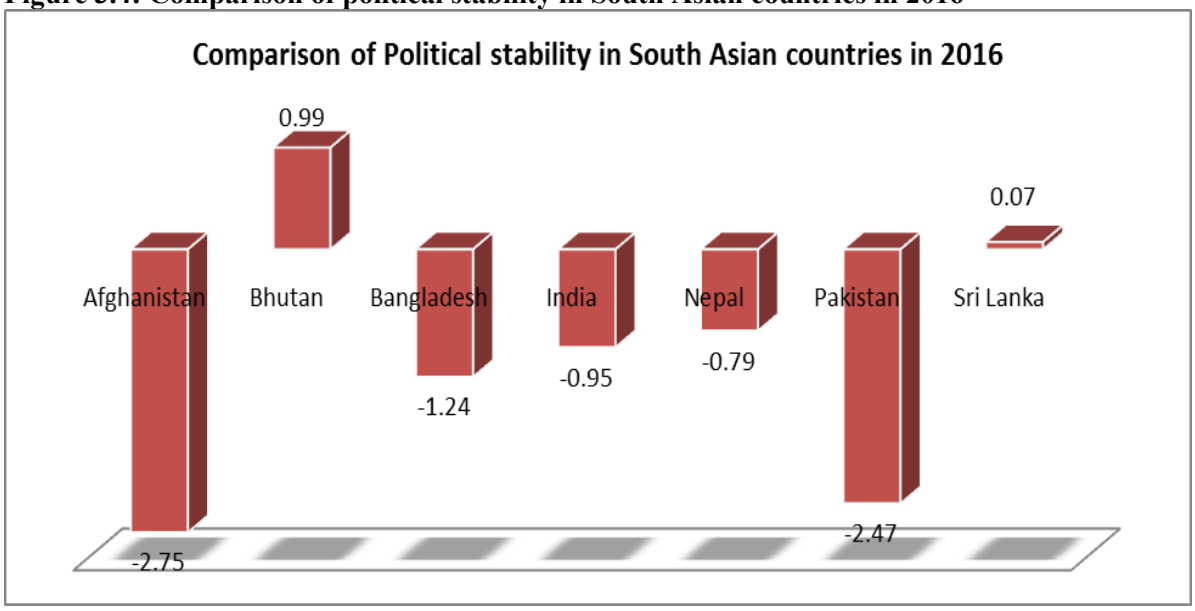
The literature review identifies that the following components are interrelated in the institutional framework, which is essential for the implementation of PPP programs:

3.6.1.2.1 Political stability

The socio-political climate of a country increases productive activities and accumulated capital (Alesina & Perotti, 1996). Political instability has an adverse effect on investment and, ultimately, on growth (see, for example Alberto Nucciarelli, 2010; Alesina & Perotti, 1996; OEDC, 2010; Zhang & Fan, 2004). The average value for Pakistan on the political stability index[30] during the period from 1996 to 2014 is -2.6 points with a minimum of -2.81 points in 2011 and a maximum of -1.14 points in 2000 (World Bank Governance Indicators, 2014). However, Pakistan's points have slightly increased to -2.47, which was still the second lowest point in South Asian countries in 2016. A comparison of South Asian countries is shown in Figure 3.4. Overall the country ranks 191 out of 194 countries. The average for 2016 was -0.04 points. Singapore has the highest value with 1.53 points and Syria has the lowest value with -2.91 points. A stable political system and consistency of public policies over the change of government are essential to promote private investment.

[30] The index of political stability measures perceptions of the likelihood that the government will be destabilised or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. The index is an average of several other indexes from the Economist Intelligence Unit, the World Economic Forum, and the Political Risk Services, among others. The political stability index is measured at the score -2.5 = weak and 2.5 = strong.

Figure 3.4: Comparison of political stability in South Asian countries in 2016



Source: (The World Bank Governance Indicators, 2014),TheGlobalEconomy.com, Retrieved on 02/07/2018.

3.6.1.2.2 Regulatory framework

A transparent and comprehensive regulatory framework is necessary for private sector participation in PPP projects (Jamali, 2004; Johnston & Kouzmin, 2010). Otherwise, excessive regulatory formalities and unilateral changes in contractual clauses are a threat that may increase the sunken costs of the investment (OEDC, 2010). Mona et al. (2006) argue that institutional quality (involving enforcement of legal contracts, clarity and application of laws, regulations and policies with fairness and consistency) matters most for investors as PPP arrangements are by nature based on contracts (between public authority and the private sector investors). Therefore, the sustainability of contracts is critically dependent on the regulatory environment, which in turn is established by the quality of institutions. Adrias (2010) and Martin (2007) concluded that there is a clear need for effective legal and regulatory frameworks, strengthening of institutions, standardising of practices, transparency and integrity in procurement procedure and revision of procurement method for a successful partnership with the private sector.

3.6.1.2.3 Legal framework

Cheung et al. (2012) found an efficient, fair and independent legal framework is a key factor for successful PPP program implementation. Effectively and equitably enforced PPP contracts and protection of investors' rights help to make contracts bankable. Sufficient legal

resources at reasonable costs must be available to deal with legal issues and required documentation (Cheung et al., 2012). Disputes between parties need to be resolved according to law and contracts without lengthy appeals. Further, a comprehensive, transparent and effective dispute-resolution mechanism combined with an established independent arbitration system helps to ensure stability in the PPP program. A successful public partnership with the private sector demands an effective and efficient institutional structure including the legal and regulatory framework (Jamali, 2004). The legal structure builds up the principle of transparency and competition and indirectly provides government assistance to the private sector for the acquisition of land for projects, grant of foreign exchange facility and protection against nationalisation (Fombad, 2015; Ismail, 2013).

The literature reviewed broadly shows that the following facilitate trade and transactions, promote investors' confidence including FDI and develop capital markets:

i) the judicial system – institutions of enforcement of private property rights (which are vital for fostering sustainable growth process); and

ii) the institutions of rule of law (which matter most for economic growth) (The Pak Bankers, 2011).

Emmanuel et al. (2011) suggest that state political institutions are prerequisites for the smooth operation of economic institutions and policy implementation. According to Tavares (2004), the judicial system may affect economic performance i.e. enforcement of property rights, execution of contracts and facilitation of exchanges between business partners. Mo (2011) concludes that public good governance determines the quality of institutional structures and develops public policies and infrastructure that are supportive of business activities within an economy. Accordingly, well-functioning state institutions, such as political institutions, the judicial system, the financial system and effective governance play significant roles in implementing PPP to achieve economic and social development parameters.

Empirical evidence suggests that PPP projects develop infrastructure and further play an important role in determining economic and social development. However, the success of a PPP scheme depends on clear PPP guidelines and policies, appropriate legal framework, and institutional and administrative set-ups (Paul, 2010). Public administration, policies, laws and institutions are the key drivers of private-sector participation in infrastructure services provision (Joop and Bert, 2009). Effective legal and regulatory frameworks are essential: strengthening of institutions, standardising of practices, transparency and integrity in

procurement procedure and revision of procurement methods for successful public partnership with the private sector (Adrias, 2010; Smith, 2007 and Dima, 2004).

The primarily established institutional structure is a prerequisite for good governance, political stability, the rule of law, an efficient financial system, an independent judicial system and microeconomic stability. In addition, the set-up of professional and skilled organisational is the key to implementing public policies successfully. In light of findings from the literature review, established institutional frameworks and professional and competent organisational structures consisting of the private sector and the public sector jointly may attract infrastructure investment.

3.6.1.2.4 Financial framework

Many researchers (Cheung et al., 2012; Ismail, 2013; Li et al., 2005; Zhang & Fan, 2004) have discovered that availability of project finance is the key to the success of private-sector participation in public infrastructure projects. Private investors must have affordable lending facilities. Further, domestic capital markets may be capable of providing finance for infrastructure projects. The financial sector must have the capacity to provide risk-hedging instruments (finance the possibility of loss in an investment). The financial structure of a country and its economic growth are strongly correlated (Luintel, 2008) . The development of the financial sector also has a long-term impact on GDP. Indicators of financial development developed by International Monetary Fund are presented in Table 3.6.

Table 3.6: Indicators of financial development

Sr. No.	Variables
1	Ease of loan recovery through the judicial system
2	Development and profitability of the banking sector
3	Government involvement in banking and finance (Heritage Foundation)
4	Existence of forward exchange market
5	Privatisation of banking sector
6	Deposit money bank assets/total banking sector assets
7	Property rights index (Heritage Foundation)
8	Prudential monitoring of banks
9	Transparency and availability of financial and monetary data
10	Basel capital adequacy requirements
11	Independence of the central bank
12	Credit to the private sector/GDP
13	Restrictions on foreign currency purchase by residents
14	Interbank transactions markets
15	Interest rate liberalisation
16	Indirect instruments of monetary policy
17	Government securities
18	Nonperforming loans

Source: (Creane, Goyal, Mobarak, & Sab, 2003, 2006; IMF, 2004)

3.6.1.3 Transparent procurement method

A transparent procurement process is important to decreasing transaction costs and negotiation time (Cheung et al., 2012). For instance, the project selection and bidding process must be fair. The procurement process should be independent of rent seekers. Regulations should clearly be defined. The negotiation process between the parties must be fair and monitored effectively. Further, financial and economic factors should be dealt with during the project procurement process.

3.6.1.4 Stable macroeconomic condition

Mona et al. (2006) suggest that macroeconomic stability is essential for PPP arrangements. Macroeconomic stability describes a national economy that has minimum

vulnerability to external shocks and increases its prospect for sustained growth. Macroeconomic stability acts as a safeguard against currency and interest fluctuations in the international market (International Monetary Fund, 2014; Ismail, 2013). Therefore, stable macroeconomic conditions reduce uncertainty and encourage investors to focus on productive decisions rather than on trying to mitigate high risks. Consequently, it induces private investors and particularly foreign investors to participate in infrastructure development.

3.6.1.5 Public-sector capacity and PPP

Stephan and Raymond (2009) observed that infrastructure development is generally hindered by two broad public-sector constraints: lack of public capital (lack of funds for establishing a new infrastructure and maintaining and upgrading existing infrastructure) and lack of public-sector capacity (lack of resources and specialised expertise e.g. financial capability and managerial skills). Both capacity gaps (lack of capital and lack of public-sector capacity) lead to private-sector involvement in developing, financing and maintaining of infrastructure facilities. The authors investigated public-sector capacity in two categories: i) defining capacity in terms of the functions that the public sector executes; and ii) defining capacity in terms of the level of which it is found in the public sector.

- Capacity embedded in public sector functions – the functions delivered by the public authority[31]. This approach identifies three broad types of capacity: i) strategic capacity; ii) executive capacity; and iii) political (or institutional) capacity. Table 3.7 describes the functional classification of capacity.

Table 3.7: Functional classification of capacity

Functional area	Description
Strategic capacity	Ability to identify problems and to deliver policy advice to decision makers
Executive capacity	Ability to operate government programs/ability to implement policies/ability to deliver services
Political capacity	Ability to define rules and regulations, resolve conflicts and respond to citizens.

Source: Stephan and Raymond (2009)

[31] Throughout this thesis, the focus in relation to public authority is on the executive branch of government. Although this might include inputs into the judiciary and legislative branches, a detailed discussion of their specific roles is beyond the scope of this thesis.

- Capacity embedded in the public sector level – the capacity embedded in different levels of the public sector. The authors concluded public sector capacity in three broad types of capacity: i) capacity embedded at the human level in the skills and capabilities of public sector employees; ii) capacity at the organisational level contained in processes, structures, management systems and relationships; and iii) capacity at an institutional level, consisting of both the rules, norms and standards of the public context, as well as the macroeconomic and political environment. Table 3.8 describes the level classification of capacity.

Table 3.8: Level classification of capacity

Functional area	Description
Human level	Human resources – the capacity of the individual public sector employees and service delivery capability
Organisational level	Organisations – management style of public sector organisations Bureaucratic capability – both financial and administrative capability The task network – the set of organisations involved in accomplishing given tasks
Institutional level	Rules and procedures set for public sector and the financial resources at its disposal Institutional development including community participation Investment climate The creation of an enabling environment, with appropriate policy and legal frameworks National checks and balances institutions; public attitudes towards private sector involvement in infrastructure.

Source: Stephan and Raymond (2009)

Major success factors of PPP implementation are summarised in Table 3.9.

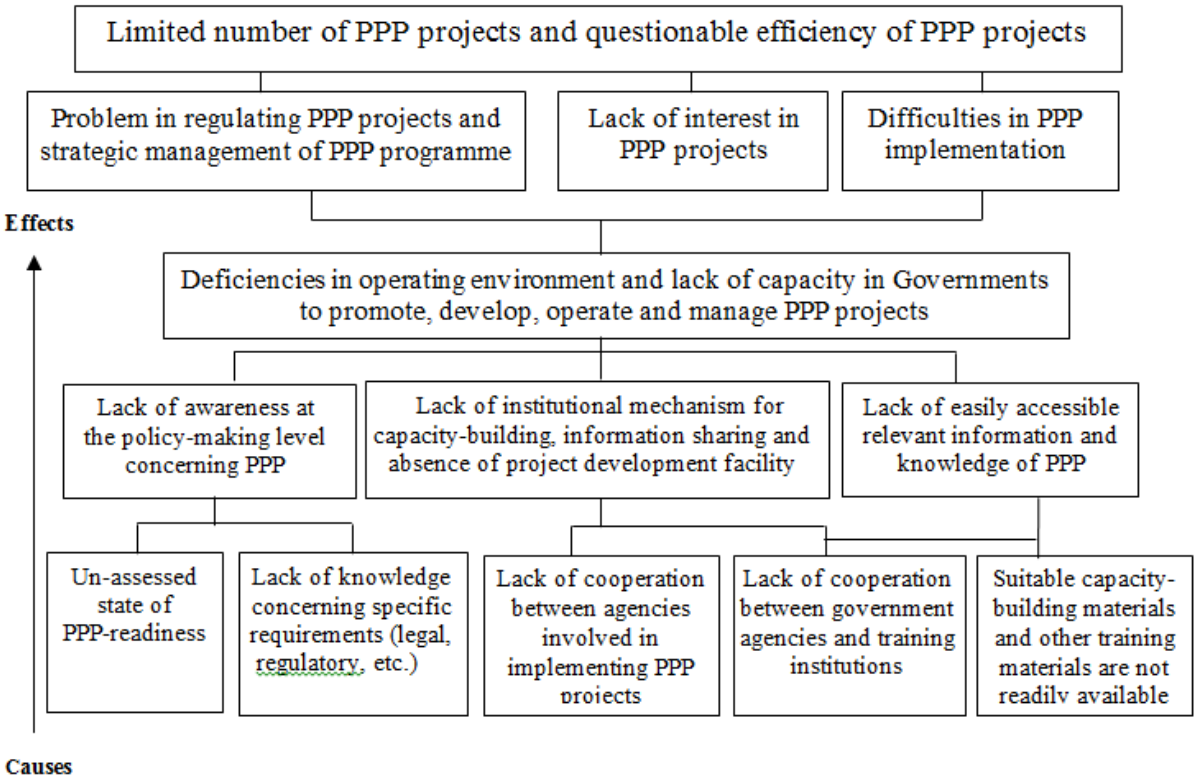
Table 3.9: Summary of major success factors of PPP implementation

Researcher/Author	Political stability	Regulatory framework	Legal framework	Transparent procurement process	Monitoring mechanism/ Managerial efficiency	PPP facilitation/ Coordination Agency	Macroeconomic stability (economic stability)	Financial framework/ Financial capability
(Li et al., 2005)								✓
(Cheung et al., 2012)			✓					✓
(Zhang & Fan, 2004)	✓							✓
(Mona et al., 2006)		✓					✓	✓
(International Monetary Fund, 2014)							✓	✓
(Cheung et al., 2012)	✓		✓	✓				
(Luintel, 2008)								✓
(Fombad, 2015)			✓					
(Jamali, 2004)	✓	✓	✓		✓	✓	✓	✓
(Martin, 2007)		✓						
(Adrias, 2010)		✓						
(Johnston & Kouzmin, 2010)		✓						
(OEDC, 2010)	✓	✓						
(Alberto Nucciarelli, 2010)	✓							
(Alesina & Perotti, 1996)	✓							
(North, 1990, 1994)	✓	✓						
(Durham, 2004)	✓							
(Dani Rodrik, 2002)	✓							
(UNESCAP, 2010)		✓						
(Adeniyi et al., 2011)					✓			
(IPDF, 2007)						✓		
(Vieitez-Martinez, 2005)						✓		
(Ismail, 2013)			✓				✓	✓

3.6.2 Barriers to implementation of successful PPP in infrastructure development

UNESCAP (2010) noted that lack of PPP awareness, deficiencies in operating environment and lack of capacity in governments to manage PPP projects are the major barriers to implementation of successful PPP program. An analysis is shown in Figure 3.5.

Figure 3.5: Problem Tree Analyses of PPP



Source: UNESCAP (2010)

3.6.2.1 Generic barriers in PPP implementation

The generic barriers in PPP implementation have been identified by several researchers (see, for example, Adeniyi et al., 2011; Adrias, 2010; Chan et al., 2009; Infrastructure Management Unit, 2007; Jamali, 2004; Klijn & Teisman, 2003; Koppenjan & Bert, 2009; MoF Lithuania, 2018; National Audit Office, 2003; Nisar, 2011; OEDC, 2010; Podriguez, 2018) and are summarised in Table 3.10.

Table 3.10: Generic barriers in PPP implementation

Barriers in PPP implementation	Description
Administrative/ Rules and Regulations	• Governance – bureaucratic approvals and formalities are involved in project initiative • Modifications in original project design increase cost • Lack of coordination at the federal, provincial and municipal level • Lack of unidirectional policy framework • Lines of demarcation and frequent conflict between state agencies may cause problems for PPP projects/actors/barriers against cooperation • Apprehension of the government agencies to lose public control over project management • Inconsistency of public policies • Investment policies frameworks have a focus only to attract investment rather than any defined objectives • Excessive regulations and complex legal framework • Judicial system is not supportive to PPP • Inflexible tariff adjustment (tariff is not adjusted according to change in consumer price index) • Land acquisition is constrained where federal and provincial priorities are divergent • Overlapping role of various state agencies
Delay in project execution	• Lengthy delays due to lack of PPP awareness • Lengthy delays due to political debates • Lengthy delays in negotiations between contracting parties • Delay due to resistance from community groups and environmentalists • Delay due to modifications in original project design • No use of public sector competitor/benchmark PPP model prior to request for bids
Public sector experience and qualification	• Lack of experience and appropriate skills to implement PPP projects by the public sector • Lack of specialised research for PPP in Pakistan • Frequent turnover of staff/PPP specialists due to better opportunities in the private sector side
Financial sector	• Lack of established debt market for long-term financing instruments for infrastructure investment • Non-existence of specialised infrastructure financing institution
Unrealistic feasibility study	• Unrealistic financial models (unrealistic revenue and expenditure) • Unrealistic assumptions in feasibility studies

Nataraj (2007) summarises the experiences and lessons learned from PPP programs undertaken within Mexico, Chile, the United States, and the Philippines:

i. Governments are weak in making enabling policies and regulatory framework;

ii. There has been a lack of capacity to meet long-term equity and debt financing needed by infrastructure projects;
iii. There has been a lack of credible, bankable infrastructure projects; and
iv. There has been a lack of capacity in public institutions and officials to manage the PPP process.

Espelt (2015) studied the "lesson learned and the best practices in PPP in Latin America and the Caribbean" and found that:

i. Government involvement – PPP law needs to be created in such a way that structures government involvement in PPP projects;
ii. Specific PPP law – PPP law must illuminate a legal environment which provides a stable support system for private sector participation in PPP contracts;
iii. PPP Unit – the government must set up a PPP unit to ensure that the PPP is designed by following solid criteria that allows for adequate transfer of risks between public and the private sectors and generates value for money when compared with traditional forms of project promotion;
iv. Capacity building – training in the public and private sectors to ensure successful application of PPP projects;
v. Development of Guidelines and Methodologies – PPP guidelines and methodologies are needed to identify, select, evaluate and structure PPP projects.

3.6.2.2 PPP failure factors

Several authors (see, for example, Confederation of British Industry, 2007; Li et al., 2005; Rosenau, 1999; Wijeweera, 2010; Zhang & Fan, 2004) identify the main causes of PPP failure as:

- Unidentified economic and social targets
- Resources and competences of the contracting partners are not identified effectively
- Poor feasibility study and weak business plan (expected service demand and required services are not properly identified)
- PPP contracts are aimed at long-term (more than 10 years) therefore it is difficult to foresee future contingencies.

3.6.3 PPP studies in the context of South Asia

The literature review suggests that at present, a substantial amount of research has been done on the subject of PPP in the perspective of developed and developing countries. However, there are few studies that have examined PPP issues for South Asian developing countries and particularly in the context of Pakistan. The few exceptions are the study by Nataraj (2007) and Infrastructure Management Unit (2007).

Nataraj (2007) addresses the PPP status of India, Pakistan and Sri Lanka and suggests a few policy measures targeted towards the growth of PPP in India. Based on global experience with PPP, Nataraj identifies constraints associated with the PPP method and how these may impact upon India and other South Asian countries. The Infrastructure Management Unit of the Planning Commission of Pakistan, (2007) in its report *Constraints to Private Investment in Infrastructure: Diagnostic Report* ascertains generic constraints to PPP programs in Pakistan. This report focuses on PPP constraints and does not cover the entire spectrum of PPP implementation framework.

3.7 Role of institutions and private-sector participation in infrastructure development

Institutions have both formal and informal features. Formal institutions are a set of explicit, detailed, coded rules which are applied within their defined limits, while informal institutions are a set of social conventions, customs, norms and prevalent social rules, which are widely followed in a given society. Broadly, institutions provide a systematic framework that reduces uncertainty, establishes property rights and "the rules of the game", and provides the choices available to individuals and groups (Durham, 2004; Tavares, 2004). North (1994) defines institutions as the rules of the game: the humanly devised constraints that structure human interaction. They are made up of formal constraints (such as rules, laws, constitutions), informal constraints (such as norms of behaviour, conventions, self-imposed codes of conduct), and their enforcement characteristics. "Organisation" denotes a group of individuals bound by some common purpose to achieve objectives. Organisations include political bodies (political parties, regulatory agencies), economic bodies (firms, trade unions), social bodies (churches, clubs), and educational bodies (schools, universities) (North, 1990).

New institutional economics (NIE) focuses on the social and legal norms and rules that underlie economic activities. Among many aspects in current NIE analysis are: transaction

costs, property rights, contractual safeguards, organisational arrangements, credible commitments, modes of governance, enforcement mechanisms, monitoring costs, surrounding uncertainty, asymmetric information, persuasive abilities, human assets, social capital, social norms, and bargaining strength, etc. (Klaes, 2000; Lueck, 2008).

Institutional economics focuses on understanding the role of the evolutionary process and the role of institutions to determine economic behaviour (Albelda, Gunn, & Waller, 1987). Institutions are the rules of the game in the economy, and "organisations" ("the players of the game") arise in response to the institutional structure. North (1994) explains: "It is the interaction between institutions and organisations which shapes the institutional evolution of the economy." The characteristics of institutions include organisational activities, procedural devices and regulatory framework. Tridico (2007) argues that if formal economic institutions are ignored then informal institutions prevail. They may be illegal, such as the Mafia, organised crime, corrupt bureaucracy, negative informal economic networks and lobbies etc. These informal institutions will generate an illegal economy. Consequently, economic underdevelopment forces will prevail, human development will be lowered and transaction costs will increase.

According to the World Bank report The *Atlas of Global Development* (2009), during the past 15 years there was an increase in economic growth rate particularly in those countries that opened their economies to trade and investment, maintained sound policies and strengthened their political and law enforcement institutions. Economists have acknowledged that the quality of institutional structure in terms of protection of property rights, enforcement of contracts, efficient judicial systems, public administration, control of corruption and market regulations play an important role in strengthening long-run economic performance (Tebaldi & Elmslie, 2008). Dawson (2006) notes that: i) economic liberalism affects growth and investment; ii) free market institutions have a positive effect on growth; iii) political stability may stimulate investment; and (iv) the promoting liberalism is an effective policy framework to enhance growth.

Research (Escobal & Ponce, 2011) has found that strong institutions have positive relationships with public infrastructure for achieving income growth and poverty reduction, whereas institutional weakness is one of the poverty traps. Therefore, the economy can take full advantage of infrastructure investment (including private investment) in the presence of efficient institutional structure. Regan (2004) noted that established infrastructure, government institutions and regional development polices can create a favourable environment to attract

public and private investment. Regional growth and investment returns are greater when government has consistent policies and provides complementary institutional frameworks such as political stability, rule of law, an independent judicial system and well-established and regulated capital markets. Well-functioning institutions together with policy reforms and public sector initiatives in infrastructure investment may increase private investment, certainty of profit, and reduce private costs (Ali, 2003).

The *Atlas of Global Development* (2009), suggests that the basis for growth of any country depends on: i) the attitude of public officials; and ii) the role of institutions in providing public facilities including health care, education, social and economic justice, property rights, rule of law and provision of investment-friendly climate. A stable macroeconomic environment, generalised access to the world economy, protection of individual property rights and spending in public infrastructure provide benefits to all. Institutions affect economic performance because of their effects on transaction costs and productivity (Albert & Wouter, 2011). However, the effects of policies and institutional structures vary from country to country depending on each country's phase of development (Romain, Romain, & Fabrice, 2011).

The growth literature broadly shows that: i) institutions of enforcement of private property rights (which are vital for fostering sustainable growth process); and ii) institutions of rule of law (which matter most for economic growth) facilitate trade and transactions, promote investors' confidence including FDI and develop capital markets (The Pak Banker, 2011). Flachaire, García-Peñalosa, and Konte (2014) suggest state political institutions are prerequisites for the smooth operation of economic institutions and policy implementation. According to Tavares (2004), the judicial system may affect economic performance i.e. enforcement of property rights, execution of contracts and facilitating exchanges between business partners. Mo (2011) concludes that public good governance determines the quality of institutional structures and develops public policies and infrastructure that are supportive of business activities within an economy. Accordingly, well-functioning state institutions, such as political institutions, the judicial system, the financial system and good governance, play significant roles in implementing PPP to achieve economic and social development parameters.

Paul (2010) notes that PPP shape up infrastructure and further play an important role in determining economic and social development. However, the success of the PPP scheme is dependent on clear PPP guidelines and policy, appropriate legal frameworks, and institutional and administrative set-ups (Espelt, 2015). Public administration, policies, laws and institutions are the key drivers of private sector participation in infrastructure services provision

(Koppenjan & Bert, 2009). Effective legal and regulatory frameworks are essential, which are strengthening of institutions, standardising of practices, transparency and integrity in procurement procedure and revision of procurement methods for successful public partnerships with the private sector (Adrias, 2010; Jamali, 2004; Martin, 2007).

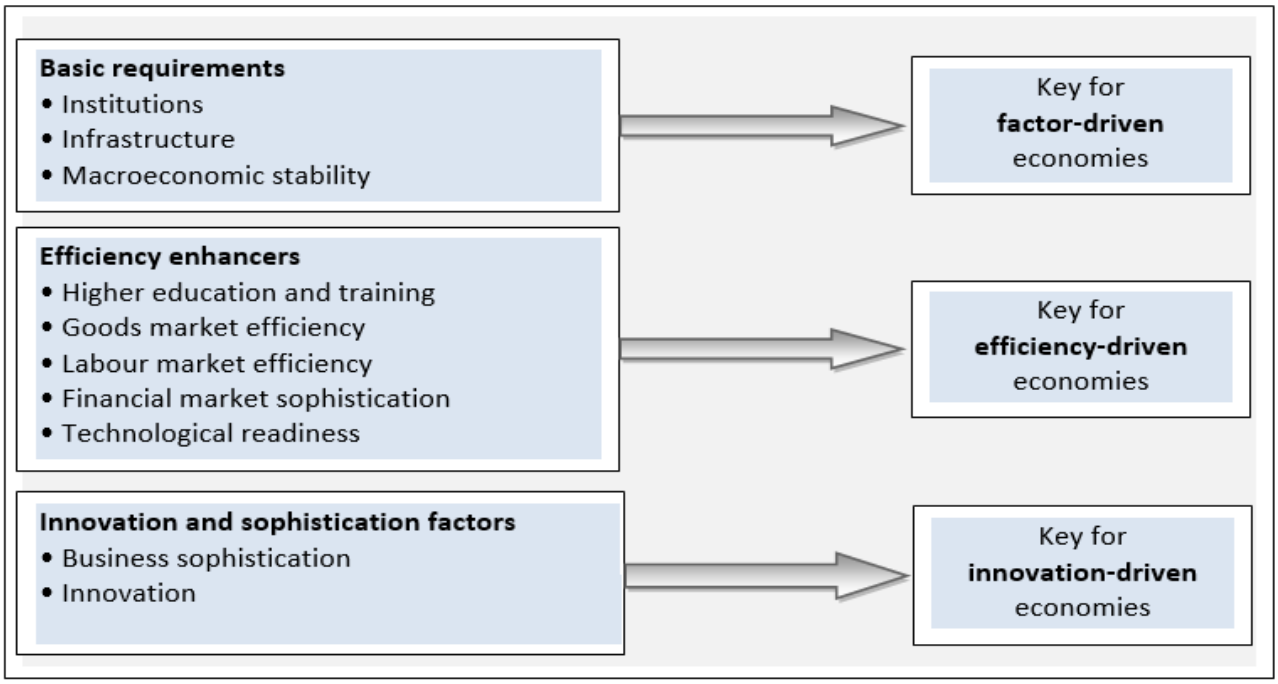
Government is primarily responsible for strengthening institutional structures and the formation of sound business-friendly policies to attract private investment (domestic and foreign investment) for providing infrastructure facilities to achieve development goals. Hence, at this stage, a simple question arises about why developing countries would not adopt better institutional frameworks. In response to this question, Cavalcanti (2005) argues that firstly, some vested interest groups erect barriers in providing social infrastructure and strengthening of institutions. Secondly, Europeans had adopted different colonisation policies in different colonies with different institutions.

The WEF in Global Competitiveness Reports 2009 – 2018 have provided benchmarking tools to identify competitiveness. It has grouped all components into 12 pillars of competitiveness and categorised them into three stages (Figure 3.6). However, it is clear that different pillars affect different countries differently according to their development phases. These pillars are not independent: not only are they related to each other, they tend to reinforce each other. For example, innovation is not possible without basic requirements i.e. institutional development and basic infrastructure.

Stage-I of development – "Factor Driven" is a turning point for economies. Well-functioning public and private institutions: increase well-developed infrastructure services, a stable macroeconomic framework, more job opportunities, increase in income level and living standard, and literate and healthy workforce. At this stage countries may be at a low level of productivity and import goods and services to meet their requirements.

As wages rise with advancing development, countries move into the Stage-II of development – "Efficiency-Driven". Then countries must be able to develop more efficient production process and increase product quality. At this point, competitiveness is increasingly driven by higher education, training, specialised labour force, market size, availability of affordable finances and use of modern technology. At this stage countries may become self-sufficient due to increase in productivity.

Figure 3.6: The 12 pillars/3 stages of competitiveness



Source: Global Competitiveness Reports 2017-18.

Finally, countries move into the Stage-III of development – "Innovation-Driven". Countries are able to sustain higher wages and standard of living, provided their businesses are able to compete with new and unique products through innovation and by using the most sophisticated production process. At this stage countries may achieve highest levels of their productivity, credibility and ability to export their goods and services.

The Global Competitiveness Index (GCI) analysis indicates three key challenges and lessons, which are relevant to economic progress, public-private collaboration and policy action. GCI can be used to categorise the passage of policy reforms and can help to identify the areas of emphasis (GCI, 2017-18). Pakistan ranks 115th out of 138 countries and scores 3.7 out of 7 in GCI 2017-2018. The number 1 rank is the highest (Table 3.11) while score 7 is the most desirable outcome (Figure 3.7). The basic determinants of GCI competitiveness namely are institutions, infrastructure, macroeconomic environment, and health primary education. Pakistan ranks 90, 110, 106 and 129 respectively. Global Competitiveness Reports 2011-2012 and 2017-2018 have identified that institutional development and infrastructure development are the basic requirements for competitiveness. Pakistan's economy is at stage-I of development – Basic Requirements (*Factor Driven*), which is regarded as a turning point for the economies. Pakistan's ranking in GCI is presented in Table 3.11.

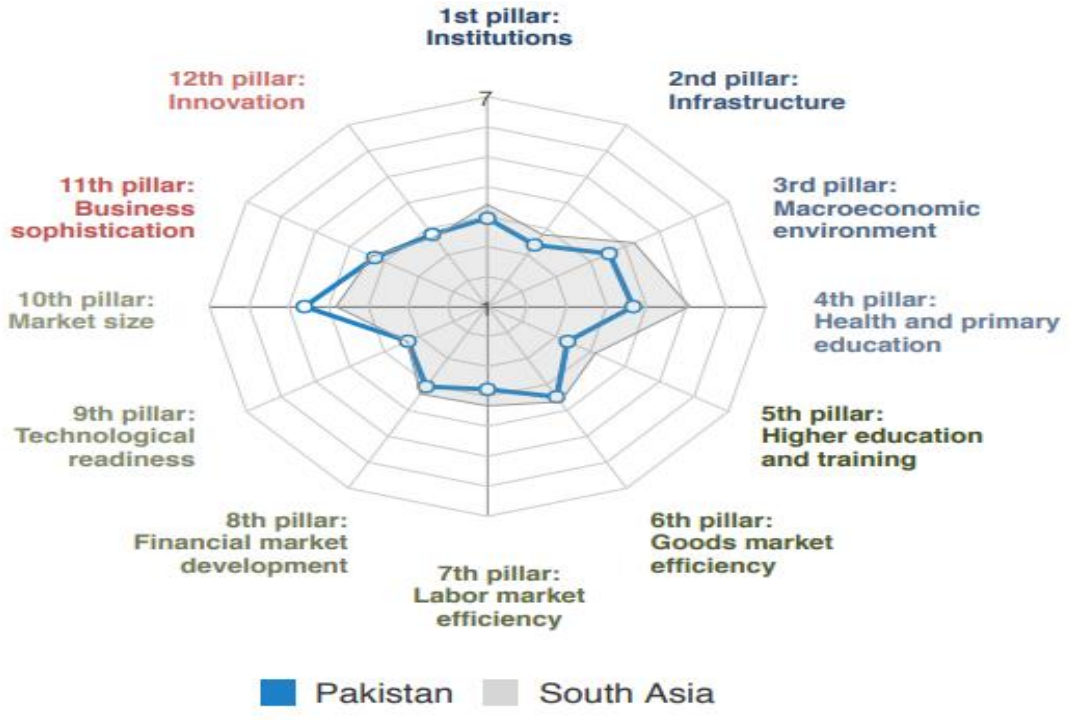
Table 3.11: Pakistan's overall score and rank in Global Competitiveness Index 2007-08 to 2017-18

Year	Overall Score	Overall Rank
GCI Index 2017-2018 (out of 137)	3.7	115
GCI Index 2016-2017 (out of 138)	3.5	122
GCI Index 2015-2016 (out of 140)	3.4	126
GCI Index 2014-2015 (out of 144)	3.4	129
GCI Index 2013-2014 (out of 148)	3.4	133
GCI Index 2012-2013 (out of 144)	3.5	124
GCI Index 2011-2012 (out of 142)	3.6	118
GCI Index 2010-2011 (out of 139)	3.6	123
GCI Index 2009-2010 (out of 133)	3.5	101
GCI Index 2008-2009 (out of 134)	3.6	101
GCI Index 2007-2008 (out of 131)	3.8	92

Source: Global Competitiveness Reports 2009-2010, 2011-12 & 2017-18.

The comparison of South Asian countries shows that Pakistan scores/ranks lowest (score 3.7/7 and rank 115/138) in GCI 2017-18, while India is at the top with 4.6 score and 40 rank. A comparison is shown in Figure 3.7 and Table 3.12.

Figure 3.7: Comparison of GCI 2017-18 in South Asian countries (Overall Score 7)



Source: Global Competitiveness Reports 2017-18.

Table 3.12: Comparison of GCI 2017-18 in South Asian countries (Score out of 7, Rank out of 138)

Global Competitiveness Index	Pakistan		Bangladesh		Bhutan		India		Nepal		Sri Lanka	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank
Overall Score and Rank	3.7	115	3.9	99	4.1	82	4.6	40	4.0	88	4.1	85
Basic requirements	3.7	114	4.1	101	4.6	66	4.7	63	4.4	86	4.5	78
1st pillar: Institutions	3.5	90	3.4	107	4.8	32	4.4	39	3.6	89	3.8	77
2nd pillar: Infrastructure	3.0	110	2.9	111	3.6	89	4.2	66	2.6	119	3.8	85
3rd pillar: Macroeconomic stability	4.0	106	4.9	56	4.6	78	4.5	80	5.6	31	4.3	94
4th pillar: Health & primary education	4.1	129	5.2	102	5.4	95	5.5	91	5.7	77	6.2	43
Efficiency enhancers	3.7	104	3.7	105	3.7	101	4.5	42	3.6	112	3.8	90
5th pillar: Higher education & training	3.0	120	3.1	117	4.0	90	4.3	75	3.4	108	4.2	78
6th pillar: Goods market efficiency	4.0	107	4.1	94	4.2	88	4.5	56	4.0	108	4.2	83
7th pillar: Labour market efficiency	3.4	128	3.6	118	4.7	24	4.1	75	3.9	97	3.3	131
8th pillar: Financial market sophistication	3.6	96	3.6	98	4.0	67	4.4	42	3.9	73	3.8	83
9th pillar: Technological readiness	3.0	111	2.8	120	3.2	105	3.1	107	2.8	119	3.2	106
10th pillar: Market size	4.9	28	4.7	38	1.9	132	6.4	3	3.4	85	4.2	59
Innovation and sophistication factors	3.6	72	3.3	106	3.5	78	4.3	30	3.1	122	3.8	58
11th pillar: Business sophistication	3.8	81	3.7	91	3.8	77	4.5	39	3.4	119	4.1	59
12th pillar: Innovation	3.4	60	2.8	114	3.2	79	4.1	29	2.8	121	3.4	54

Source: Reproduced from Global Competitiveness Reports 2009-2010, 2011-12 & 2017-18.

3.8 Review of investment theories

The research objectives of this thesis, *inter alia*, is to survey the current status of infrastructure development in Pakistan and to evaluate contributions of both the public and private sectors to infrastructure development. Therefore, it is imperative to identify the purview of infrastructure investment through public and private partnerships. The purpose of reviewing investment theories is to identify which investment theory is supporting PPP investment. This section presents the review of various investment theories.

3.8.1 Neoclassical theory of investment (NTI)

Neoclassical theories represent a radical shift away from International Dependence Theories. Neoclassical theories argue that governments should not intervene in the economy. However, they also argue that real-world markets are perfectly competitive and economies naturally reach equilibrium over time (Blinder, 2002; Pressman, 2011). In other words, these theories claim that an unobstructed free market is the best means of inducing rapid and successful development. In neoclassical macroeconomics, output is a function of employment given the capital stock, and output growth is determined by the interest rate in capital markets, which is linked to the demand of investment with the supply of savings (Gordon, 1992). In view of the neoclassical theory of optimal capital accumulation, investment is modelled as adjusted capital aggregate at an optimal level, assuming perfect competition and profit maximisation and well-behaved neoclassical production function (Crotty, 1992; Pressman, 2011).

Neoclassical (NC) is anti-Keynes, under which planned savings and planned investment are assumed to be identical ex-ante[32] (predicted results). There is no connection between past and present in terms of investment, because of capital malleability (flexibility). NTI also assumes that the future is certain, in which case the interest rate is a risk-free rate. The ideal properties of the investment under certainty mean perfectly competitive capital markets, where there are no transaction costs, no taxes and equal information of all market participants (Gordon, 1992).

Neoclassical theory does not give importance to complete information about the future state of the economy, mainly because of reversible investment and reversible debt. In this case

[32] See Glossary of Technical Terms.

investment decisions are riskless and mistakes are relatively costless. Besides, capital goods can also be resold to retire the debt burden (James, 1992). In view of its classical basis, money plays no role in determination of value and prices of production. Neither is there an instrumental role for uncertainty. Expectations are stabilised by the institutional environment. These aspects interface with the Post-Keynesian vision (Kerr, 2005).

3.8.2 Keynesian investment theory

The theories forming the basis of Keynesian economics were first presented in *The General Theory of Employment, Interest and Money*, published in 1936. According to Fletcher (1989) Keynesian economics advocates a mixed economy where the private sector plays a primary role, but government and the public sector plays a significant role. Keynesian economics argues that private-sector decisions sometimes lead to inefficient macroeconomic outcomes and, therefore, advocates active policy responses by the public sector, including monetary policy (actions by the central bank) and fiscal policy (actions by the government) to stabilise output over the business cycle[33] (O'Sullivan & Sheffrin, 2003). A variant business cycle[34] is the most serious economic problem according to most Keynesians. Thus, Keynesians advocate active stabilisation policies to reduce the scale of the business cycle. Public policies can be used to increase aggregate demand and economic activity, reducing unemployment and depression. For example, when the unemployment rate is very high, a government can use an expansionary monetary policy[35].

The Keynesian investment model served as the economic model during the time of the Great Depression, World War II and the postwar economic expansion 1945-1973. Keynes argued that the solution to the Great Depression was to increase economic activities by stimulating investment through some combination of two approaches: 1) reduction in interest rates; and 2) government investment in infrastructure. Public investment injects income, which results in more spending in the general economy. This in turn stimulates aggregate demand, more production, investment and spending and so forth. A number of activities will be started as a result of initial stimulation, and the total increase in economic activity will be manifold of the original investment (Blinder, 2002).

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[33] See Glossary of Technical Terms.
[34] See Glossary of Technical Terms.
[35] See Glossary of Technical Terms.

Keynesian investment and financing decisions require complete information regarding the behaviour of price, products and profits for decades into the future. Conversely, there is no scientific formula to calculate predictability. Firms operate under uncertainty. Therefore, most crucial economic decisions must be taken in ignorance and uncertainty based on "animal spirits"[36] (human emotions that drive consumer confidence) or the state of confidence of business executives, which indeed influence investment, income and employment (Crotty, 1980).

3.8.3 Post-Keynesian investment theory

Post-Keynesian economics mainly focuses on macroeconomic issues such as financial instability, inflation, exchange rate regimes, trade deficits and unemployment (Pressman, 2011). Neo-Keynesian (NK) investment theory determines saving, rather savings determine investment. Post-Keynesians (PK) primarily focus on understanding the process through which investment, savings, and financing decisions are determined in a monetary economy in which the future is uncertain, production takes time, the capital stock is not malleable (flexible), and an efficient spot market for durable goods does not exist (Crotty, 1980).

Institutionalist and post-Keynesians (IPK) support Keynes and Kalecki in arguing that savings do not determine investment. Rather profit expectations, interest rates and the availability and the cost of finance are the important influences on investment, not the flow of savings (Niggle, 2006). IPK strongly believes in demand-management intervention, arguing that the economy is inherently unstable and that intervention is needed to ensure stable conditions for investment and long-run growth. Uncertainty indicates great risk for many crucial decisions and the resultant instability of expectations regarding profits from investment and future price of assets. Economic instability and financial instability are dialectically interactive and must be constrained with appropriate institutions (Niggle, 2006; Sloman & Norris, 2008). Salient features of IPK are:

- Aggregate demand
- Savings and investment
- Inflation and employment

[36] See Glossary of Technical Terms.

- Uncertainty
- Exchange rate
- Financial market regulations

3.8.3.1 Aggregate demand

IPK advocates demand-enhancing policy and supports aggregate demand (Peter, 2010). Insufficient aggregate demand causes low growth as well as recession. Kerr (2005) cites Harcourt (1999B) and Dow (1996) that post-Keynesianism should be a situation and issue-specific method of doing political economy. Methodological approach under post-Keynes theories is an open-systems approach. The open system allows for creativity and the independent evolution of behaviour and institutions. In this way, a number of Post-Keynesian investment theories are compatible with the more general principle of effective demand. IPK sees a strong reinforcing link between demand, cycles, and growth: high demand leads to high investment and capacity utilisation, which leads to high investment and then higher productivity in the next period (higher growth).

3.8.3.2 Savings and investment

Profit expectations, interest rates and the availability and the cost of finance are the important influences on investment, not the flow of savings. Kerr (2005) cites Robinson and Asimakopulos's proposal that accumulation and profitability have a two-sided relationship. Actual investment is a major determinant of current profits, while current profits are major determinants of expected profits, which in turn determine planned accumulation in situations of given financial conditions and long-term expectations. Therefore, PK investment theory has a strong link with investment growth and profitability.

3.8.3.3 Inflation and employment

IPK prioritises full employment over low inflation. Inflation can be seen as a result of distributional struggles between capital and labour, which can lead to "cost push" inflation. Institutions which socially control wages, prices, and the distribution of income are necessary for full employment and price stability (Niggle, 2006).

PK investment function is unstable, therefore the PK vision is one of instability and disequilibrium. The role of uncertainty in investment decision-making is a key concern of Post-Keynesian economics (Poitras, 2002). Uncertainty has given a new concept to international

economic system. In an uncertain world, future market valuations are always uncertain. Keynes and Post-Keynesians have rejected the classical theory of an efficient market. Because of the uncertainty, previous data is not valid anymore for rational expectations and forecasting. Hence, the existing result cannot provide accurate future information and free markets are not necessarily efficient (Alves, Ferrari, & De Paula, 1999; Ökten, 2011).

3.8.3.4 Uncertainty

Uncertainty means that a future payment may have more than one value. Uncertainty cannot be estimated because it is based on probability distribution (Gordon, 1992). Uncertainty is created by the infinite number of future outcomes which are possible at a given point in time (Poitras, 2002). Uncertainty implies great risk for many crucial decisions and the resultant instability of expectations regarding profits from investment and future price of assets (Niggle, 2006). Uncertainty involves unmeasurable and unknowable probabilities. However, past evidence is no guide when events happen irregularly or the situation extends far into the future (Pressman, 2011).

Uncertainty arises when we do not know what others will do and when their behaviour is unpredictable. At a macroeconomic level, uncertainty leads to under investment and unemployment. This situation requires remedial measures through government institutional intervention to implement policies effectively. Similarly, uncertainty at a microeconomic level also needs government intervention to improve economic outcomes. Uncertainty does not preclude systematic relationships; rather institutions which evolve to accommodate its effects are likely to provoke stability. In PK macroeconomics, government plays an effective role to reduce uncertainty and improve economic performance (Pressman, 2011). The role of primary institutions is to accommodate the uncertainty in economic processes. This is the reason why institutions are so central to Post-Keynesian theory (Kerr, 2005).

3.8.3.5 Exchange rate

Most IPK economists favour some form of exchange rate regime which would reduce exchange rate instability (Kerr, 2005). Ökten (2011) cites Davidson (1998) and Wray (1996) that in an uncertain world, reliance on historical or current market data for forecast future prices is not reliable. Unpredictability of future prices can have really costly consequences for the aggregate real income of the community. Therefore, it is obvious that exchange rates must be

fixed. Otherwise, a flexible exchange system will raise speculation to a currency and decrease investment and growth.

Keynes was firmly against the gold standard (i.e. one particular type of fixed exchange rate regime). Keynes claims that only "fluctuating" exchange rates could maintain wages as stable in the face of an aggregate demand shock. Fixed exchange rates would lead to a greater destabilisation of domestic incomes by causing problems of effective demand through wage adjustment (Ökten, 2011). However, Post-Keynesians have rejected the flexible exchange rates concept. PK states that flexible exchange rates will destabilise expectations (destabilise the prices of goods and services) that would encourage speculation. On the other side, it will discourage future contracts that may seize the economic activities in the nation and the world economy Ökten (2011) cites (Morengos, 2001, p.695; Wray,1996,p.143; Davidson, 1994,p.238-9). That is why IPK economists favour some form of exchange-rate regime which would reduce exchange-rate instability. Neo-Keynesians see financial instability and crises as occasional episodes, which can be handled on an ad hoc basis. IPK favours financial market regulation and sees unregulated markets as enhancing instability.

3.8.3.6 Financial market regulations

Financial markets and money are central to IPK macroeconomics. PK considers the roles of institutions and conventions in economic processes rather than deferring to market coordination as a universal explanation. Further, institutions are necessary to accommodate uncertainty surrounding many economic decisions (Niggle, 2006; Ökten, 2011).

3.8.4 Conclusion of investment theories

In the view of neoclassical theorists, the theory of value and distribution develops the surplus approach. Normal prices are determined by the conditions of reproduction and the distribution of the surplus over the wages as a normal rate of profit in each line of capital. Money plays no role in determination of value and prices of production. Neither is there an instrumental role for uncertainty. Expectations are stabilised by the institutional environment. These aspects interface with the PK vision (Kerr, 2005).

Keynesians see economy as a monetary production economy, put into motion by the effects of volatile investment expenditure which governs the level of output and employment. Finance, particularly for investment, plays an important role and money is endogenous. The distribution of income between wages and profits is central to growth. More precisely, Keynes

recommends leveraging up, which means increase in capital investment with borrowing (Poitras, 2002). Keynes rejects neoclassical value and distribution theory for industry as a whole (Niggle, 2006).

The Post-Keynesian approach has adopted much of what neoclassical and Keynes proposed, and states that this work has to be reworked and moulded to fit the contemporary social setting. For both Keynes and Post-Keynesians, uncertainty plays a central role in the investment process (Poitras, 2002). Instability is not as important a concern in new Keynesian economics, and financial markets are discussed mainly as an afterthought (Niggle, 2006).

The following five key aspects distinguish PK economics from neoclassical economics:

1) A recognition that the future is uncertain rather than the future can be predicted with some probability distribution;

2) Individual decision-making depends on social factors such as habits and emulation rather than individual rational choice;

3) A belief that economic analysis should examine economies that move through historical time rather than economies that naturally reach some equilibrium;

4) A recognition that real-world markets are not perfectly competitive;

5) A focus on income effects rather than on substitution effects (Pressman, 2011).

The PK approach tends to see individuals within the context of structures in the form of institutions, conventions, classes, the State, and all underlying individual behaviour. Individuals are interdependent, they act in groups. The whole is more than the sum of its parts (Kerr, 2005). PK models are characterised by systemic risk or uncertainty. For instance, no one can guarantee that hyperinflation (rapid monetary inflation that is great enough to threaten a nation's economic stability) or the collapse of financial asset prices and depression will not occur in the future (Crotty, 1996). PK accepts the existence of oligopolistic firms (an economic condition in which there are so few suppliers of a product that one supplier's actions can have a significant impact on prices and on its competitors) but emphases the need to regulate them in the best public interest (Pressman, 2011).

According to Lin and Doemeland (2012) several core aspects of the Post-Keynesian approach support its positive impact on growth, such as infrastructure investment through private sector, which is likely to have a positive impact on GDP rather than increase government

consumption. Lin and Doemeland (2012) analysed that scaling-up of infrastructure investment would go beyond the traditional Keynesian approach. These dimensions are:

i) Decrease in government direct spending in the domestic economy;

ii) For the growth-lifting strategy, government should focus on implementing austerity measures, structural and policy reforms for private-sector participation for increasing demand in short-term and growth prospects in long-term; and

iii) For infrastructure-initiative, government could use existing financial resources efficiently and improve policies and institutional environment to attract private investment.

This thesis focuses on PK investment theory to develop infrastructure investment estimation model. IPK proposes "demand-led" growth economics. IPK considers the roles of institutions and conventions in the economic process rather than deferring to market coordination as a universal explanation and the primary institution for accommodating the uncertainty surrounding many economic decisions about money. PK and IPK public-spending approaches are rich and have more explanatory power and more usefulness in formulation of macro policy.

3.9 Scope of the literature review

The literature review has helped in identifying the current research gaps and problems in the study area. The key aspects that have been investigated via the literature review are summarised below:

- The origin and evolution of PPP and found that PPP is not a new concept of the contemporary era. There has always been some extent of cooperation between public and private sector over the centuries. Present PPP structures and models including advantages and disadvantages and essential ingredients of a successful PPP implementation were also investigated.
- The role of institutions and private sector participation in infrastructure development has uncovered that institutional framework may be given priority which can attract private investment for achieving the desired objectives of PPP.
- A review of investment theories has defined the domain of PPP investment. In other words, the review of investment theories has identified that PPP investment is being embraced under the auspices of Post-Keynesian investment theory.

3.10 Literature review conclusions

In general, infrastructure is recognised as a key element of economic and social development. Improved quality and service coverage in physical infrastructure projects is essential for a country's economy and the livelihood of its people. But tight fiscal constraint requires an innovative approach that moves away from the traditional way to finance infrastructure projects by public funding. Therefore, a solution could be to take an initiative to establish partnerships with private-sector investors in terms of PPP that could meet the increasing infrastructure services demand without burden on public budget. Public infrastructure expansion in Pakistan has created a need for private-sector investment due to public budget constraints.

PPP procurement methods are considered the most attractive in terms of positive factors such as introduction of new technology, cost effectiveness and improved quality of service delivery. The literature review has pointed out a number of significant benefits for infrastructure services delivered by PPP models that are not being achieved with the traditional model and suggests that traditional procurement models are based on lowest-cost evaluation, which are the worst performing of the state procurement options.

Although it is a difficult task to compare different procurement methods over different time frames and measurement criteria, evidence exists of better procurement outcomes with methods that employ a full or partial output specification. The literature review has revealed that PPP is the best method of procurement specially to deliver large, complex and expensive projects, achieving significant savings in both time and cost. However, there are some weaknesses in PPP procurement methods such as:

i) Lack of institutional framework;
ii) Lack of capacity in both public and the private sector (at the working level) concerning project development and implementation;
iii) Over-commercialisation of projects; and
iv) High participation cost and time. Consequently, theses weaknesses need to be addressed to make PPP procurement more attractive for infrastructure services delivery.

3.10.1 Concluding remarks

It has been revealed from the literature review of PPP that the establishment of institutional frameworks should be given priority for achieving the desired objectives of PPP. A successful PPP program needs to develop:

- Institutional frameworks to generate enabling environments which can attract private investment including reduction of public-sector participation in infrastructure services provision;
- Capacity of both public and the private sectors to participate in PPP projects;
- Higher transparency in bidding processes; and
- Equal access for both public and private sectors to financing facilities and capital market. Further, success factors of PPP programs include realistic feasibility studies, accurate economic and environmental appraisal, and effective risk analysis and risk mitigation mechanisms.

3.10.2 PPP is a valuable solution to the current infrastructure challenges in Pakistan

It is recognised from the empirical studies that infrastructure is an integral part of economic and social development in any economy. Pakistan is lagging behind in achieving its development goals mainly because of poor infrastructure facilities. Financial constraint is one of the major impediments in infrastructure development, combined with other problems such as poor infrastructure planning, policy and management. Infrastructure projects in Pakistan are mostly financed by the public sector through taxes and or by lending from multilaterals financial institutions and donors on concessional terms.

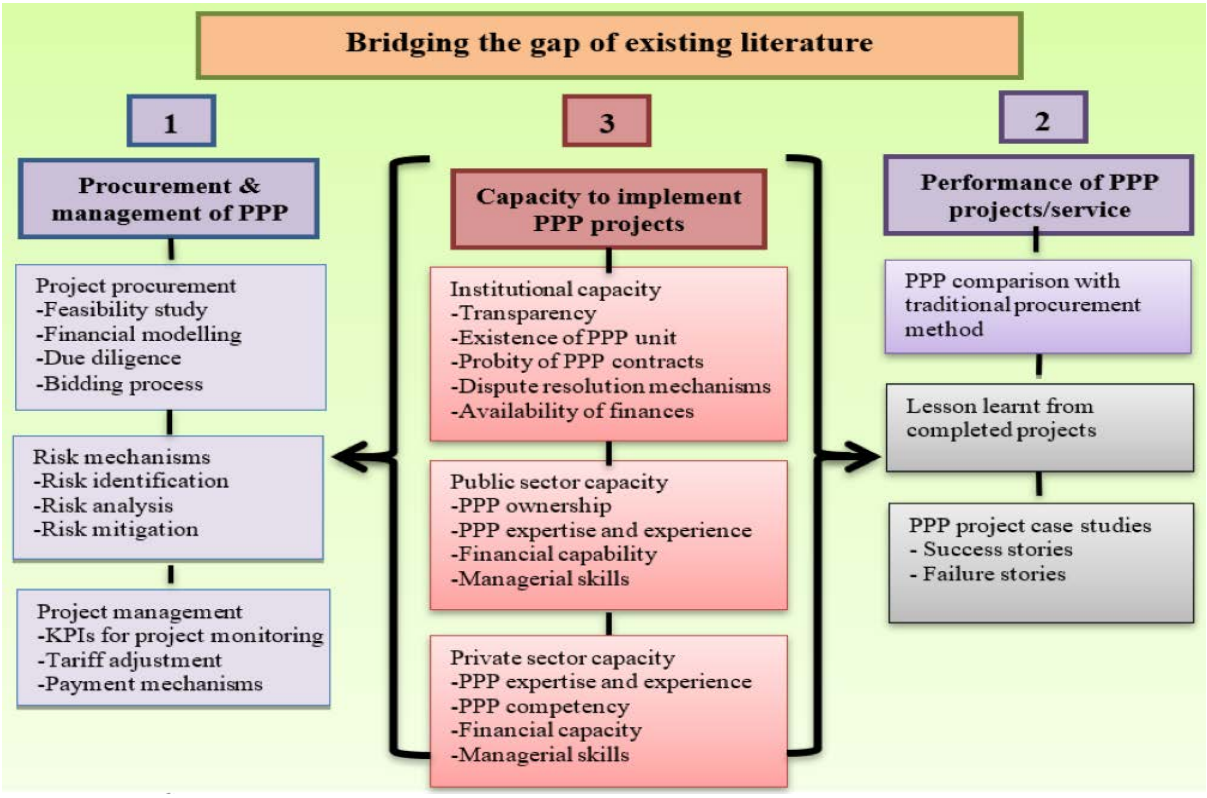
However, infrastructure projects cannot be financed thought tax revenues because of smaller tax net, inefficient tax administration and weak economic growth in Pakistan. Besides, government cannot impose additional taxes, increase tax rates and tax net due to political reasons. Therefore, new avenues to increase infrastructure investment may be found elsewhere, beyond the scope of public resources. In this situation/context private sector participation in terms of PPP can be a part of the solution to the infrastructure financing and management problem.

3.11 Identification of literature gaps

Various aspects of PPP have been explored by past researchers, such as determinants of PPP in infrastructure development, increasing construction and operational efficiency, reasons for implementing PPP, PPP success and failure factors, macroeconomic analysis of PPP, assessment methods of gaining efficiency of PPP projects, enhancing value for money in PPP projects, study of various PPP models, improving service delivery, reducing costs, fostering services expansion, bringing efficiency, and productivity.

To date, most of the existing literature has concentrated on identifying the key critical success factors in PPP implementation, PPP procurement mechanisms, management and lessons learned from completed projects. Therefore, the overall emphasis of the existing literature is generally concerned with PPP projects procurement mechanisms, PPP projects management and performance of PPP projects. A summary of past research is illustrated in Figure 3.8, which shows that research on PPP has focused primarily on two aspects, procurement and performance (parts 1 and 2 of Figure 3.8).

Figure 3.8: Summary of existing PPP research



Source: Author

Part 1 reflects project procurement processes, management and operation of PPP projects. Existing research in this part focuses on PPP procurement processes:

- PPP needs and options/models analysis, legal, technical, financial and environmental due diligence, market test – affordability and value for money test;
- Bidding process – determination of viability gap funding[37] (VGF) needs for PPP projects and negotiations between contracting parties (public-sector authority and the private investors);
- Risk mechanisms – risk identification, risk analysis and risk mitigation; and
- Project management – key performance indicators for project monitoring, tariff adjustment in accordance with consumer price index, and payment mechanisms including users' charges and unitary charges[38] or payments.

Part 2 emphasises the performance of PPP projects/service delivery. Earlier research focused on PPP completed projects, which provides useful information and case studies including success and failure stories of PPP projects, and comparison of PPP projects with traditional procurement methods.

Part 3 is the focal point between part 1 and part 2. The research objectives of this thesis in Part 3 are composed of three key elements of successful implementation of PPP:

- Capacity of institutional framework – transparent procurement process, probity and enforcement of PPP contracts, availability of fast-track dispute-resolution, opportunity of private-sector participation in project development, capital market capacity to finance infrastructure projects;
- Public-sector capacity – PPP awareness and ownership at highest leadership level, PPP expertise and experience of the organisation, financial and managerial capacity of the organisation to implement PPP projects and organisational capacity to select right PPP model for suitable projects; and
- Private-sector capacity – PPP expertise and experience of the organisation, competency and qualification (work plan and methodology) ability to identify project/sector-related issues and approaches to address them, financial and managerial capacity of the organisations to implement PPP projects.

[37] See Glossary of Technical Terms.
[38] See Glossary of Technical Terms.

Part 3 (capacity of institutions, public-sector contracting authority and the private-sector investors) plays a pivotal role as a bridge to connect Part 1 (project procurement and management of PPP projects) and Part 2 (performance of PPP project/service delivery) right from the beginning/first step of the PPP project, i.e. project feasibility study and procurement to the last step i.e. service delivery of the PPP project. Accordingly, Part 3 needs to be strengthened to achieve intended project objectives, which are to ensure availability of the services at agreed service delivery standards and an affordable price. However, all three factors must be considered for a successful implementation of a PPP program.

This thesis focuses on Part 3 as no study has been carried out to determine the capacity of institutions, public sector and the private sector to implement PPP programs in the perspective of Pakistan, which is shown as Part 3 in Figure 3.8.

The lack of research on PPP in relation to developing countries in South Asia warrants increased research efforts. This thesis is an attempt to contribute to this area by examining PPP program implementation issues concerning Pakistan. It constitutes the first empirical attempt to identify key determinants of PPP performance with reference to Pakistan such as:

- What are the major impediments, and their affects, of PPP implementation in Pakistan?
- What kind of institutional arrangements are needed and how can they be developed in Pakistan to boost PPP undertakings for infrastructure development?
- Do the public sector and the private sector have the capacity to implement PPP programs in Pakistan?

Research methodological issues for the studies undertaken for this thesis are discussed in Chapter Four.

Chapter Four: Research Methodology

In this chapter the methodology used to answer the research questions is described. The studies undertaken were analysed using both qualitative and quantitative techniques. Section 4.1 describes the conceptual framework used to assess institutional, private sector and the public sector capacity and other factors to implement PPP program in Pakistan. Research hypotheses are also presented in this section. Section 4.2 examined the modelling issues. Section 4.3 describes the data used for this study.

4.1 Conceptual Considerations

The objective of the overall thesis is to identify the main obstacles to implementation of a successful PPP program for infrastructure development in Pakistan. As noted in the previous chapter (refer to Section 3.8 and 3.9) various factors can affect the successful implementation of a PPP program. The major ones can be summarised below:

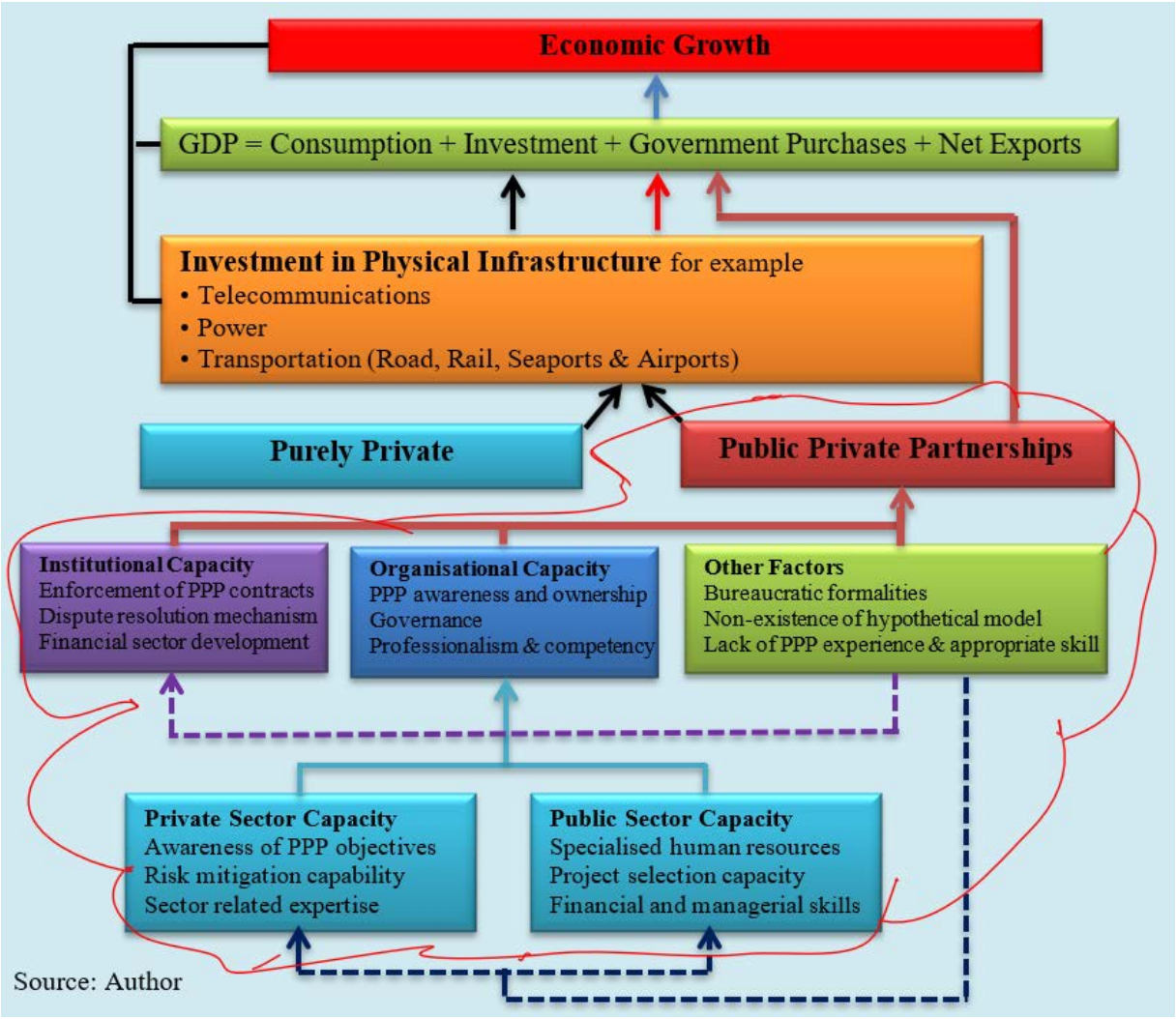
- Institutional capacity
- Organisational capacity
  - Private sector capacity
  - Public sector capacity
- Other factors.

The relationships between the above-mentioned factors, the implementation of PPP programs and how they will affect a country's economic growth is illustrated in Figure 4.1. Empirical studies reviewed in Chapter Three (refer to Section 3.8 and 3.9) pointed out that determining the specific roles of PPP investment in infrastructure development and economic growth is neither simple nor straightforward. To summarise, the performance of PPP in infrastructure development is associated with the institutional quality/capacity, organisational capacity and other factors to play their due role effectively. In this conceptual model, organisational capacity was segregated into two components: private-sector capacity and the public sector's capacity to implement a PPP program. Collectively, both capacities perform an important role in successful PPP program implementation. The relationship states that an increase in physical infrastructure investment positively affects total investment, government purchases, GDP and ultimately economic growth. Note: a detailed examination of purely private

investment in infrastructure development is beyond the scope of this thesis which focuses on identifying the factors that underpin succeful implentation of PPP programs.

The significance of each of the factors shown in Figure 4.1 are now discussed in detail, together with the relevant links to the research questions set for the thesis.

Figure 4.1: Possible interrelationship



Institutional capacity and PPP

As mentioned in Chapter Three, institutional capacity means readiness of public institutions (which involve the development of infrastructure) to carry out infrastructure projects using PPP models.

Organisational capacity and PPP

The factors impacting on the effectiveness of organisational set-up include structures, procedures, human resources, administrative actions, and other resources that public and private stakeholders bring together to achieve a development goal (The World Bank Institution, 2011). In this thesis, the organisational capacity is taken to comprise both private-sector capacity and the public sector's capacity to implement PPP projects.

Other factors

The proposed conceptual model (Figure 4.1) shows that there are a few other factors, to address for a successful implementation of a PPP program.

Finally, if all components of the proposed conceptual model are implemented effectively, they can contribute to encouraging investment in physical infrastructure and have a significant impact on economic growth in terms of GDP as shown in Figure 4.1. The following section presents research hypotheses to verify the research questions in a testable form.

4.2 Research questions and research hypotheses

The research questions are set up as econometrically testable research hypotheses corresponding to model 1 of Section 4.3. The primary data (survey quesionnaire data – qualitative data) sources were used to address the research questions. The preliminary test results are provided in Chapter Five.

Question 1. Does institutional capacity have an effect on PPP implementation in Pakistan?

To address this research question, a variable was created called "institutional capacity" (IC). IC assessment scoring criteria were developed in light of The World Bank Institute's (2011) Capacity Development and Results Framework (CDRF) and Economists' Intelligence Unit's (2009) model/scoring criteria to evaluate the role of state institutions in implementing PPP programs in Pakistan. This variable is ordinal by construction. IC has six levels of variables. The scoring criteria are developed on a five-point Likert scale (1=lowest and 5=highest). IC is evaluated by asking the following questions to the survey participating organisations. Further details about the survey and data collection procedure are given in Chapter Five.

1. Does a PPP unit/board exist in your organisation?
2. Are procurement methods transparent?
3. Are PPP contracts enforced?
4. Do dispute-resolution mechanisms (DMRs) exist?
5. Does your organisation allow private-sector participation (PSP) in project development?

6. Are domestic capital markets (DCMs) capable of providing finance for infrastructure projects?

   The following hypotheses can be tested to address the above research question:
   Institutions in Pakistan have the capacity to implement PPP programs.

   $H_0: \beta_{IC} = 0$

   $H_1: \beta_{IC} \neq 0$

This hypothesis is tested in a total investment model, public investment model and private investment models. If we do not reject the null hypotheses H_0 then institutional capacity (IC) does not have the capacity and is a barrier to adopting PPP procurement methods for infrastructure investment in Pakistan.

Question 2. Does the private sector have the capacity to implement PPP programs in Pakistan?

Private-sector capacity is essential for a successful PPP implementation. Therefore, the private sector should have:

- PPP-related expertise, qualifications and risk-mitigation capacity and the ability to identify project/sector-related problems and have the approaches to address these;
- Financial capacity to develop, operate and maintain PPP projects and have long-term financing facilities for PPP infrastructure projects, as well as the capacity to mitigate financial risk effectively;
- Financial, operational and managerial capacity to deliver PPP projects successfully; and
- Capacity to mitigate project-related risks effectively.

A variable "Private sector capacity (PVC)" was created to assess the effect of private-sector capacity. Research findings of Tahir (2011), Jin and Zhang (2010), UNESCAP-PPP Network (2010), Stephan and Raymond (2009), Yuan et al., (2009), Chan et al. (2009), Klijn and Teisman (2003), NAO (2003), and WBI CDRF (2011) have been elaborated to measure the readiness of the private and public sectors as well to implement successful PPP programs in Pakistan.

The scoring criteria is developed on a five-point Likert scale (1=lowest and 5=highest) to estimate PVC variables. PVC is evaluated by asking the following four questions to the private sector survey participating organisations.

1. Does your organisation have PPP experience in the relevant sector?
2. Does your organisation have competency and qualification (work plan and methodology)?
3. Does your organisation have financial capacity?
4. Does your organisation have managerial skills to implement PPP?

This research question can be tested by the following hypotheses:

The private sector in Pakistan has the capacity to implement PPP programs.

$H_0: \beta_{PVC} = 0$

$H_1: \beta_{PVC} \neq 0$

If the null hypotheses H_0 is rejected then it is obvious that the private sector in Pakistan does have the capacity to engage in PPP procurement methods for infrastructure investment.

Question 2.1. Do other factors have an effect on PPP implementation in Pakistan?

As stated, other factors such as good governance, availability of specific PPP legislation, sector-specific guidelines, an effective judicial system, experienced and skilled human resources and access to the affordable financial facilities can play an important role in the success of PPP projects. These factors may be supportive to develop a successful PPP project with the help of well-functioning institutions and capacity building of both the private sector and the public sector.

The literature reviewed in Chapter Three revealed that private firms can contribute to PPP via innovation, new technology, efficient management and financial practices that can improve the quality of services offered to the public sector. Public investment may crowd in private investment (including FDI). Subsequently, infrastructure projects may be developed on PPP modality. Simultaneously, well-functioning institutions and infrastructure investment through PPP may contribute to achieving high growth.

Economic growth requires sound policies, strong and focused institutional structures, experienced and skilled organisational structures along with the supportive association of line agencies. In fact, there are many determinants of competitiveness that are undoubtedly complex in nature. Therefore, a harmonised policy framework is needed to steer all the key stakeholders

of the economy in one direction to achieve higher growth as a whole. Nevertheless, in developing countries, particularly in the context of Pakistan, very little attention is paid to examining institutional quality and capacity, private- and public-sector skills and the capacity to develop public infrastructure with private sector participation.

In order to consider other factors that may have an impact on PPP program implementation in Pakistan, a variable called "Other Factors in PPP implementation (OF)" was developed. Twenty-five possible factors were considered and measured on a 5-point Likert scale (the detail of each factor is provided in the questionnaire in Appendices 5.1 and 5.2). Thereafter, the other factors were divided up into four sections: i) Admin/Rules & Regulations (OF_1); ii) Delay in Project execution (OF_2); iii) Public & Private Sectors' Experience and Qualification (OF_3); and iv) Unrealistic Feasibility Study (OF_4). Survey participants were also given the option to identify additional factors if they are experiencing any kind.

In the private-sector investment model, a variable called "other factors" can be tested to verify the impact of other factors on private-sector investment in Pakistan by testing the following hypotheses:

$$H_0: \ OF_1 = OF_2 = OF_3 = OF_4 = 0$$

$$H_1: \ OF_1 \neq OF_2 \neq OF_3 \neq OF_4 \neq 0$$

There was a need to test jointly the significance of institutional capacity (IC), private-sector capacity (PVC) and the other factors (OF) to PPP implementation in Pakistan. This can be achieved by testing the following hypotheses:

$$H_0: \beta_{IC} = \beta_{PVC} = \beta_{AllOFs(\beta_6 OF_1, \beta_7 OF_2, \beta_8 OF_3, \beta_9 OF_4)} = 0$$

$$H_1: \beta_{IC} \neq \beta_{PVC} \neq \beta_{AllOFs(\beta_6 OF_1, \beta_7 OF_2, \beta_8 OF_3, \beta_9 OF_4)} \neq 0$$

If the null hypotheses H_0 is rejected, then institutional capacity, private-sector capacity and all other factors have an impact jointly on the adoption of PPP procurement methods for infrastructure investment in Pakistan.

The interaction between public-sector capacity and private-sector capacity was tested to establish their effects on public infrastructure investment.

Question 3. Does the public sector have the capacity to implement PPP programs in Pakistan?

A variable called “Public sector capacity” (PBC) was developed to assess the public sector capacity to implement a successful PPP program in Pakistan. In summary, the public sector should have:

- PPP awareness, ownership and expertise to implement PPP.
- Expertise and PPP-related experience and qualification to select the right PPP model and project.
- Operational and managerial capacity to deliver PPP projects successfully.
- The capacity to mitigate project-related risks effectively.
- Effective services monitoring mechanisms.

PBC is evaluated by asking the following questions to the public-sector survey participating organisations.

1. Does the Chief Executive of your organisation have PPP awareness and ownership?
2. Does your organisation have PPP experience?
3. Does your organisation have the financial capacity to implement PPP?
4. Does your organisation have managerial skills to implement PPP?
5. Does your organisation have the capacity to select the right PPP model and project?

The influence of public-sector capacity (PBC) on PPP undertakings for infrastructure development can be tested by the following hypotheses:

The public sector in Pakistan has the capacity to implement PPP programs.

$H_0: \beta_{\text{PBC}} = 0$

$H_1: \beta_{\text{PBC}} \neq 0$

If the null hypotheses H_0 is rejected then it is evident that the public sector in Pakistan does have the capacity to take up PPP procurement methods for infrastructure investment.

4.3 Research Methodology

PPP and institutions collectively perform an important role in economic growth. Initially, PPP provides investment for infrastructure development (economic, social and financial), which contributes to economic growth (Lin and Doerte, 2012). Proficient public and private sectors and well-functioning state institutions are essential to implement successful PPP

programs (planning, procuring, developing and monitoring). Empirical evidence suggests that public and private-sector partnerships may provide investment for infrastructure development, which contributes to economic growth. Proficient public and private sectors and well-functioning state institutions are essential to implement a successful PPP program (planning, procuring, developing and monitoring). Therefore, to describe the role of physical infrastructure development, institutional frameworks, private-sector and public-sector capacity to manage PPP projects effectively and efficiently to achieve higher economic growth in Pakistan were combined.

It was noted in Chapter Three that Keynesian and Post-Keynesian investment theory advocates demand-enhancing policy and expansionary macroeconomic policies (Blinder, 2002). Institutionalist and Post-Keynesian (IPK) recognise that there is a strong reinforcing link between demand, cycles, and growth: high demand leads to high investment and capacity utilisation, which leads to high investment and then higher productivity in the next period (higher growth) (Kerr, 2005). Therefore, in this study, infrastructure investment analyses the impacts of private and public investment in infrastructural development. The private and public investment functions are estimated separately by physical infrastructure applying multiple regression methods and jointly by using panel vector autoregression (PVAR) to uncover the effect of cross-sectoral causality.

In the regression context the dependent variable of the regression model is the investment and the independent variables include GDP, interest rates of Pakistan, institutional capacity, public-sector capacity, private-sector capacity and other factors involved in implementation of PPP programs in Pakistan. Under the PVAR framework, all the quantitative variables were treated as the dependent variable with sectors playing the role of the panel. The model is a long panel (where the time period is larger than the physical infrastructure sectors). The physical infrastructure includes the power sector (total investment by both public and private sectors), telecommunications sector (total investment by both public and private sectors) and the transportation sector (total investment by both public and private sectors). However, the transport sector consists of roadways, railway, airports and seaports. The qualitative independent (explanatory) variables were collected through a questionnaire. As mentioned earlier, the qualitative explanatory variables were measured on a 5-point Likert scale (1=lowest and 5=highest order of preferences).

The collected data were tabulated and further checked for various basic statistical properties including the dependency of the qualitative data and stationarity of the quantitative variables. Once the data properties are satisfied, the model could be estimated within the multiple regression frameworks. In adopting a multiple regression model, care must be taken because our investment variable is different for different sectors. Consequently, the cross-correlation would provide useful information about cross-sectoral dependence in investment. Further, the mean investment for different sectors could be different. Therefore, the model in this study was built up within the panel vector autoregression framework allowing dynamics of investment and other quantitative independent variables. The next panel regression model is presented below.

Panel regression model

The panel regression that we use takes the following specific form:

$$\log_e INV_{it} = \mu + \alpha_i + \beta_1 \log_e GDP_t + \beta_2 \log_e IR_t + \beta_3 IC_{it} + \beta_4 PBC_{it} + \beta_5 PVC_{it} + \beta_6 OF_{1it} + \beta_7 OF_{2it} + \beta_8 OF_{3it} + \beta_9 OF_{4it} + e_{it} \quad (1)$$

Where

- i = Telecommunications, Power and Transport.
- INV_{it} (in $US millions) denote the total, public, and private investment in the $i\,th$ sector at time *t*.
- *IC*, *PBC* and *PVC* represent institutional capacity, public-sector capacity and private-sector capacity respectively.
- The parameter α_i is the effect of the $i\,th$ sector.
- μ is the intercept parameter.
- β_j ($j = 1,2.....9$) is the unknown coefficient associated with the respective variables.
- α_i is the *i th* panel specific effect
- e_{it} is the random error term with certain distributional assumptions.
- *OF* represent other factors.

Panel vector autoregression (PVAR)

The quantitative variables were all treated as endogenous and modelled as a PVAR model. The random effects PVAR model can be written as follows:

$$W_{it} = \theta_i + \sum_{j=1}^{p} \Gamma_i W_{it-j} + \varepsilon_{it}$$

$$W_{it} = \begin{pmatrix} Inv_{it} \\ GDP_{it} \\ ir_{it} \end{pmatrix} = \theta_i + \sum_{j=1}^{P} \Gamma_i(j) W_{it-j} + \varepsilon_{it} \qquad (2)$$

Where

W_{it} is a vector of all quantitative variables ($\log_e INV$, $\log_e GDP$, $\log_e IR$)' of the *i th* sector at time *t*

ε_{it} is the vector of errors.

Where $\theta_i + \varepsilon_{it}$ is treated as an error term consisting of two components: an individual specific component and the overall error component. It can also be treated as purely random for the case of random effects model.

Γ_i is the square matrix of parameters associated with the lags of the dependent vector of variables.

This model is extended to include the qualitative policy variables as follows.

$$W_{it} = \theta_i + \sum_{j=1}^{p} \Gamma_i W_{it-j} + \Pi_{it} Z_{it} + \varepsilon_{it}$$

$$W_{it} = \begin{pmatrix} Inv_{it} \\ GDP_{it} \\ ir_{it} \end{pmatrix} = \theta_i + \sum_{j=1}^{P} \Gamma_i(j) W_{it-j} + \Pi_{it} Z_{it} + \varepsilon_{it} \qquad (3)$$

In this model, we combine the quantitative variables and the survey responses to articulate the effects of the variables (both quantitative and qualitative) in the infrastructural development of Pakistan. Model (3) generally is known as panel vector autoregression with exogenous variables denoted PVAR-X

Where

- Z_{it} is the vector of qualitative explanatory variables.
- Π_{it} is the matrix of parameters associated with Z_{it}.

The other variables and parameters are as defined above.

The estimation of the panel regression model (1) is carried out by using ordinary least squares (OLS), and generalised least squares (GLS). While model (2) and (3) are estimated using Generalised Method of Moment (GMM) estimation. The GMM estimation encompasses

OLS, two-stage least squares, (2SLS), and instrumental variable (IV). The GMM has an advantage in that it produces consistent and asymptotically normally distributed estimates. These properties are useful for developing the statistical tests of our research hypotheses.

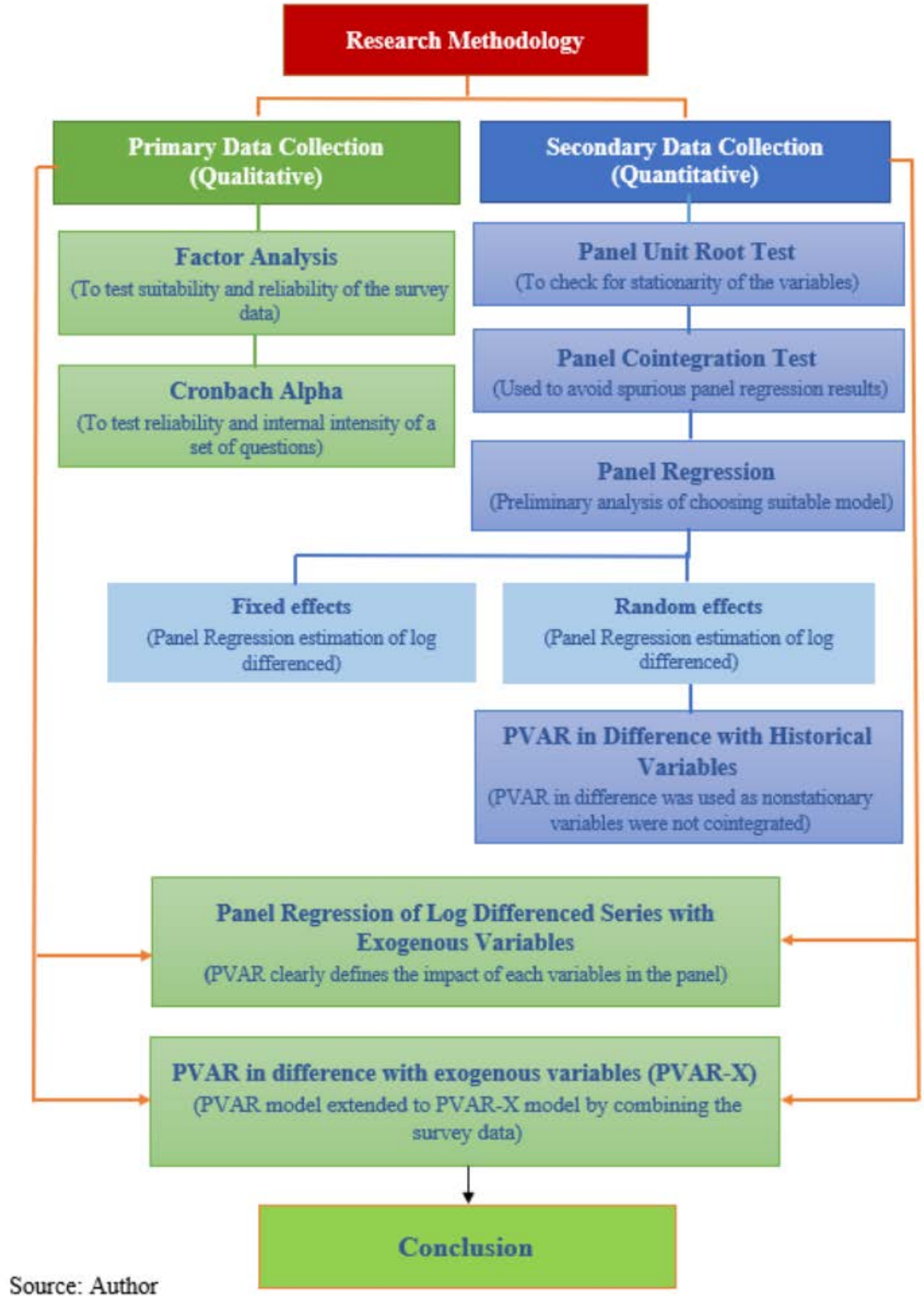
The post-estimation analysis was performed to check (i) theory consistency, (ii) statistical significance, (iii) model adequacy and (iv) goodness-of-fit tests. Hausman (1978) & Breusch-Pagan (1980) tests for model selection (between fixed effects and random effects models) were also conducted, and a Lagrange multiplier (LM) test for serial correlation. Once the model satisfied most of the model selection criteria, the model was then used for testing the research hypotheses and reporting the empirical results. The research problems were restated in terms of statistical hypotheses and tested within the classical testing framework (e g. t, F, χ^2, LR, LM, Wald testing approaches.)

The PVAR and PVAR-X models are estimated using Abrigo and Love (2015) in STATA, while the panel regression is estimated using xtset code in STATA. The empirical modelling approaches and the results used to address the research questions are detailed in Chapter Six.

4.4 Estimation approaches

In this thesis, both quantitative and qualitative data have been used to address the research questions. For the qualitative data, factor analysis was used to test the suitability and reliability of the survey data. Cronbach alpha (α) was also used to measure the reliability and internal intensity of a set of questions which were asked in the survey questionnaire. As far as the historical panel data is concerned, a range of panel unit root tests were applied to check for stationarity of the variables under study. Once the variables were found first difference stationary then a panel cointegration test among the variables was used to avoid spurious panel regression results. It was found that the nonstationary variables were not cointegrated. Consequently, PVAR in difference was used, which is considered one of the key empirical tools in modern macroeconomics and appears to be an appropriate modelling strategy in this situation. The PVAR model was extended to the PVAR-X model by combining the survey data with time-series data to address the objective of this thesis. Model estimation techniques are described in the following section, whereas empirical results are presented in Chapter Six Section 6.2.

Figure 4.2: Flowchart of estimation approaches



Source: Author

4.4.1 Primary (qualitative) data collection

Testing of questionnaire quality

The quality of the qualitative data was tested by using popular methods such as factor analysis and the Cronbach alpha. The dimensionality of the survey data was dealt with by utilising factor analysis. However, Cronbach alpha (α) is used to measure the reliability and internal intensity of a set of questions asked in the survey questionnaire.

4.4.1.1 Factor analysis

The basic goal of factor analysis is to describe a set of observable random variables $\mathrm{X}_1, \mathrm{X}_2, ..., \mathrm{X}_p$ in terms of a smaller number of unobserved factors $F_1, F_2, ..., F_m$ common to each variable X_i , $m < p$. Factor analysis is determined by interpreting the coefficients of the factor model, called "factor loadings" or simply "loadings." The common factor model can be expressed as:

$$\mathrm{X}_i = \sum_{j=1}^{m} a_{ij} F_j + \varepsilon_i \qquad (1)$$

- The unobservable random errors $\varepsilon_1, \varepsilon_2, ..., \varepsilon_p$ are assumed to satisfy the following:
- $E(\varepsilon_i) = 0,\ Cov(\varepsilon_i, \varepsilon_l) = \psi_{ii}\ \ (i = 1,2,....., p;\ l = 1,2,....., p)$. We further assume that $Cov(\varepsilon_i, F_j) = 0$ for all i and j and $Cov(F_j, F_k) = 0$, for $j \neq k$; $E(.)$ is the expectation of its argument.
- The coefficient a_{ij} is the $j-th$ factor loading for the $i-th$ observable variable.
- The total variance of X_i can be split up as

$$\mathrm{var}(\mathrm{X}_i) = \sigma_{ii} = \sum_{j=1}^{m} a_{ij}^2 + \psi_i = h_i^2 + \psi_i \qquad (2)$$

- Where $i-th$ communalities are $h_i^2 = \sum_{j=1}^{m} a_{ij}^2$, which is the variance common to all variables and ψ_i is the variance specific to X_i (called common variance) the ψ_i can be estimated using $\tilde{\psi}_i = 1 - \tilde{h}_i^2$. The loading has an important role in determining the proportion of variance of X_i that is explained by the factor F_j .

- The pairwise "partial correlation" between the variables after controlling for all other variables should be small compared to the original variables.

Sampling accuracy of the partial correlations can be measured by using Kaiser's Measure of Sampling Adequacy. The unobserved factors can be estimated using either by a principal factor analysis or maximum likelihood method. Factor analysis does not provide unique solutions by either of these methods. To overcome this problem, an orthogonal transformation of the factor loadings using VARIMAX rotation due to Kaiser (1958) can be utilised. The factors that explain the least amount of variance are generally discarded.

4.4.1.2 Cronbach alpha

The Cronbach alpha (α) is used as a measure of reliability and internal intensity of a set of questions in a survey instrument. The Cronbach alpha (α) is computed using the following formula:

$$\alpha = \frac{N}{N-1}\left(1 - \frac{\sum_{i=1}^{N}\sigma_i^2}{\sigma_X^2}\right)$$

Where N is the number of items in the scale, σ_i^2 is the variance of item i (i=1, 2,.., N), and σ_X^2 is the variance of the observed total test scores of the construct/factor. Traditionally a high value of $\alpha \geq 0.7$ implies a high internal consistency of the construct X.

4.4.2 Secondary data collection (Quantitative)

In addition to the survey data, we also used historical data including investment (both public and private), real GDP, and interest rates (10 years) in this thesis. These variables are transformed into natural logarithmic form. The logarithmic transformation of the series is useful first to handle the exponential growth of the series and secondly, to stabilise the variability of the economic series. This section discusses panel unit root tests, panel cointegration test, estimating panel regression, PVAR and panel vector auto regression combining with survey data (PVAR-X).

4.4.2.1 Panel unit root test

The time-series property of the data is conducted by panel unit root tests. The unit root nonstationarity of the variables within the panel framework is tested utilising the following panel unit root tests.

1. The Levin-Lin and Chu (LLC) test (2002)
2. The Im, Pesaran and Shin test (1997)
3. The Maddala and Wu test (1999) (Fisher-type test)
4. Hadri test (2000)

4.4.2.1.1 The Levin-Lin and Chu (LLC) test (2002)

The Levin-Lin-Chu (LLC) test can be seen as an extension of Dickey-Fuller / Augmented Dickey-Fuller test based on the following model

$$\Delta y_{it} = \alpha_i + \rho y_{i,t-1} + \sum_{l=1}^{p} \beta_l \Delta y_{i,t-l} + \delta_i t + \theta_t + \varepsilon_{it}$$ (This model allows for panel fixed effects, α_i, and time fixed effects, θ_t)

The null hypotheses of this test are against the alternative, $H_1 : \rho < 0$. The t-statistic of the test converges to Normal (0, 1) distribution in large samples.

4.4.2.1.2 The Im, Pesaran and Shin test (1997)

The Im-Pesaran-Shin (IPS) test is based on the mean of the individual unit root statistics of panel variables. The test uses a standardised t-bar statistic based on the following model.

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{l=1}^{p} \beta_l \Delta y_{i,t-l} + \delta_i t + \theta_t + \varepsilon_{it}$$

The null hypothesis is $H_0 : \rho_i = 0$ for all i against the alternative $H_1 : \rho_i < 0$ for at least one i.

The individual ADF t-statistics are used to form the test statistic $\bar{t} = \frac{1}{N} \sum_{i=1}^{N} t_{\rho_i}$, ($N$ is the number of panels).

The IPS statistic converges to a standard normal variate sequentially as $T \to \infty$ followed by $N \to \infty$.

4.4.2.1.3 The Maddala and Wu test (1999) (Fisher-type test)

The Maddala & Wu (MW) Test (Fisher-type test) is based on the p-value (π_i) of individual ADF t-statistics for testing the null hypothesis $H_0 : \rho_i = 0$ for all i against the alternative $H_1 : \rho_i < 0$ for some i by estimating the IPS ADF model as above. The test statistic is $\pi = -2\sum_{i=1}^{N} \ln \pi_i$. This statistic has a χ^2 - distribution with 2N degrees of freedom.

4.4.2.1.4 Hadri test (2000)

The Hadri test is similar in spirit to Kwiatkowski-Phillips-Schmidt-Shin regression-based null of stationarity versus the alternative of the non-stationary test. The Hadri test is based on the residuals obtained from the following.

$y_{it} = r_{it} + \varepsilon_{it}$ and $y_{it} = r_{it} + \beta_i t + \varepsilon_{it}$. Where $r_{it} = r_{it-1} + v_{it}$. After repeated substitution, it can be written $y_{it} = r_{it} + \beta_i t + \varepsilon_{it}$ as $y_{it} = r_{i0} + \beta_i t + \sum_{t=1}^{t} v_{it} + \varepsilon_{it}$ or, $y_{it} = r_{i0} + \beta_i t + e_{it}$, where $e_{it} = \sum_{t=1}^{t} v_{it} + \varepsilon_{it}$. It is assumed that ε_{it} are i.i.d, $E(\varepsilon_{it}) = 0$ and $E(\varepsilon_{it}^2) = \sigma_\varepsilon^2 > 0$. Further, $E(v_{it}) = 0$ and $E(v_{it}^2) = \sigma_v^2 \geq 0$. The stationarity hypothesis is simply $\sigma_v^2 = 0$. So, under the null hypothesis y_{it} is stationary around a level in model $y_{it} = r_{it} + \varepsilon_{it}$ and trend stationary in the model $y_{it} = r_{it} + \beta_i t + \varepsilon_{it}$.

If $\sigma_v^2 = 0$, then e_{it} is identical to ε_{it}. Whereas if $\sigma_v^2 \neq 0$ then e_{it} is nonstationary. So, the locally best invariant test and /or the LM test is to test the $H_0 : \lambda = 0$ against $H_1 : \lambda > 0$, where $\lambda = \frac{\sigma_v^2}{\sigma_\varepsilon^2}$.

4.4.2.2 Panel Cointegration test

Once the panel unit root tests have been performed and variables have been found to be stationary in first difference, one must test for cointegration to avoid spurious panel regression. The test for panel cointegration among the variables is conducted by utilising a Persyn & Westerlund (2008) Error-Correction based cointegration test for the panel data. Persyn & Westerlund have developed four tests: two are group mean tests (denoted Gt and Ga respectively) and the other two are panel tests (denoted pt and pa respectively). If the

nonstationary variables are not cointegrated, then PVAR in difference might be an appropriate modelling strategy.

In the panel VAR regression model our objective is to establish linkages between public and private partnerships in the context of Pakistan to: i) evaluate contributions of public and the private sectors to infrastructure development; ii) examine the causes of the lack of PPP undertakings; iii) identify a framework which helps establish essential institutional arrangements conducive to PPP adoption; and iv) draw implications for policy development to implement PPP in Pakistan effectively.

4.4.2.3 Panel regression

A common pooled panel data regression model may take the form: $y_{it} = \alpha + x_{it}\beta + \varepsilon_{it}$, where y is dependent and x is the independent variable, α and β are unknown parameters, the suffices i and t indicate individual and time index respectively. The error ε_{it} has an important role in the analysis of panel data. In fixed effects model ε_{it} is assumed to vary non-stochastically over *i* or *t* making the fixed effects model analogous to a dummy variable model in one dimension. In a random-effects model ε_{it} is assumed to vary stochastically over *i* or *t* requiring special treatment of the error variance matrix (Hsiao et al., 1999). The preliminary analysis of choosing between a random-effect model and a fixed-effect model was done by utilising a Hausman (1978) test and a Bruesch Pagan (1979) test and a random-effect model was retained. The theoretical development of panel data regression is presented in the next step.

In this study, three variables jointly were modelled, which can be expressed in VAR form. The Sims (1980) VAR is extended within panel VAR (PVAR) context as the data is panel data.

4.4.2.4 *PVAR*

The VAR appears to be a multivariate generalisation of univariate autoregressive models. Secondly, VAR turns out to be one of the key empirical tools in modern macroeconomics (Del Negro and Schorfheide, 2011). The VAR basically is used for two purposes i.e. macroeconomic forecasting and structural analysis. VAR often provides superior forecasting and sometimes elaborates theory based on simultaneous equation models.

In the classical univariate regression analysis of economic variables, the variables are classified into response (dependent) variables and explanatory (independent) variables to study

the linkages among economic variables. At the outset, however, when it is not clear which of the variables is/are to be treated as response and which to be treated as explanatory variables, Sims' (1980) modelling methodology is perhaps very promising. Sims' methodology treats all the underlying response variables as endogenous and is modelled within the multivariate autoregression framework. These models are widely known as vector autoregressive (VAR) models.

Basic VAR uses only time dimension of the data. While PVAR uses both time dimension and panel specific effects jointly. The PVAR also increases the degrees of freedom and treat the individual specific heterogeneity. PVAR is used as it clearly defines the impact of each variables in the panel. The VAR models are also used to investigate the short-run dynamics among economic variables under various shocks. In other words, VAR can be used to investigate the response to shocks. For example, what would happen to the prices and output if a demand shock hit? Another use of VAR is to analyse the sources of business cycle fluctuations or it can provide the benchmark against which modern dynamic macroeconomic theories can be evaluated. In short, with the statistically acceptable model, one can produce a forecast and structural VAR specification and estimation. In this context, one can analyse the impact of innovation through impulse response analysis and can also understand the forecast-error variance decompositions. One important aspect of VAR is the determination of VAR order. VAR order selection is usually undertaken by utilising the multivariate AIC, BIC, and Hannan & Quinn among other statistics.

The VAR model can easily be estimated by the OLS method. The OLS thus obtained are consistent and asymptotically efficient. The number of parameters in the VAR model increases as an increase in the variables and the lag order of the VAR.

There is an issue of whether the variables in a VAR need to be stationary. Sims (1980), Stock & Watson (1990) recommend against differencing even if the variables in a VAR contain a unit root. If the variables in a VAR are difference stationary and the variables are cointegrated, then VAR in difference is misspecified. In this situation, the appropriate modelling approach would be a vector error correction (VEC) model. In this case, the VEC Model is appropriate in explaining both the short-run and long-run dynamics of the data generating process.

A useful extension of VAR is the panel VAR (PVAR). This model combines the time-series and cross-sectional dimension. Panel gives more information on data, more variability among variables, more degrees of freedom and more efficiency. Both cross-sectional and time-

series units are considered jointly in this specification. The PVAR model is useful because it captures both static and dynamic interdependence among panel variables of interest. It incorporates time variations in coefficients and in the variance of the shocks. PVAR further accounts for cross-sectional dynamic heterogeneities. It allows for cross-sectional dependence among shocks and cross-sectional interactions in short-run dynamics.

The general form of the panel VAR model of order p can be written in the following form:

$$Y_{it} = A_1 Y_{it-1} + ...+ A_p Y_{it-p} + \eta_i + \varepsilon_{it} \qquad (1)$$

Where Y_{it} is a vector of dependent variables of interest, $A_j (j = 1,2,3....p)$ is a coefficient matrix, ε_{it} is a $(m \times 1)$ vector of the error term and η_i is a $(m \times 1)$ vector of panel variable specific effect (which can be fixed or random).

The roots of the determinantal equation (I_m - $\sum_{j=1}^{p} A_j z_j$) = 0 are assumed to lie outside the complex unit circle for stationarity of the time series of interest. Where I_m is a ($m \times m$) identity matrix.

We can rewrite (1) more compactly as:

$$Y_{it} = AX_{it} + \eta_i + \varepsilon_{it} \qquad (2)$$

Where $X_{it} = (Y'_{i,t-1}, Y'_{i,t-2}, ...Y'_{i,t-p})'$ is a $(mp \times 1)$ vector.

In this study, $Y_{it} = (\ln inv, \ln gdp, \ln ir)'$, the variables are in natural logarithm.

If the panel unit root tests of the previous section confirm that the variables ln*inv*, ln*gdp and* ln*ir* are first differenced stationary, i. e. if $Y_{it} \sim I(1)$, then $\Delta Y_{it} \sim I(0)$. Therefore, we can rewrite (1) or equivalently (2) in terms of differenced variable as.

$$\Delta Y_{it} = \Gamma_1 \Delta_{it-1} + ... + \Gamma_p \Delta_{it-p} + \eta_i + \varepsilon_{it}$$

Or equivalently

$$\Delta Y_{it} = A \Delta X_{it} + \eta_i + \varepsilon_{it} \qquad (3)$$

Where the notations are as described above. In this study, a simple PVAR (1) model is selected by the multivariate AIC criterion. The model 3 becomes:

$$\Delta Y_{it} = \Gamma_1 \Delta Y_{it-1} + \eta_i + \varepsilon_{it} \qquad (4)$$

Where Γ_1 is a (3x3) unknown matrix of coefficients to be estimated using the sample data. Since the variables are first differenced stationary, the variables (Y_{it}) were tested for

cointegration. Persyn and Westerlund (2008) test found no support of panel cointegration. Thus, the differenced series were used to analyse the linkages among the variables using (4). The tools employed by PVAR analysis are Granger-Causality, impulse response analysis and variance decomposition. These techniques are helpful in understanding the dynamic interrelationships among the economic variables in formulating of a more structured economic model.

The parameters of the model (4) can be estimated by using an equation-by-equation OLS method, see Abrigo and Love (2015). However, because of lagged dependent variables on the right-hand-side of the model (1), the OLS would be biased even with large N and T, see Nickell (1981). Following Abrigo and Love (2015), The generalised method of moment (GMM) estimators were used, which were consistent and asymptotically normal.

The STATA codes (see Abrigo and Love, 2015) are used for estimation and for testing the relevant hypotheses to serve the purpose of the thesis. The empirical results are provided in Section 6.2.

4.4.2.5 *Panel vector auto regression combining with survey data (PVAR-X)*

As mentioned earlier PVAR-X is an extended version of panel VAR model. PVAR-X may be extended to include extraneous variables. These variables can be based on survey data or on some other useful variables that are expected to provide more specific objectives of the research. Both the PVAR and PVAR-X models are used to address the research questions stated in Chapter One.

4.5 Data

In this study, both primary data and secondary data are used. The primary dataset was collected using a survey questionnaire (Appendices 5.1 and 5.2). The secondary dataset was collected for the period from 1991 to 2014, from various sources including the World Bank, DX-time data base and the Pakistan statistical year book. PPP was introduced in Pakistan in the early 1990s that is why the time period 1991 to 2014 is chosen. Major secondary data sources included:

- Investment in both the private sector and the public sector in physical infrastructure i.e. telecommunication, power and transport sector.
- GDP in real term based on the year 2010.

- The interest rate has been taken as a variable in the investment model instead of unemployment and inflation. Because there is an inverse relationship between the rate of unemployment and inflation. In other words, decreased unemployment (or increased levels of employment) in an economy correlates with higher rates of 10 years. An interest rate of 10 years maturity period was used. Further, Institutionalist and post-Keynesian theory adheres to Keynes and Kalecki in arguing that savings do not determine investment. Profit expectations, interest rates and the availability and the cost of finance are the important influences on investment – not the flow of savings (Chris, 2006). The quantitative variables are summarised in Table 4.1.

Table 4.1: Summary of quantitative variables for the period 1991-2014

Variable	Description	Data Source
Total investment (INV)	Total of public-sector investment and the private-sector investment in telecoms, power and transport sectors. Transport sector includes roadways, railways, air transport and seaports.	The World Bank database
Private investment (INV1)	Private-sector investment in telecoms, power and transport sectors.	The World Bank database
Public investment (INV2)	Public-sector investment and the private-sector investment in telecoms, power and transport sectors.	The World Bank database
GDP	GDP in real terms based on the year 2010.	The World Bank database
Interest rate (IR)	Interest rate of 10 years of maturity period	State Bank of Pakistan

Chapter Five: The Survey and Preliminary Results

This chapter presents the methodology used for the primary data (survey data) collection procedure and the development of the survey questionnaire and discusses limitations/problems in the survey data collection. Section 5.1 describes the design and administration of the survey questionnaire. Descriptive statistics and preliminary results are discussed in Section 5.2. Section 5.3 summarises the survey results.

5.1 The Survey

5.1.1 The questionnaire

A questionnaire was designed to examine the impact of private and public-sector capacity and institutional barriers to developing physical infrastructure including telecommunications, power and transportation (railways, roadways, airports and seaports) through PPP in Pakistan. Two questionnaires are shown in Appendix-III and Appendix-IV respectively. The public-sector survey questionnaire had 10 main question sections, with subsets of questions under several of the main sections. The private sector questionnaire had nine main question sections, with subsets of questions under several of the main sections. Most questions were measured by a Likert scale that ranged from 1-5 (1=lowest, 5=highest order of preferences)

Some questions required only a dichotomous "yes" or "no" answer. At the end of these questions, participants were offered the opportunity to provide additional comments, if any. Descriptions and objectives/justifications for each of the questions in the survey questionnaire are given below:

- Question 1. Personal information – sought personal information about the survey participants, such as their gender and age. This question investigated the experience and educational background of the participants and their employment profiles such as job title, qualifications and tenure in their current job.
- Question 2. Information of the organisation – sought organisational information about the main employer of the survey participants. The intention of this question was to elicit information about the work experience and the background of the organisation: the name and address of the organisation, date of inception, line/sector of the organisation and whether their organisation was involved in PPP projects.

- Question 3. Importance of infrastructure[39] – consists of two sub-questions:
  a. Infrastructure and the performance of your organisation – contained a subset of nine questions that sought to identify the perceived importance of infrastructure to the performance of the organisations; for example agreement or disagreement with statements such as better infrastructure helps organisations to reduce their operating costs, improves their labour and capital productivity, their service delivery and operational networks, increase their business opportunities, revenue and profitability.
  b. Infrastructure and the economic growth of Pakistan – contained a subset of six questions that evaluated how much infrastructure can help Pakistan to increase market size, public revenue, public capital stocks and productivity and to create employment opportunities and improves people's living standards.
- Question 4. Public- and private-sector capacity assessment – public-sector questionnaire contained a subset of five questions, while private-sector questionnaire contained a subset of four questions. The underlying principle of these questions was to determine whether the PPP model is being used effectively in Pakistan to proactively involve both sectors in infrastructure development. If it is not, the questions then enabled an understanding of why and the major obstacles? In other words, this information measured the readiness of both sectors to become involved in PPP projects at an operational/working level.
- Question 5. Institutional capacity assessment – public-sector questionnaire contained a subset of six questions, while the private-sector questionnnaire contained a subset of five questions. The rationale for this question was to identify how public institutional capacity influences public and private-sector infrastructure investment in Pakistan.
- Question 6. Availability of guidance materials[40] – contained a subset of threee questions. These questions were measured on a "Yes" or "No" basis. These questions confirmed that availability of PPP guidance material is essential to implement PPP

[39] Question 3 to 10 were evaluated on a Likert 5-point scale (1=lowest and 5=highest) except question 6 which was measured on a "Yes" or "No" basis.

[40] Question 6 was beyond the scope of this thesis and was not included in the analysis.

programs effectively. This question was beyond the scope of this thesis and was not included in the analysis.

- Question 7. Barriers to PPP program implementations in Pakistan – contained a subset of 25 questions. Theses questions identified whether governance-admin/rules and regulations, delays in PPP project execution, public and private-sectors participant PPP experience and qualification, and unrealistic feasibility study are barriers to PPP implementation in Pakistan.
- Question 8. What are the key factors that can drive successful PPP programs in Pakistan?[41] This question provided an opportunity to survey participants about key factors which can drive successful PPP programs in Pakistan. This was an open-ended question and beyond the scope of this thesis and was not included in the analysis.
- Question 9. Suggest changes in laws, regulations and administrative procedures required for successful implementation of PPP in Pakistan, if any[42]. This question provided an opportunity to survey participants to propose necessary changes in laws, regulations and administrative procedures for successful implementation of PPP in Pakistan. This was an open-ended question and beyond the scope of this thesis and was not included in the analysis.
- Question 10. Private-sector investment and the performance of your organisation – public-sector questionnaire contained a subset of 10 questions which were asked in relation to the public-sector organisations to investigate the perceived effects of private-sector investment on the performance of the public-sector organisations. For instance, agreement or disagreement with statements such as private investment helps public organisations to introduce modern technology to their operations, reduces their operating costs and increases their revenues, improves their labour and capital productivity, improves public amenity, service delivery and operational networks, brings forward public investment and creates job opportunities.

[41] Question 8 was beyond the scope of this thesis and was not included in the analysis.
[42] Question 9 was beyond the scope of this thesis and was not included in the analysis.

5.1.2 Administration of the survey

An information sheet (placed at Appendix-V) was attached to the survey questionnaire, explaining the objectives of the study and its relevant variables (as this thesis mainly focuses on PPP implementation and selected/investigated determinants of PPP implementation in Pakistan) and assuring respondents' confidentiality. The information sheet invited participants to take part in this study voluntarily. The information sheet also contained the researcher's contact details so that the respondents could send their questionnaire responses directly to the researcher or notify the researcher if they had any concerns or questions. To increase the response rate, an offer was made that, at the end of the study, a copy of the aggregated results would be provided to the survey participants if they desired. However, no one requested a copy of the aggregated results.

Initially, the researcher met with some of the proposed survey participants in November 2013 before sending them the survey questionnaire. This was the preferred approach for two main reasons. Firstly, it introduced respondents to the objectives of the research and allowed them to discuss the research topic to assess their response. Secondly, before finalising the survey questionnaire it was intended to incorporate their suggestions and perceptions of issues that obstruct attracting private-sector investment and impede implementation of PPP programs in Pakistan. These preliminary meetings with survey participants helped to modify and improve the questionnaire. Subsequently, the questionnaire was sent via email to the chief executive officers/top management of those industries which are involved in implementing PPP in Pakistan. These executives included infrastructure experts, sector consultants, investment companies, lenders, construction companies, engineering consulting companies, transaction advisory firms including chartered accountants and legal advisers. A survey questionnaire was also sent to the public sector stakeholders involved in infrastructure development in Pakistan, such as the telecommunications sector, power sector, road sector, railways sector, seaports, aviation, banking, public sector, PPP facilitating and coordinating organisations, and regulatory authorities of Pakistan.

In this study, care was taken in selecting the survey participants. Therefore, the survey questionnaires were sent/limited to those professionals, senior managers, directors and chief executive officers of public and private-sector organisations involved in infrastructure facility development and/or had an interest in PPP projects and had the professional commitments and expertise to assess the questions carefully before answering them. In total 149 survey

questionnaires were distributed. The survey was conducted from December 2013 to June 2014. In the beginning, the response rate was very low (below 7 percent) so reminders were sent to those who did not respond. Survey participants were also contacted via telephone and any queries were discussed, explained and answered. Participants were reassured that their responses were confidential. However, the response rate was not encouraging despite repeated reminders through telephone calls and emails. Consequently, the researcher organised in-person interviews with the survey participants on a visit to Pakistan in March 2014 to obtain completed survey questionnaires.

As a result, 67 (about 45percent) responses were received in total, of which 50 (75 percent) were obtained through in-person interviews, 10 (15 percent) via phone calls and seven (about 10 percent) by emails. The completed questionnaires received were from 11 industries including: telecommunications, power sector, transport (roadways, railways, seaports and aviation), legal adviser project financing, project finance and transaction advisory services, banking sector, investment companies, sector experts/principal facilitator and coordinator for PPP in Pakistan, engineering consulting firms, construction companies (roads, bridges, canals and buildings) and regulators, facilitator of the stock exchange. Finally, industries directly involved and most relevant to implementing PPP in Pakistan were selected from the 67 overall responses. Therefore, a short-list of 40 relevant questionnaires from three industries (telecommunications, power sector, transport) was selected for analysis. Responses from 27 participants were not included in the analysis as these were not directly involved in PPP and developing infrastructure facilities. This resulted in the small sample size of the analysed questionnaire. A flowchart of administration of survey questionnaire is provided in Figure 5.1.

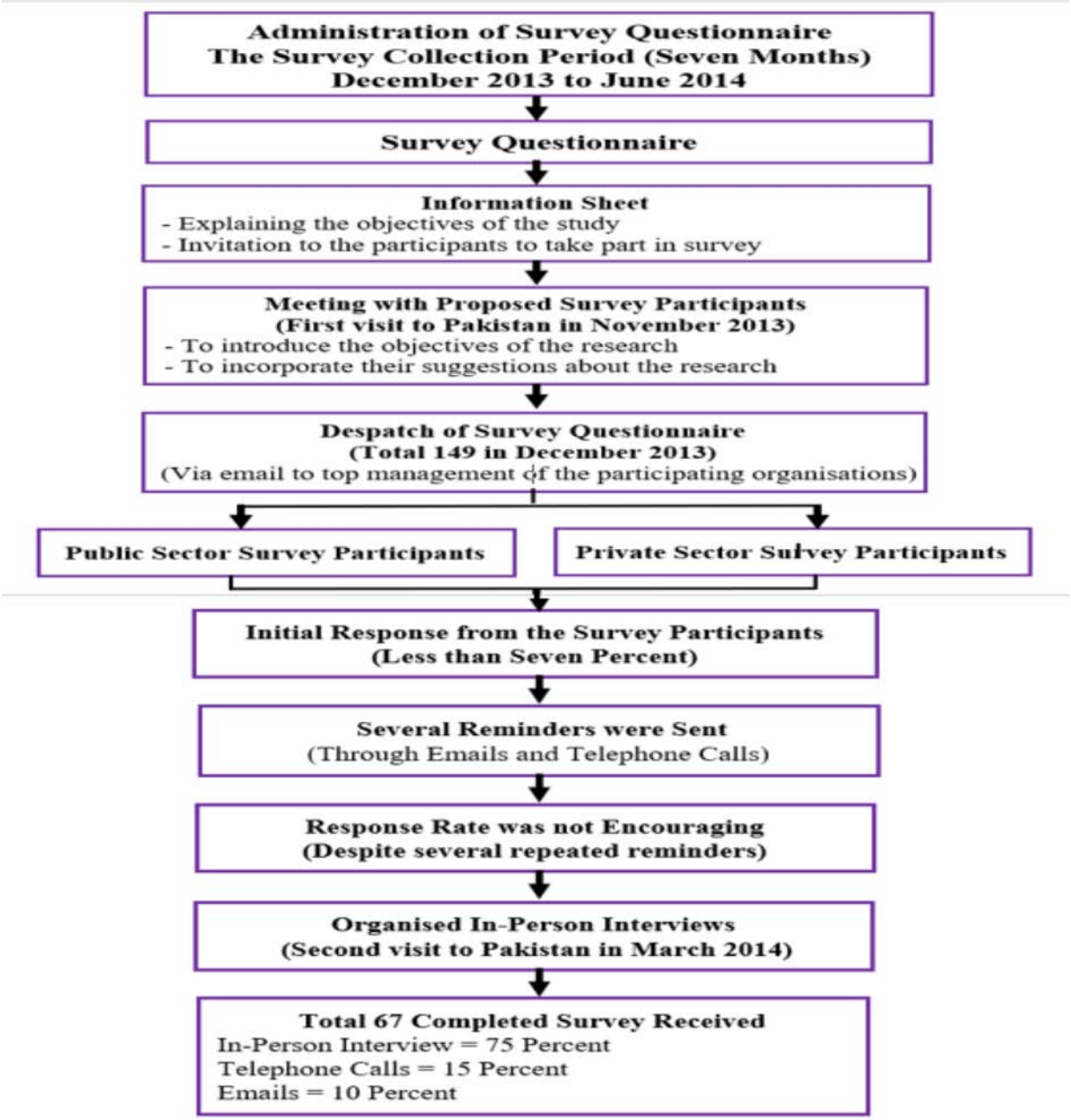
5.1.3 Challenges in the initial data collection

The data collection process had some limitations, which are discussed below:

- The main reason for a low response rate from survey participants was their lack of PPP awareness. Most people in Pakistan do not have a concept of PPP.
- The targeted participants were only public- and private-sector organisations directly involved in providing infrastructure services and engaged in infrastructure development in Pakistan. This means one questionnaire was sent to the head of each organisation.
- Survey participants were unwilling to participate.
- Participants did not have a research orientation due to limited exposure to research related activities.

- Participants had other priorities and work-related commitments or personal reasons leading to delay in response.
- Unavailability of streamlined organisational data.
- Some participants who did not respond to the questionnaire apparently feared that they might disclose information about their organisation and the researcher could draw conclusions about their organisations on the basis of their responses, although their confidentiality was guaranteed.

Figure 5.1: Administration of survey questionnaire



Source: Author

5.2 Descriptive statistics and preliminary results

This section presents descriptive analysis, description of the participants including gender, age group, qualification, work experience (years) and tenure in their current job. Sector-wide descriptive statistics of the survey participants in terms of frequency and percentage are presented in Table 5.1.

Table 5.1: Sector-wide detail of data collection

Sector	Frequency	Percentage %
Public	12	30
Private	28	70
Total	40	100

Source: Survey questionnaire

In this survey, 70 percent of respondents were from the private sector and 30 percent from the public sector. Industry-wide details of data collection shows that more than half the participants (55 percent) were from the transport sector. The transport sector consists of four sub-sectors: i) railways, ii) roadways, iii) airports, and iv) seaports. Participants in the survey from the power sector were the second largest in number (30 percent). At present, a number of private-sector investors are involved in the power sector. The smallest number of participants (15 percent) came from the telecommunications sector, because of the small number of private investors in that sector. Industry-wide details of the data collection are presented in Table 5.2.

Table 5.2: Industry-wide detail of data collection

Sector	Frequency	Percentage %
Telecommunication	6	15
Power	12	30
Transport	22	55
Total	40	100

Source: Survey questionnaire

5.2.1 Description of the survey participants (Question set 1 and 2)

Descriptive statistics for the demographics of survey participants comprising the profile of the participants are presented in terms of frequency and percentage in Table 5.3.

Table 5.3: Descriptive statistics of participants

Description	Frequency	Percentage %
Gender:		
Male	38	95.0
Female	2	5.0
Age group in years:		
≤ 30	1	2.5
31-40	4	10.0
41-50	13	32.5
≥ 51	22	55.0
Qualification:		
Intermediate	2	5.0
Graduate	8	20.0
Master	29	72.5
PhD	1	2.5
Work Experience (years):		
1-5	1	2.5
6-10	3	7.5
11-15	6	15.0
≥ 16	30	75.0
Tenure with the current job:		
1-5	4	10.0
6-10	5	12.5
11-15	9	22.5
≥ 16	22	55.0

Source: Survey questionnaire

Table 5.3 highlights the descriptive statistics of the survey participants who responded to this study. As mentioned earlier, to obtain authentic feedback and reliable data from survey participants, chief executive officers and the top position holders of the organisations were approached. Descriptive statistics for the demographics of survey participants indicates the following profile:

- Gender – because of the culture of the society, male participation was 95 percent, while female participation was 5 percent.
- Age group – the participants below or equal to 30 years were the smallest number (2.5 percent), participants aged between 31-40 years were the second smallest group (10 percent) and participants aged between 40-50 years were the second largest group (32.5 percent). In contrast, participants older than 51 years were the largest group (55 percent). As the targeted survey participants were the heads of organisations, 87.5 percent of participants were aged 40 or over.

- Qualifications – most participants held masters degrees (72.5 percent), some held graduation degrees (20 percent) and intermediate degrees (5 percent). Only 2.50 percent of participants held PhD degrees.
- Work experience – 75 percent of participants had work experience of 16 years or more, followed by those who had work experience of 11-15 years (15 percent). Participants had worked for 1-5 years were the lowest in number (2.5 percent).
- Tenure with current job – more than half of the survey participants (55 percent) had been working in the current job/organisation for 16 years or more while 22.5 percent of participants had worked in their current job/organisation from 11-15 years. In other words, 77.5 percent of survey participants had been working in their current job/organisation for 10 years or more. Participants who had worked for their current job/organisation from 1-5 years were the smallest group (10 percent).

5.2.2 The importance of infrastructure (Question set 3-A)

The purpose of the question about "importance of infrastructure" was to assess whether improved and better infrastructure could help organisations to reduce their costs, improves their productivities, business opportunities and increase their revenues, as well as helping Pakistan to achieve higher economic growth. The responses of the survey participants are interpreted on the basis of mean, median and mode. Each question was measured by their maturity level (from lowest level to highest level) on a Likert 5-point scale. The question comprised the following two sub-questions:

i. Infrastructure and performance of your [participant's] organisation. To attain detailed statistics about the impact of better and improved infrastructure on the organisations, the question had nine sub-questions. The industry-wide responses of the survey participants are presented in Table 5.4.
ii. Infrastructure and the economic growth of Pakistan. To evaluate the effects of better and improved infrastructure on the economy of Pakistan the question contained six sub-questions. The industry-wide responses of survey participants are shown in Table 5.5.

Table 5.4: Infrastructure and performance of your organisation

Description	Mean	Median	Mode	No. of respondents
Telecommunications sector				
1.1 Reduce operating costs	4.3	4.5	4	6
1.2 Bring forward investment	4.5	4.5	4	6
1.3 Improve capital productivity	4.3	4.5	5	6
1.4 Improve labour productivity	4.3	4.5	5	6
1.5 Increase revenue	4.0	4.0	3	6
1.6 Improve service delivery	4.5	4.5	4	6
1.7 Create business opportunities	4.5	4.5	4	6
1.8 Improve operational networks	4.3	4.5	5	6
1.9 Improve profitability	3.8	4.0	4	6
Power sector				
1.1 Reduce operating costs	4.3	5	5	12
1.2 Bring forward investment	4.4	5	5	12
1.3 Improve capital productivity	4.2	5	5	12
1.4 Improve labour productivity	4.2	5	5	12
1.5 Increase revenue	4.4	5	5	12
1.6 Improve service delivery	4.5	5	5	12
1.7 Create business opportunities	4.5	5	5	12
1.8 Improve operational networks	4.5	5	5	12
1.9 Improve profitability	4.2	5	5	12
Transport sector				
1.1 Reduce operating costs	4.6	5	5	22
1.2 Bring forward investment	4.8	5	5	22
1.3 Improve capital productivity	4.4	5	5	22
1.4 Improve labour productivity	4.5	4	5	22
1.5 Increase revenue	4.3	5	5	22
1.6 Improve service delivery	4.7	5	5	22
1.7 Create business opportunities	4.9	5	5	22
1.8 Improve operational networks	4.8	5	5	22
1.9 Improve profitability	4.2	4	4	22

Source: Survey questionnaire

The business statistics mean, median and mode of a dataset indicate the overall performance of a characteristic of the dataset. This survey deals with the qualitative nature of the statement that is measured on a (ordinal) Likert scale 1 to 5 (where 1 = lowest to 5 = highest value of response).

In this type of data, median is usually considered as a best measure of central location. The survey responses were collected and computed to find the mean[43], median and mode[44] of the data (Gail & Anthony, 2013).

[43] Where data are qualitative (no outliner) then mean is considered as a best measure of central location.
[44] Mode is considered as the best measure of central location where data is purely nominal.

For the telecommunications, power and transport sectors, the median response to each of the set of questions slightly varies from question to question which indicates each of the questions has a high median value that supports the need for infrastructure development in Pakistan. These results indicate that improvement in infrastructure increases investment, improves service delivery, operational networks and creates business opportunities in the telecommunications, power and transport sectors.

The results show that the survey participants believed that improved and better infrastructure could help their organisations to reduce costs, improve productivities, service delivery and operational networks, and increase business opportunities and revenues.

5.2.3 Infrastructure and the economic growth of Pakistan (Question set 3-B)

Industry-wide survey results on the question of whether infrastructure development has an impact on economic growth in Pakistan are presented in Table 5.5.

Table 5.5: Infrastructure and the economic growth of Pakistan

Description	Mean	Median	Mode	No. of respondents
Telecommunications sector				
1.1 Create employment opportunities	4.7	5.0	5	6
1.2 Increase public revenue	3.8	4.0	4	6
1.3 Increase market size	4.5	4.5	4	6
1.4 Increase public capital stocks	4.5	4.5	4	6
1.5 Increase productivity	4.5	4.5	5	6
1.6 Improve people's standard of living	4.2	4.0	4	6
Power sector				
1.1 Create employment opportunities	4.3	5	5	12
1.2 Increase public revenue	4.8	4	5	12
1.3 Increase market size	4.5	5	5	12
1.4 Increase public capital stocks	4.5	5	5	12
1.5 Increase productivity	4.3	5	5	12
1.6 Improve people's standard of living	4.3	5	5	12
Transport sector				
1.1 Create employment opportunities	4.7	5	5	22
1.2 Increase public revenue	3.7	3	3	22
1.3 Increase market size	4.4	5	5	22
1.4 Increase public capital stocks	4.9	5	5	22
1.5 Increase productivity	3.8	4	3	22
1.6 Improve people's standard of living	3.7	4	3	22

Source: Survey questionnaire

The median response to each of the set of questions for telecommunications, power and transport sectors varies slightly from question to question which indicates each of the questions

has a high median value. The high median value indicates that upgraded infrastructure has a positive impact on economic activities in Pakistan.

Preliminary results suggest that improved and better infrastructure creates employment opportunities, increases public revenue, market size, public capital stocks, productivity and improves people's living standards and contributes to achieve higher economic growth in Pakistan.

5.2.4 Private sector investment and the performance of public organisations

The question relating to the impact of private investment on the public sector organisations was asked to the public sector organisations only. Results of the survey participants' responses are presented in Table 5.6.

Table 5.6: Private sector investment and the performance of your (public) organisation

Description	Mean	Median	Mode
Telecommunications sector			
4.1 Introduce modern technology	5.0	5.0	5
4.2 Reduce operating costs	4.0	4.0	0
4.3 Increase revenue	4.5	4.5	0
4.4 Bring forward public investment	3.5	3.5	0
4.5 Create job opportunities	3.5	3.5	0
4.6 Improve capital productivity	3.5	3.5	0
4.7 Improve labour productivity	3.5	3.5	0
4.8 Improve public amenity	4.0	4.0	0
4.9 Improve service delivery	4.0	4.0	0
4.10 Improve operational networks	4.0	4.0	0
Power sector			
4.1 Introduce modern technology	4.3	4.0	4
4.2 Reduce operating costs	4.3	4.5	5
4.3 Increase revenue	4.0	4.0	4
4.4 Bring forward public investment	3.5	3.5	0
4.5 Create job opportunities	4.5	4.5	5
4.6 Improve capital productivity	4.0	4.0	4
4.7 Improve labour productivity	4.0	4.0	4
4.8 Improve public amenity	4.3	4.5	5
4.9 Improve service delivery	4.5	4.5	5
4.10 Improve operational networks	4.5	4.5	5
Transport sector			
4.1 Introduce modern technology	4.8	5	5
4.2 Reduce operating costs	2.8	3	3
4.3 Increase revenue	3.0	3	3
4.4 Bring forward public investment	3.2	3	3
4.5 Create job opportunities	4.7	5	5
4.6 Improve capital productivity	3.3	3	3
4.7 Improve labour productivity	3.3	3	3
4.8 Improve public amenity	4.8	5	5
4.9 Improve service delivery	4.7	5	5
4.10 Improve operational networks	4.8	5	5

Source: Survey questionnaire

The median response to each of the set of questions for telecommunications, power and transport sectors varies slightly from question to question which indicates each of the questions has a high median value. The high median value implies that private investment in infrastructure development has a positive impact on public telecommunications, power and transport sectors in Pakistan.

Preliminary results showed that private investment in telecommunications, power and transport sectors creates employment opportunities, introduces modern technology, improves public amenity, improves capital and labour productivities, crowds in public investment and service delivery and operational networks in power and transport industries.

5.2.5 Public sector capacity to manage PPP programs in Pakistan

The responses of the survey participants to questions about public sector capacity to manage PPP programs in Pakistan for the period 1991-2014 appear in Table 5.7 and in Figure 5.1. Results of the survey data are presented in Table 5.8. The survey responses were standardised to take care of variability in the responses for long time period survey.

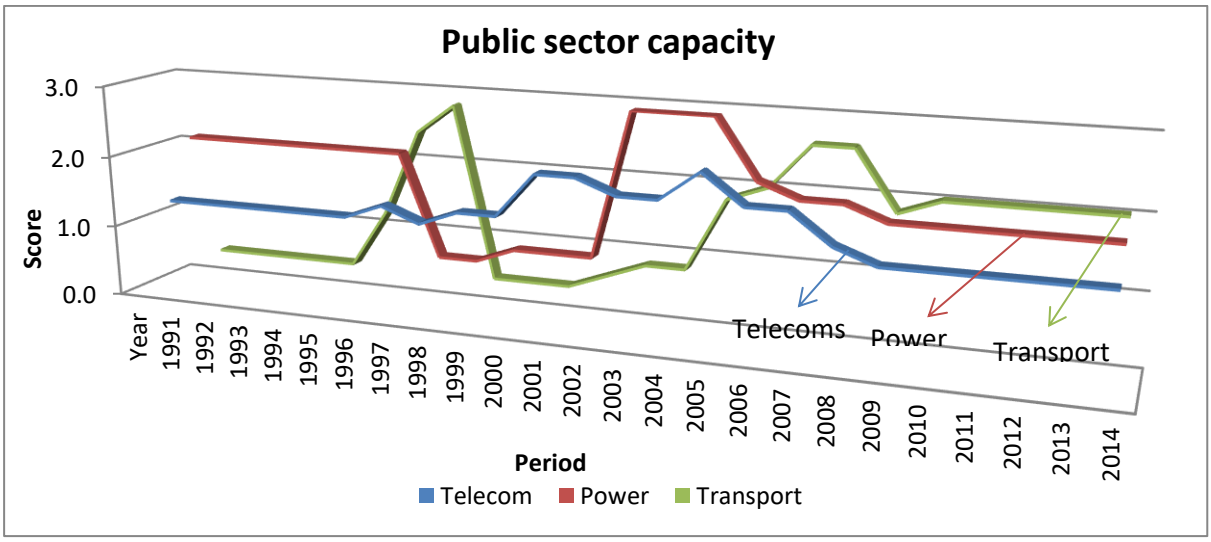
Table 5.7: Public sector capacity to manage PPP program in Pakistan

Year	Telecom	Power	Transport
1991	1.4	2.2	0.4
1992	1.4	2.2	0.4
1993	1.4	2.2	0.4
1994	1.4	2.2	0.4
1995	1.4	2.2	0.4
1996	1.4	2.2	1.2
1997	1.6	2.2	2.4
1998	1.4	0.8	2.8
1999	1.6	0.8	0.4
2000	1.6	1.0	0.4
2001	2.2	1.0	0.4
2002	2.2	1.0	0.6
2003	2.0	3.0	0.8
2004	2.0	3.0	0.8
2005	2.4	3.0	1.8
2006	2.0	2.2	2.0
2007	2.0	2.0	2.6
2008	1.6	2.0	2.6
2009	1.4	1.8	1.8
2010	1.4	1.8	2.0
2011	1.4	1.8	2.0
2012	1.4	1.8	2.0
2013	1.4	1.8	2.0
2014	1.4	1.8	2.0

Source: Survey questionnaire

The above table indicates yearly public-sector capacity of telecoms, power and transport sectors for managing PPP programs in Pakistan. The score is measured on a (ordinal) Likert scale 1 to 5 (where 1 = lowest to 5 = highest value of response).

Figure 5.2: Public sector capacity to manage PPP program in Pakistan



Source: Survey questionnaire

Figure 5.1 illustrates that there was high variation in public-sector capacity to manage PPP programs during 1996-2007. After 2008 the capacity level was steady but do not able to manage PPP program effectively. These results indicate that the top management of public telecommunications, power and transport sectors are aware of PPP benefits but do not have managerial, financial and monitoring capacity to implement a PPP program.

Table 5.8: Public sector capacity to manage PPP programs in Pakistan

Description	Mean	Median	Mode
Telecommunications	1.6	1.4	1.4
Power	1.9	2.0	2.2
Transport	1.4	1.5	0.4

Source: Survey questionnaire

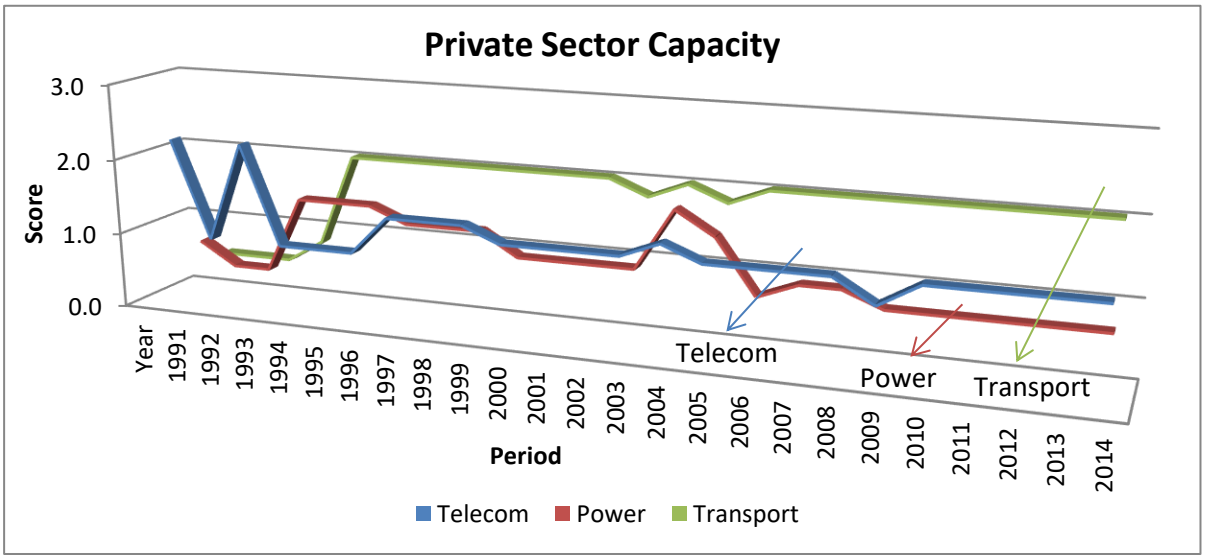
Results shown in Table 5.8 indicate that the chief executives of organisations in telecommunications, power and transport sectors are aware of PPP benefits but have limited expertise and PPP-related experience, and limited managerial and financial capacity to implement PPP projects, as well as no project monitoring mechanisms and support for PPP programs.

The results will be further confirmed by economic analysis in Chapter Six.

5.2.6 Private sector capacity to manage PPP programs in Pakistan

Results on the survey data are presented in Table 5.9. Responses of the survey participants on private sector capacity to manage PPP programs in Pakistan for the period 1991-2014 are shown in Table 5.10 and in Figure 5.2.

Figure 5.3: Public sector capacity to manage PPP programs in Pakistan



Source: Survey questionnaire

Table 5.9: Private sector capacity to manage PPP programs in Pakistan

Description	Mean	Median	Mode
Telecommunications	1.4	1.3	1.3
Power	1.0	1.0	0.8
Transport	1.7	2.0	2

Source: Survey questionnaire

Results shown in Table 5.10 indicate that between 1991 and 1994, the private telecommunications sector had reasonable managerial and financial skills and expertise and PPP-related experience to implement PPP. From 1995 until 2014 the sector showed a slight decline and variation in its capacity to manage PPP projects. The declining trend in private-sector capability is the result of political instability and inconsistency in public policy including investment policy. Figure 5.2 also illustrates the declining trend/variation.

Table 5.10: Private sector capacity to manage PPP programs in Pakistan

Year	Telecoms	Power	Transport
1991	2.3	0.8	0.5
1992	1.0	0.5	0.5
1993	2.3	0.5	0.5
1994	1.0	1.5	0.8
1995	1.0	1.5	2.0
1996	1.0	1.5	2.0
1997	1.5	1.3	2.0
1998	1.5	1.3	2.0
1999	1.5	1.3	2.0
2000	1.3	1.0	2.0
2001	1.3	1.0	2.0
2002	1.3	1.0	2.0
2003	1.3	1.0	1.8
2004	1.5	1.8	2.0
2005	1.3	1.5	1.8
2006	1.3	0.8	2.0
2007	1.3	1.0	2.0
2008	1.3	1.0	2.0
2009	1.0	0.8	2.0
2010	1.3	0.8	2.0
2011	1.3	0.8	2.0
2012	1.3	0.8	2.0
2013	1.3	0.8	2.0
2014	1.3	0.8	2.0

Source: Survey questionnaire

The above table indicates yearly private sector capacity of telecoms, power and transport sectors for managing PPP programs in Pakistan. The score is measured on a (ordinal) Likert scale ranges 1 to 5.

The private power sector did not have PPP-related expertise and experience and financial and managerial skills from 1991 to 1993. From 1994, the sector slightly developed its capacity but still did not have the financial capacity, the ability to identify project/sector related problems or the means to address them. However, it has limited managerial capacity.

The private transport sector did not have PPP experience, expertise or the financial and managerial capacity to operate and maintain PPP projects during 1991-1994. From 1995, the sector began to develop its expertise and managerial and financial skills to manage PPP programs. However, the private sector had neither the ability to identify the right project/ sector-

related problems nor an approach to address them, and no mechanisms to mitigate financial and project-related risk management.

The results are further confirmed using economic analysis in Chapter Six.

5.2.7 Sector-wide institutional capacity to manage PPP programs in Pakistan

Responses of the survey participants regarding sector-wide institutional capacity to manage PPP programs in Pakistan for the period 1991-2014 are shown in Table 5.11 and illustrated in Figure 5.3. Results of the survey data are presented in Table 5.12.

Table 5.11: Sector-wide institutional capacity to manage PPP programs in Pakistan

Year	Public sector	Private sector
1991	0.8	1.8
1992	0.8	2.0
1993	1.0	2.0
1994	1.0	1.5
1995	1.3	2.3
1996	2.0	2.3
1997	2.2	2.3
1998	2.2	2.7
1999	2.0	2.8
2000	2.0	2.8
2001	2.0	2.8
2002	2.2	2.8
2003	3.2	2.8
2004	3.2	3.2
2005	3.2	3.2
2006	3.2	3.3
2007	3.3	3.3
2008	3.3	3.3
2009	3.2	3.3
2010	3.2	3.3
2011	3.2	3.3
2012	3.2	3.3
2013	3.2	3.3
2014	3.2	3.3

Source: Survey questionnaire

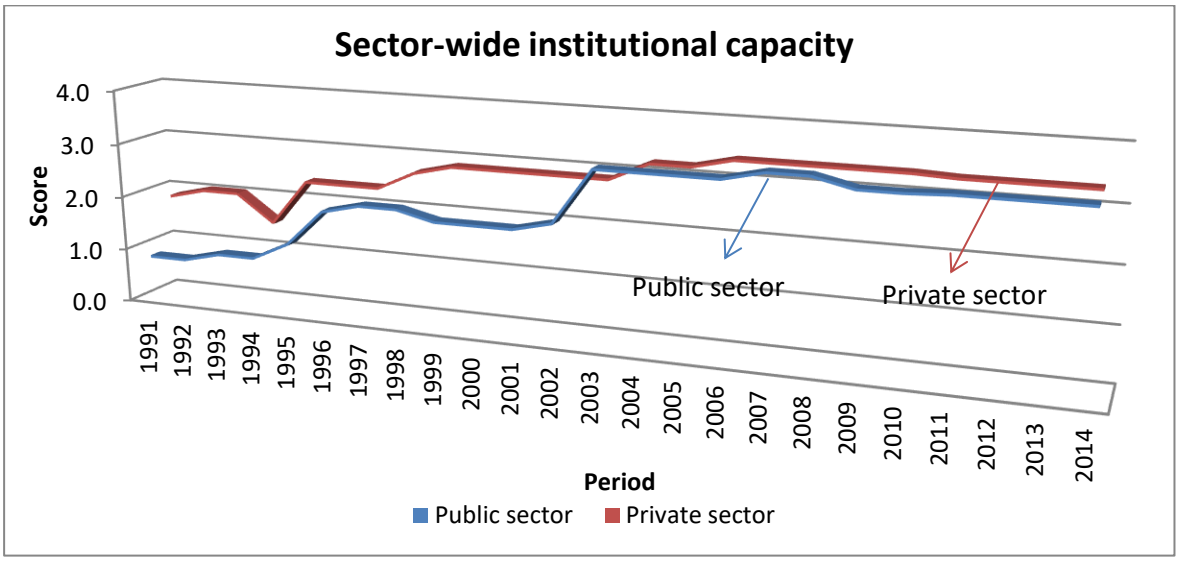
The above table indicates yearly institutional capacity of public and private sectors for managing PPP programs in Pakistan. The score is measured on an (ordinal) Likert scale ranges 1 to 5 (where 1 = lowest to 5 = highest value of response).

Table 5.12: Sector-wide institutional capacity to manage PPP programs in Pakistan

Description	Mean	Median	Mode
Public sector	2.4	2.7	3.2
Private sector	2.8	2.8	2.8

Source: Survey questionnaire

Figure 5.4: Sector-wide institutional capacity to manage PPP programs in Pakistan



Source: Survey questionnaire

The responses of survey participants regarding sector-wise institutional capacity to manage PPP programs in Pakistan indicate that in 1991 this capacity was at its lowest level. However, capacity increased gradually over time and was at its highest level in 2014. Responses of both sectors show that since 2000, institutions have been able to participate in transparent procurement bidding processes, are familiar with dispute-resolution mechanisms, and have opportunities for private-sector participation to develop infrastructure.

However, project monitoring systems at an institutional level are ineffective, their negotiation processes poor, their arbitration period lengthy and complex, their rules, regulations and procedures to involve the private sector in infrastructure development ambiguous, domestic capital markets develop too gradually and risk-hedging instruments are still not robust enough. In short, both public and the private sectors suggested that institutions did not have the capacity to implement successful PPP programs and needed improvements.

5.2.8 Industry-wide institutional capacity to manage PPP programs in Pakistan

The responses of the survey participants to the industry-wide (telecoms, power and transport) institutional capacity to manage PPP programs in Pakistan for the period 1991-2014 are shown in Table 5.13. Results of the survey data are presented in Table 5.14 and illustrated in Figure 5.4.

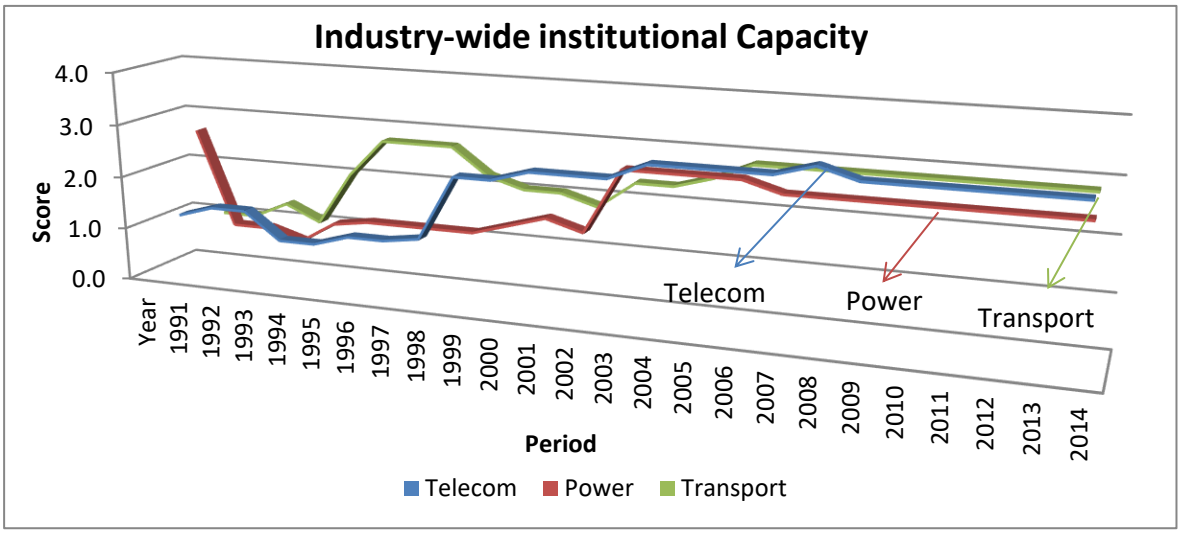
Table 5.13: Industry-wide institutional capacity to manage PPP programs in Pakistan

Year	Telecoms	Power	Transport
1991	1.3	2.8	1.0
1992	1.5	1.0	1.0
1993	1.5	1.0	1.3
1994	1.0	0.8	1.0
1995	1.0	1.2	2.0
1996	1.2	1.3	2.7
1997	1.2	1.3	2.7
1998	1.3	1.3	2.7
1999	2.5	1.3	2.2
2000	2.5	1.5	2.0
2001	2.7	1.7	2.0
2002	2.7	1.5	1.8
2003	2.7	2.7	2.3
2004	3.0	2.7	2.3
2005	3.0	2.7	2.5
2006	3.0	2.7	2.8
2007	3.0	2.5	2.8
2008	3.2	2.5	2.8
2009	3.0	2.5	2.8
2010	3.0	2.5	2.8
2011	3.0	2.5	2.8
2012	3.0	2.5	2.8
2013	3.0	2.5	2.8
2014	3.0	2.5	2.8

Source: Survey questionnaire

The above table indicates yearly institutional capacity of telecoms, power and transport sectors for managing PPP program in Pakistan. The score is measured on a (ordinal) Likert scale 1 to 5 (where 1 = lowest to 5 = highest value of response).

Figure 5.5: Industry-wide institutional capacity to manage PPP programs in Pakistan



Source: Survey questionnaire

Table 5.14: Industry-wide institutional capacity to manage PPP programs in Pakistan

Description	Mean	Median	Mode
Telecommunications	2.3	2.7	3
Power	2.0	2.5	2.5
Transport	2.3	2.6	2.8

Source: Survey questionnaire

The responses of survey participants regarding the industry-wide institutional capacity to manage PPP programs in Pakistan indicates that in the early 1990s telecommunication and transport industries had no PPP-related expertise, qualifications, experience or risk-mitigation capacity. Neither industries have managerial or financial capacity to develop PPP projects. During this period, the capacity of telecommunications and transport industry was at its lowest level. Due to a change in public policy, after 1994 transport industry, and after 1998 telecommunications industry, commenced developing their capacities gradually. During 2006-2014, the capacity of both industries was at its highest level. Telecommunications and the transport industry have reasonable expertise and PPP-related experience, risk mitigation capacity and reasonable managerial and financial capacity to manage PPP programs. However, neither industry has the mechanisms to mitigate project-related financial risks or the capacity to implement a successful PPP program.

In 1991, the capacity of the power industry was at its highest level, which means that the industry had reasonable expertise, risk mitigation and the managerial and financial capacity to manage PPP programs. In the early 1990s, public policy meant that the power industry

developed few projects with private-sector participation. However, the industry could not maintain its peak level of expertise and decreased to its lowest level during 1992-1995 due to political instability (dismissal of two political governments on grounds of corruption without completion of their tenure) and inconsistency of public policies. After 1996, the capacity of the industry began improving gradually. However, until 2014 the power industry did not have the capacity to implement a successful PPP program.

Preliminary results indicate that the telecommunications, power and transport industries do not have the capacity to manage PPP programs in Pakistan effectively.

5.2.9 Sector-wide availability of guidance materials

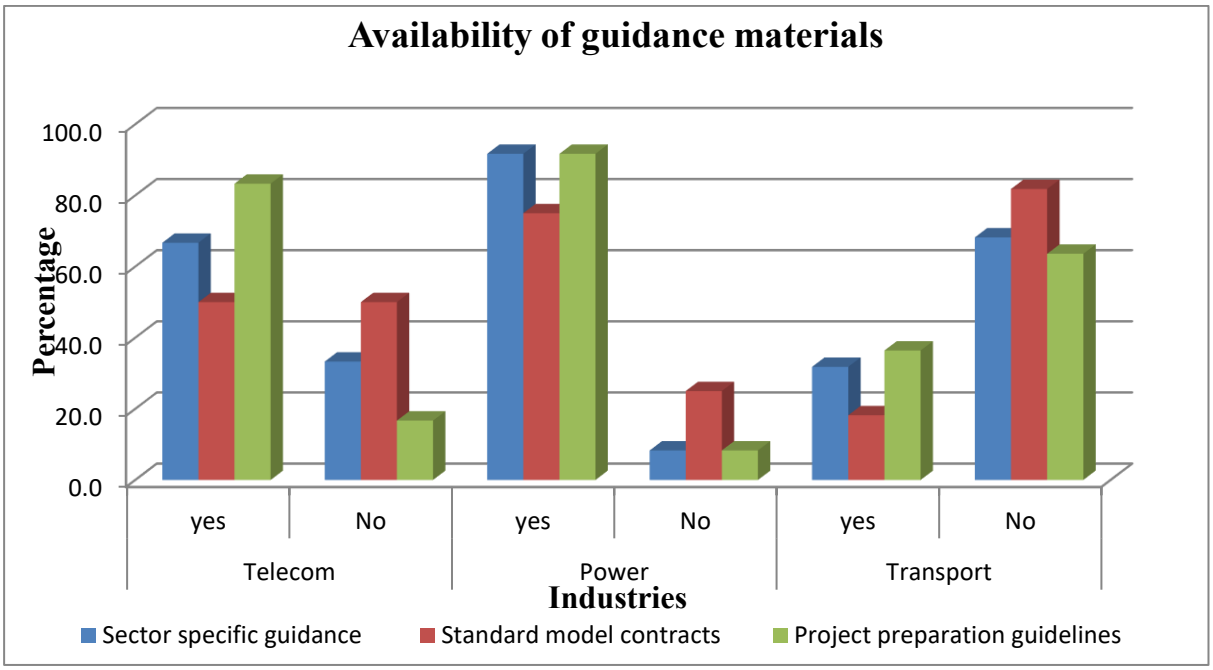
Results based on responses from the survey participants on sector-wide availability of PPP guidance material to implement PPP programs in the telecommunications, power and transort industries for the period 1991-2014 are presented in Table 5.15 and graphically presented in Figure 5.5.

Table 5.15: Industry-wide availability of guidance materials

	Telecoms		Power		Transport	
Description	Yes %	No %	Yes %	No %	Yes %	No %
PPP standard documents/ sector-specific guidance	66.7	33.3	91.7	8.3	31.8	68.2
PPP standard model contracts	50.0	50.0	75.0	25.0	18.2	81.8
PPP project preparation guidelines	83.3	16.7	91.7	8.3	36.4	63.6

Source: Survey questionnaire

Figure 5.6: Industry-wide availability of guidance materials



Source: Survey questionnaire

Results shown in Table 5.15 indicate that the majority of participants from the telecommunications and power industries agreed that PPP project preparation guidance material was available to them. However, well-defined PPP guidelines are needed to embrace the entire telecommunications and power industries. Conversely, responses from the majority of the survey participants from the transport industry indicate that sector specific guidance, PPP standard model contracts and PPP project preparation guidelines were not available. Guidance material was made available from time to time for specific projects but not for the entire transport industry. This situation may an obstacle to implementing PPP programs in the transport industry.

5.2.10 Barriers to PPP program implementations in the telecommunications industry

Responses of the survey participants on barriers to implementation of PPP program in the telecommunications industry for the period 1991-2014 are shown in Table 5.16 and graphically presented in Figure 5.6. Results of barriers to implementation of PPP programs in the telecommunications industry from an analysis of the survey data are presented in Table 5.17.

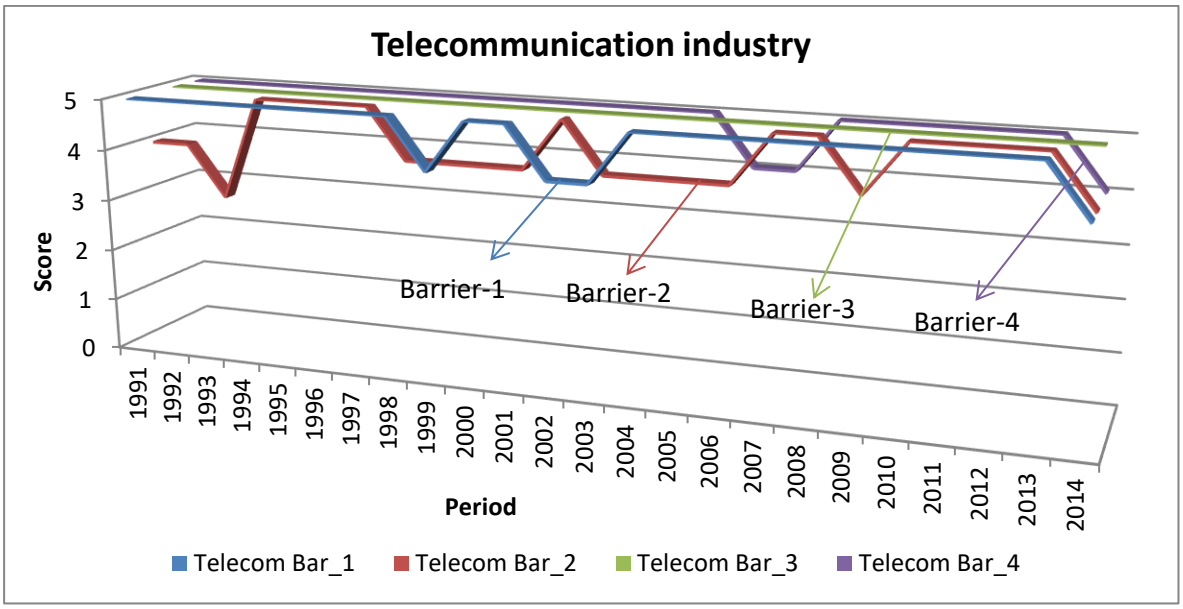
Table 5.16: Barriers to implementing PPP programs in the telecommunications industry

Telecommunications industry				
Year	Admin/Rules and Regulations	Delay in Project execution	Public & Private Sectors Experience and Qualification	Unrealistic Feasibility Study
1991	2.3	0.7	0.7	0.5
1992	2.2	0.7	0.7	0.3
1993	2.3	0.3	0.8	0.5
1994	1.8	1.0	0.3	0.5
1995	2.2	1.0	0.7	0.3
1996	2.5	1.0	0.7	0.7
1997	2.5	1.0	0.7	0.7
1998	2.0	0.3	0.7	0.7
1999	1.8	0.3	0.7	0.5
2000	2.5	1.0	0.7	0.8
2001	2.3	1.0	0.8	0.5
2002	1.8	1.0	0.3	0.7
2003	1.7	1.0	0.3	0.8
2004	1.7	0.3	0.7	0.7
2005	2.0	0.7	0.7	0.3
2006	2.2	0.3	0.8	0.5
2007	2.5	1.0	0.7	0.3
2008	2.5	1.0	0.7	0.3
2009	2.3	0.7	0.7	0.5
2010	2.5	1.3	0.7	0.5
2011	2.5	1.3	0.7	0.5
2012	2.5	1.3	0.7	0.5
2013	2.5	1.3	0.7	0.5
2014	2.5	1.3	0.7	0.5

Source: Survey questionnaire

The above table indicates yearly barriers in the telecoms sector for managing PPP programs in Pakistan. The score is measured on an (ordinal) Likert scale 1 to 5 (where 1 = lowest to 5 = highest value of response).

Figure 5.7: Barriers to implementing PPP programs in the telecommunications industry



Source: Survey questionnaire

Table 5.17: Barriers to implementing PPP program in telecommunications industry

Description	Mean	Median	Mode
Barrier-1: Admin/Rules & Regulations	4.8	5	5
Barrier-2: Delay in project execution	4.4	4	4
Barrier-3: Public and private sectors experience and qualification	5.0	5	5
Barrier-4: Unrealistic feasibility study	4.9	5	5

Source: Survey questionnaire

In the telecommunications industry barrier 1, administrative and rules and regulations barriers, was at its highest level during 1991-1997. There was variation/a slightly diminishing trend in barrier 1 during 1998-2004. The level of barrier 1 again rose to the highest level during 2003-2012. However, the trend finally turned down after 2012. Administrative formalities and rules and regulations are barriers to the implementation of PPP in the telecommunications industry.

Barrier 2, delays in project execution, was at its lowest level during 1991-1993. During 1994-1997 and 2009-2013 the barrier was at its highest level. There was variation/a slightly diminishing trend in barrier 2 during 1998-2008. The trend finally declined after 2013 but it remains an obstacle in PPP implementation in the telecommunications industry.

Barrier 3, public and private sector's experience and qualification, was at its highest level from 1991-2013 and was a barrier to implementing PPP programs. Barrier 4, unrealistic

feasibility study, was at its highest level during 1991-2004 to implement PPP programs. The barrier was at its lowest level during 2005-2008. The trend finally diminished after 2013 but unrealistic feasibility study is still a barrier to implement PPP programs in the telecommunication industry.

The scoring criteria mentioned in the questionnaire shown at Appendix – III and responses of the survey participants on barriers to implementation of PPP programs indicate that in the telecommunications industry barrier 1, "administrative and rules and regulations", was at its highest level during 1991-1997. There was a variation/slightly diminishing trend in barrier 1 during 1998-2004. The level of barrier 1 again rose to its highest level during 2003-2012. However, the trend finally turned down after 2012. Administrative formalities and rules and regulations are barriers in the implementation of PPP in the telecommunications industry.

Barrier 2, "delay in project execution", in response to privatisation policies of the government, was at its lowest level during 1991-1993. However, privatisation policy was not adopted effectively and during 1994-1997 and 2009-2013 the barrier was at its highest level. Again, during the change of government, there was a variation/slightly diminishing trend in barrier 2 during 1998-2008. The trend finally declined after 2013 but this barrier remains an obstacle in PPP implementation in the telecommunications industry.

Barrier 3, "public and private sectors' experience and qualification", was at its highest level from 1991-2013. Barrier 4, "unrealistic feasibility study", was at its highest level during 1991-2004. The barrier was at its lowest level during 2005-2008. The trend finally diminished after 2013, although this barrier remains an obstacle to the effective implementation of PPP programs in the telecommunications industry.

5.2.11 Barriers to PPP program implementations in the power industry

The responses of the survey participants on barriers to implementing PPP programs in the power industry for the period 1991-2014 are shown in Table 5.18 and graphically presented in Figure 5.7. Results of barriers to implementation of PPP programs in the power industry from an analysis of the survey data are presented in Table 5.19.

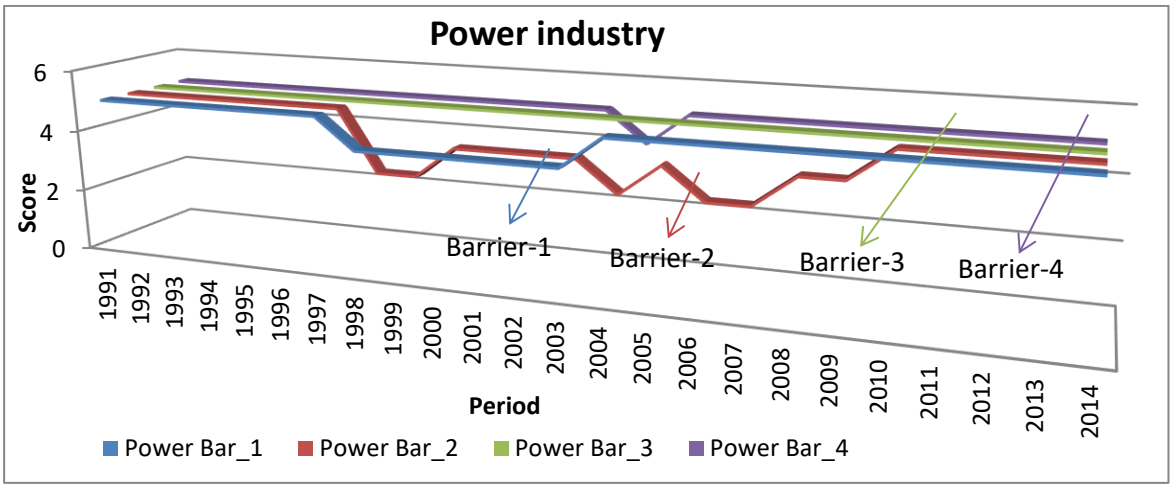
Table 5.18: Barriers to implementing PPP programs in the power industry

Power industry				
Year	Admin/Rules and Regulations	Delay in Project execution	Public & Private Sector's Experience and Qualification	Unrealistic Feasibility Study
1991	4.3	4.3	4.3	4.3
1992	4.1	4.0	3.8	3.8
1993	4.0	4.0	3.8	3.8
1994	4.3	4.3	4.3	4.3
1995	4.2	4.2	4.2	4.2
1996	4.3	4.3	4.3	4.3
1997	4.3	4.3	4.3	4.3
1998	3.4	2.5	3.8	4.3
1999	3.4	2.5	3.8	4.3
2000	3.5	2.6	3.8	4.3
2001	3.5	2.6	3.8	4.3
2002	3.5	2.6	3.8	4.3
2003	3.5	2.6	3.8	4.3
2004	3.6	2.5	3.9	3.7
2005	3.4	3.2	3.8	3.7
2006	3.8	3.0	4.0	3.8
2007	3.8	3.0	4.0	3.8
2008	4.0	3.6	4.3	4.3
2009	4.0	3.6	4.3	4.3
2010	4.3	4.3	4.3	4.3
2011	4.1	4.0	3.8	3.8
2012	4.0	4.0	3.8	3.8
2013	4.3	4.3	4.3	4.3
2014	4.2	4.2	4.2	4.2

Source: Survey questionnaire

The above table indicates yearly barriers in the power sector for managing PPP programs in Pakistan. The score is measured on an (ordinal) Likert scale 1 to 5 (where 1 = lowest to 5 = highest value of response).

Figure 5.8: Barriers to implementing PPP programs in the power industry



Source: Survey questionnaire

Table 5.19: Barriers to implementing PPP programs in the power industry

Description	Mean	Median	Mode
Barrier-1: Admin/Rules & Regulations	4.8	5	5
Barrier-2: Delay in project execution	4.3	4.5	5
Barrier-3: Public and private sectors experience and qualification	5.0	5	5
Barrier-4: Unrealistic feasibility study	5.0	5	5

Source: Survey questionnaire

Responses from survey participants on barriers to implementing PPP programs in the power industry indicate that barrier 1, "administrative and rules and regulations", was at its highest level in the power industry during 1991-1996. The barrier decreased to its lowest level during 1997-2004. The level again rose to its highest level after 2003. However, "administrative and rules and regulations" is a barrier to implementing successful PPP program in the power industry.

Barrier 2, "delay in project execution", was at its highest level during 1991-1997. During 1998-2010 the barrier was at its lowest level. There is a variation/slightly diminishing trend in barrier 2 during 1998-2008. However, after variation, the trend increased to its highest level after 2009 and remains a significant barrier to implementing a successful PPP program in the power industry.

Barrier 3, "public and private sector's experience and qualification", was at its highest level from 1991-2014. Barrier 4, "unrealistic feasibility study", was at its highest level during 1991-2003. The barrier was at its lowest level in 2004. However, the trend rose to its highest

level again after 2005 and "public and private sector's experience and qualification" is a barrier to implementing successful PPP programs in the power industry.

5.2.12 Barriers to PPP programs implementations in the transport industry

Responses of survey participants on barriers to implementation of PPP programs in the transport industry for the period 1991-2014 are shown in Table 5.20 and graphically presented in Figure 5.8. Results from analysis of the survey data are presented in Table 5.21.

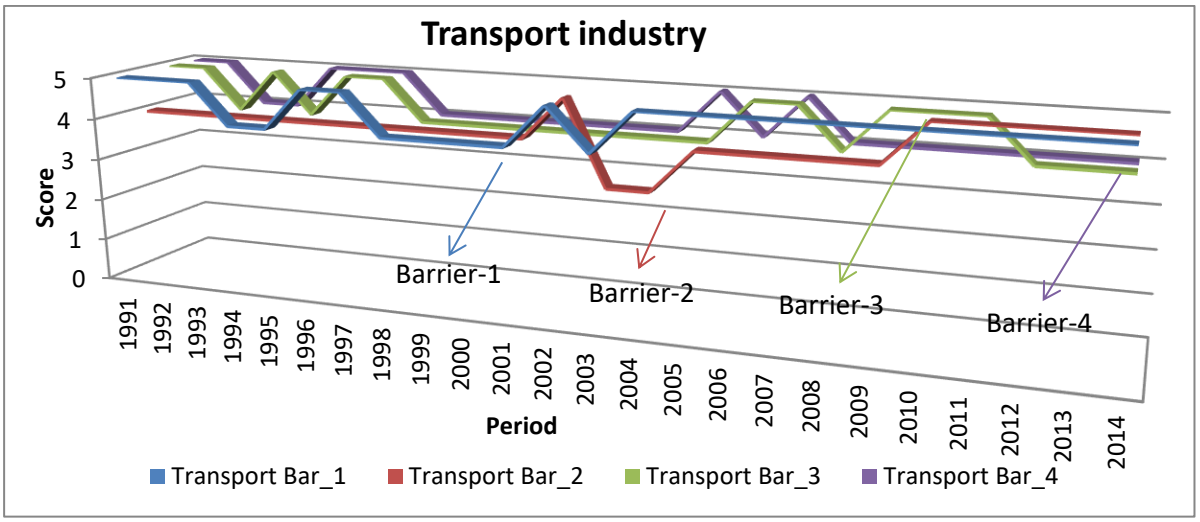
Table 5.20: Barriers to implementing PPP programs in the transport industry

	Transport industry			
Year	Admin/Rules and Regulations	Delay in Project execution	Public & Private Sector's Experience and Qualification	Unrealistic Feasibility Study
1991	4.3	4.3	4.3	4.3
1992	4.3	4.3	4.3	4.3
1993	4.1	3.8	3.6	3.6
1994	3.6	3.6	6.1	3.6
1995	3.5	3.5	3.5	3.9
1996	4.1	3.7	3.9	4.1
1997	4.1	3.7	3.9	4.1
1998	3.6	3.6	3.6	3.6
1999	3.6	3.6	3.6	3.6
2000	3.6	3.6	3.6	3.6
2001	3.6	3.6	3.6	3.6
2002	4.2	4.1	3.8	3.8
2003	3.2	2.8	2.9	3.2
2004	3.7	2.8	3.6	3.6
2005	4.3	3.6	3.6	4.3
2006	4.1	3.6	3.9	3.6
2007	4.0	3.5	3.8	4.0
2008	4.3	3.6	3.6	3.6
2009	4.3	3.6	4.3	3.6
2010	4.3	4.3	4.3	3.6
2011	4.3	4.3	4.3	4.3
2012	4.3	4.3	4.3	4.3
2013	4.3	4.3	4.3	4.3
2014	4.3	4.3	4.3	4.3

Source: Survey questionnaire

The above table indicates yearly barriers in the transport sector for managing PPP programs in Pakistan. The score is measured on an (ordinal) Likert scale 1 to 5 (where 1 = lowest to 5 = highest value of response).

Figure 5.9: Barriers to implementing PPP programs in the transport industry



Source: Survey questionnaire

Table 5.21: Barriers to implementing PPP programs in the transport industry

Description	Mean	Median	Mode
Barrier-1: Admin/Rules & Regulations	4.7	5	5
Barrier-2: Delay in project execution	4.2	4	4
Barrier-3: Public and private sector's experience and qualification	4.4	4	4
Barrier-4: Unrealistic feasibility study	4.3	4	4

Source: Survey questionnaire

Responses of survey participants on barriers to implementing PPP programs in the power industry indicate that barrier 1, "administrative and rules and regulations", was at its highest level during 1991-1992. The barrier decreased to its lowest level during 1993-1997. The level of barrier 1 increased to its highest level after 2003. "Administrative and rules and regulations" was a barrier to implementing a successful PPP program in the transport industry.

Barrier 2, "delay in project execution", was marginally low at the highest level during 1991-2001. The trend increased to the highest level in 2002. In 2003, the barrier was at its lowest level. After variation, the trend increased to its highest level after 2009. "Delay in project execution" was a barrier to implementing a successful PPP program in the transport industry.

Barrier 3, "public and private sector's experience and qualifications" was at its highest level during 1991-1992 and at its lowest level during 1993-2005. After variation during 2006-2011, the barrier turned down to its lowest level after 2012. Barrier 4, "unrealistic feasibility study" was at its highest level during 1991. The barrier was at its lowest level in 1998-2004. Following fluctuations during 2005-2008, the trend decreased to its lowest level after 2009 but

still, “unrealistic feasibility study” is a barrier to implementing successful PPP programs in the transport industry.

5.3 Summary of the survey results

The results of the survey questionnaire showed that in 1991 Pakistani institutions did not have the capacity to manage PPP programs but this capacity has been increasing since 1991 and was at its highest level in 2014. Several impediments still exist, such as ambiguous rules and regulations, poor negotiation process, and financial and economic factors being disregarded during the project procurement process. Dispute-resolution systems for PPP are undefined and arbitration and appeals processes are lengthy and complex. Therefore, the preliminary results suggest that institutional capacity is a barrier to implementing PPP programs in Pakistan and this influences infrastructure investment in the country.

In early 1990s, the private sector could not play a role in infrastructure development in Pakistan as it did not have PPP-related expertise, experience, financial or managerial skill. However, preliminary results suggest that after the mid-1990s, the private sector began to improve its expertise, managerial and financial skills to manage PPP programs. Nevertheless, the sector neither has the ability to identify the right project/sector-related problems nor an approach to address them. The sector also does not have mechanisms to mitigate financial and project-related risk management. In Pakistan, the private sector lacks the capacity to participate and manage PPP projects and has a barrier against taking part in public infrastructure development.

The preliminary results indicate that the top management of the public sector is aware of PPP benefits and the sector has an influence on PPP undertakings for infrastructure development, but the sector is unable to attract private-sector investment due to its lack of managerial, financial and monitoring capacity. The results also suggest that the public sector does not have the capacity to mitigate project-related risks.

The preliminary results conclude that institutions and the private and public sectors do not have the capacity to implement PPP programs effectively to develop infrastructure facilities in Pakistan. The results will be further confirmed by using econometric analysis in Chapter Six.

Chapter Six Empirical Results and Interpretation

This chapter provides a detailed analysis of the statistical properties of the qualitative and quantitative data used in this thesis. The chapter is organised as follows. Section 6.1 reports the test results based on an analysis for determining the quality of the questionnaire, particularly the suitability, reliability and internal consistency of the questionnaire by using factor analysis and the Cronbach alpha (α) criterion. Sector 6.2 provides data properties tested by applying panel unit root test and panel cointegration test among the variables. Section 6.3 presents empirical results and interpretation of the proposed estimated investment models (total investment, private investment and public investment). Section 6.4 presents empirical results and an interpretation of panel regression with exogenous variables which combine both qualitative and quantitative information (combination of both survey and historical data). Panel regression and panel regression with exogenous variables are estimated by using generalised least square (GLS) estimation technique. Section 6.5 reports estimation and interpretation of panel vector auto regression (PVAR) model. Section 6.6 provides estimation and interpretation of panel vector auto regression with exogenous variables (PVAR – X). PVAR and the PVAR – X were estimated by using generalised method of movement (GMM) estimation method. Hypotheses tests results for the research questions are presented in Section 6.7. The concluding remarks of the thesis and future research directions are highlighted in Chapter Seven.

6.1 Data analysis for quality test of the instrument

This section presents the internal consistency and reliability of the questionnaire by Cronbach alpha (α) and determination of the dimensionality of the variables issue resolved by using factor analysis. As mentioned in Chapter Four the qualitative variables are restated below:

IC = institutional capacity

PBC = public sector capacity

PVC = private sector capacity

OF1 = factor1 (admin/rules and regulations)

OF2 = factor2 (delay in project execution)

OF3 = factor3 (public and private sectors experience and qualification)

OF4 = factor4 (unrealistic feasibility study)

The variables (qualitative) descriptions of this thesis are provided in Chapter Four.

6.1.1 Factor analysis

The factor analysis is conducted by using STATA and retained the number of factors by using VARIMAX rotation. Factor analysis was conducted on each of the questions of the questionnaire of the survey. The results of factor analysis determined the dimensionality of the variables of the questionnaire. The results of the factor analysis along with the scree plot and reliability test using Cronbach alpha (α) criterion are presented in Table 6.1 and Figure 6.1 for the first question (X1):

X1: The importance of infrastructure

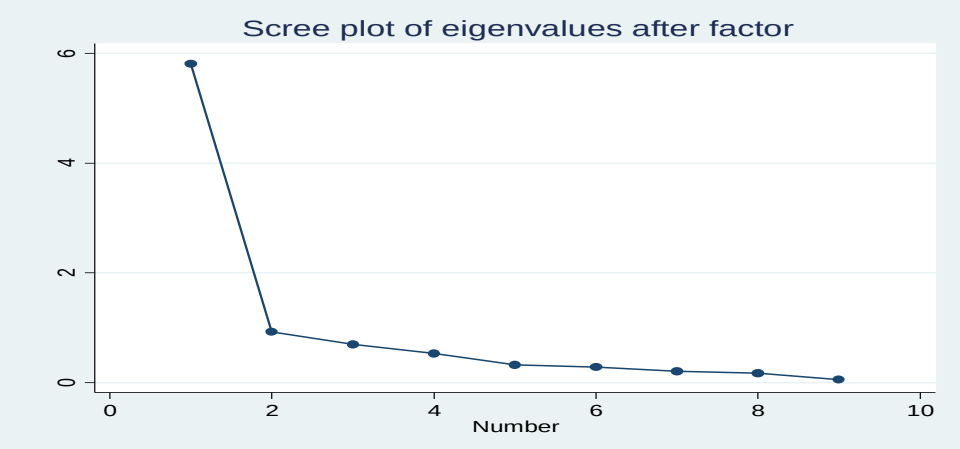
Table 6.1: Question X1 retains one factor

Variable	Factor 1
q11: Reduce operating costs	0.85
q12: Bring forward investment	0.87
q13: Improve capital productivity	0.89
q14: Improve labour productivity	0.86
q15: Increase revenue	0.81
q16: Improve service delivery	0.78
q17: Create business opportunities	0.58
q18: Improve operational networks	0.75
q19: Improve profitability	0.82

Reliability coefficient: alpha = 0.92

(Factor retained: eigenvalues > 1)

Figure 6.1: Scree plot of eigenvalues after factor



Factor loading

The factor loadings provide information on the correlation of the factors and each of the variables of the respective questions. There are nine (9) variables (sub-questions) in question

X1 (Table 6.2). The factor analysis indicates that one factor is sufficient to represent question X1. Similarly, the other tables provide the data reduction by factor analysis technique and internal consistency of the questionnaire by Cronbach Alpha. The results of the remaining questions (from X2 to X8) are detailed in Appendix – VI. Thus, the above results confirm that the Cronbach alpha and factor analysis effectively determines the reliability, internal consistency and data reduction.

6.1.2 Cronbach alpha

Internal consistency and reliability were checked by utilising the well-known Cronbach (α) criterion. The qualitative variables measured on ordinal scales were: (1) importance of infrastructure with nine items, (2) infrastructure and economic growth with six items, (3) Private sector investment and performance with 10 items, (4) public sector capacity with five items, (5) institutional capacity assessment with six items, (6) guidance material with three items, and (7) barrier to PPP implementation with 25 items. The value of α between 0.5 to 0.7 is deemed to be unreliable while a value of α >0.7 (or near to 1) is considered as an acceptable level for the internal consistency of the question items in the questionnaire (Cronbach, 1951; Sharma, 2016). The following Table 6.2 provides the Cronbach alpha (α) values.

Table 6.2: Cronbach α for checking internal consistency and reliability of the items in the questionnaire

Question	Criterion (α)
Importance of infrastructure	0.913
Infrastructure and economic growth in Pakistan	0.751
Private sector investment and performance	0.891
Public sector capacity	0.806
Private sector capacity	0.91
Institutional capacity assessment	0.897
Guidance material	0.986
Barrier to PPP implementation	0.893

The reliability of all questions in the survey questionnaire satisfies internal consistency of the items by Cronbach alpha criterion. The sample of 40 survey response was tested for quality, reliability and validity by Cronbach alpha (α) criterion. Cronbach alpha (α) finds no

inadequacy of the survey response. Factor analysis was also used to find common factors that linearly construct the original variables.

6.2 Quantitative data analysis

In this section, results are presented of tests to determine the statistical properties of the variables. The tests applied the panel unit root tests and panel cointegration tests.

6.2.1 Panel unit root tests

The variables needed to be tested for unit root prior to applying for panel VAR estimation. Consequently, each of the panel variables were tested for stationarity. Panel stationarity tests were used and these established the order of integration. In the process of testing non-stationarity, the four most popular tests were used namely, the Levine & Lin (LL) Test, Im-Pesaran & Shin (IPS) Test, Maddala & Wu Test (known as Fisher's test) and a Residual-based LM Test (Hadri). The first three tests tested the non-stationarity versus stationarity of the panel variables, while the last test tested for the stationarity versus non-stationarity of the panels.

Panel VAR regression is a popular approach to establish linkages between public and private partnership issues in the context of Pakistan to explore various policy issues for the development of infrastructure for economic and social development of Pakistan such as to:

i. evaluate contributions to infrastructure development by both the public and the private sectors;
ii. examine the causes of the lack of undertakings of PPP;
iii. develop a framework that helps to establish essential institutional arrangements conducive to PPP adoption; and
iv. draw implications for policy development for effective PPP implementation in Pakistan.

The panel unit root on each of the log-transformed series has been tested. The log series was used because the change in the log of a variable represents proportionate change. Secondly, logarithmic transformation reduces heterogeneity. The panel unit root tests results are presented in Appendix – VII.

Based on the test results, the variables ln*gdp*, ln*inv*, and ln*ir* are found to be first difference stationary by all of the previously mentioned panel unit root tests of section 6.1.2 (ii). A panel cointegration test can be used to model linkages between the level-nonstationary variables. If panel cointegration exits, then panel error-correction model (PECM) will be estimated.

6.2.2 Panel Cointegration test

The panel cointegration among the variables is tested by utilising a Persyn & Westerlund (2008) error-correction based panel cointegration test. Persyn & Westerlund have developed four cointegration tests. These tests do not impose any common factor restriction. The tests statistics are normally distributed. Two of the tests are two group mean tests (denoted Gt and Ga respectively) and the other two tests are called panel tests (denoted pt and pa respectively). The null and the alternative hypotheses are as follows:

Group tests:

H_0: no panel cointegration against

H_1: panel is cointegration

Panel tests:

H_0: no panel cointegration against

H_1: at least one unit of the panel is cointegrated

The test results are provided in the following tables.

Table 6.3: Panel cointegration tests of total investment (public and private)

Statistic	Value	Z – value	P – value
Gt	-2.329	-0.552	0.290
Ga	-3.284	-1.613	0.947
Pt	-3.194	-0.220	0.413
Pa	-2.013	1.193	0.884

Table 6.4: Panel cointegration tests of private investment

Statistic	Value	Z – value	P – value
Gt	-1.905	0.244	0.596
Ga	-9.263	-0.038	0.485
Pt	-3.273	-0.296	0.383
Pa	-6.333	-0.145	0.442

Table 6.5: Panel cointegration tests of public investment

Statistic	Value	Z – value	P – value
Gt	-2.379	-0.646	0.259
Ga	-1.704	2.049	0.980
Pt	-1.527	1.395	0.919
Pa	-1.244	1.431	0.924

The null hypothesis of no panel cointegration was not rejected by the Persyn & Westerland tests (p-value > 0.05 in all cases). Therefore, the panel variables are not cointegrated. In this situation, panel error correction does not apply. Since the first difference of the panel variables are stationary and the nonstationary variables are not cointegrated, the panel regression of each of the dependent variables in difference was estimated. The panel regression estimation is provided below.

6.3 Estimation of panel regression

For estimation of panel regression models both random effects and fixed effects are tested by utilising a Hausman test (1978).

$H_{0:}\ \beta_i Random - \beta_i Fixed\ = 0 \qquad (random\ effects)$

$H_{0:}\ \beta_i Random - \beta_i Fixed\ \neq 0 \qquad (fixed\ effects)$

The above hypothesis can be tested by the following test statistic

$$\chi^2 = (\hat{\beta}_{iRandom} - \hat{\beta}_{iFixed})'[Cov(\hat{\beta}_{iRandom} - \hat{\beta}_{iFixed})]^{-1}(\hat{\beta}_{iRandom} - \hat{\beta}_{iFixed})$$

$\hat{\beta}_i$ is the coefficient of the corresponding model parameter.

The test statistic has a χ^2distribution with K degree of freedom.

Hausman test results for random effects versus fixed effects model are provided in Table 6.6.

Table 6.6: Hausman test random effects versus fixed effects

Private investment (Inv1)	• $\chi^2(9) = 4.24$	(.895)
Public investment (Inv2)	• $\chi^2(9) = 0.65$	(.999)
Total investment (Inv)	• $\chi^2(9) = 8.68$	(.467)

Note: p-Value in parenthesis.

By the Hausman (1978) test $H_{0:}\ \beta_i Random - \beta_i Fixed\ = 0$ is not rejected. The random effects model is preferable by the Hausman test. Therefore, the model estimation and tests are based on random effects model.

6.3.1 Estimation of random effects panel regression of log differenced series

Log differenced series are used in the panel regression model because the panel log differenced series are found to be stationary by the panel unit root tests (see Section 6.3).

6.3.1.1 Random effects panel regression estimation of log differenced of total investment – The GLS estimation

$\Delta \ln(inv) = -0.00954 + 0.31403\, \Delta \ln(gdp) - 0.00828\, \Delta \ln(ir)$
p-value = (0.013) (0.000) (0.525)
n = 69
$\hat{\sigma}^2 = .01332,\ R^2 = 0.1621$
$\chi^2(2) = 12.77\ (0.0017)$
Note: Output of the model estimation is placed in Appendix – VIII.

The estimated coefficient of $\Delta \ln(gdp)$ is sign consistent with economic theory. The estimated coefficient of $\Delta \ln(ir)$ is found to be negative as expected. The GDP elasticity of investment is 0.314, which is statistically significant in the investment. In an economic sense, it indicates that a 1 per cent increase in GDP increases the investment by 0.32 percent approximately. The interest rate elasticity is economically significant (correct sign) but statistically insignificant. However, both the explanatory variables $\Delta \ln(gdp)$ and $\Delta \ln(ir)$ are jointly statistically significant at the 1 percent level by the Wald chi-square test as shown above. The coefficient of determination (R^2) indicates that only 16 percent of the total variation in investment is explained by the regressors. This is a quite low value of goodness-of-fit. However, the panel regression models usually show a small value of the coefficient of determination.

6.3.1.2 Random effects panel regression of log differenced of private investment – The GLS estimation

$\Delta \ln(invl) = -0.03180 + 1.16097\, \Delta \ln(gdp) - 0.03180\, \Delta \ln(ir)$
P-value = (0.189) (0.038) (0.956)
n = 69
$\hat{\sigma}^2 = .08449,\ R^2 = 0.\ 0626$
$\chi^2(2) = 4.40\ (0.1106)$
Note: Output of the model estimation is placed in Appendix – IX.

The estimated coefficient of $\Delta \ln(gdp)$ is sign consistent with economic theory[45]. The estimated coefficient of $\Delta \ln(ir)$ is found to be positive, which is inconsistent with economic theory and statistically insignificant[46]. The GDP elasticity of private investment is 1.161 which is statistically significant in the private investment model. In economic sense, it indicates that a 1 percent increase in GDP increases the private investment by 1.16 percent approximately. Private investment is GDP elastic. However, both the explanatory variables $\Delta \ln(gdp)$ and $\Delta \ln(ir)$ are jointly statistically insignificant by the Wald chi-square test (p-value <.01). The (R^2) indicates that only 6 percent of the total variation in private investment is explained by the regressors. This is a quite low value of goodness-of-fit. As stated above, the panel models usually show the small value of the coefficient of determination.

6.3.1.3 Random effects panel regression of log differenced of public investment – The GLS estimation

$\Delta \ln(inv2) = -0.00383 + 0.12966\, \Delta \ln(gdp) - 0.00816\, \Delta \ln(ir)$
P-value = (0.066) (0.007) (0.251)
n = 69
$\hat{\sigma}^2 = .00732$, $R^2 = 0.1084$
$\chi^2(2) = 8.02$ (0.0181)
Note: Output of data estimation is placed in Appendix – X.

The estimated coefficient of $\Delta \ln(gdp)$ is sign consistent with economic theory. The estimated coefficient of $\Delta \ln(ir)$ is found to be negative as expected (consistent with economic theory) but statistically insignificant. Generally, public decisions are taken by considering the social aspects of the projects rather than financial and economic aspects. Hence, public investment ignores the rate of interest when making investment decisions. Elasticity of the growth rate of public investment is 0.13 percent with respect to the growth rate of GDP, which

[45] It is economically meaningful and economic theory-based sign consistency. For example, GDP should be positively related to investment and interest rate is expected to have a negative impact on investment by the economic theory. It the theory consistency sign is not valid then the model /variables setup/measurement of variables could be doubtful. Therefore, the data should be changed logically.

[46] Statistical significance can be achieved by using statistically significant tests. Statistical significance applies when p-value is less than .01 or .05 or .10 depending on which level is chosen by the researcher.

is both statistically and economically significant in the public investment function. In economic sense, it indicates that a 1 percentage point increase in the GDP growth increases the public investment growth by 0.13 percent approximately. However, both the explanatory variables $\Delta \ln(gdp)$ and $\Delta \ln(ir)$ are jointly statistically insignificant by the Wald chi-square test (p-value <.01). The (R^2) indicates that only 11 percent approximately of the total variation in public investment explained the regressors. As mentioned earlier, in the panel regression model (R^2) is found to be low.

6.4 Estimation of panel regression with exogenous variables

6.4.1 Estimation of panel regression of log differenced series with exogenous variables

The above models are expanded to include the policy variables such as Institutional Capacity (IC), Public Sector Capacity (PBC), Private Sector Capacity (PVC), Other Factors (OF1, OF2, OF3 and OF4) and the model is estimated by GLS are provided below.

6.4.1.1 Random effects panel regression of log differenced series and exogenous variable total investment – The GLS estimation

$\Delta \ln(inv)$ = -0.043+0.354 $\Delta \ln(gdp)$ -0.006 $\Delta \ln(ir)$ +0 .003 IC-0.004 PBC+0.004 PVC+.0043 OF1-.002 OF2-.001OF3+.003 OF4
p-value = (0.004) (0.000) (0.648) (0.066) (0.066) (0.061) (0.029) (0.503) (0.843) (0.124)
n = 69
$\hat{\sigma}^2$ = .01239, R^2 = 0.3359
$\chi^2(2)$ = 29.853 (0.0005)

Note: Output of data estimation is placed in Appendix – XI.

The estimated coefficient of $\Delta \ln(gdp)$ is sign consistent with economic theory and also statistically significant in the private investment model. In economic sense, it indicates that a 1 percentage point increase in $\Delta \ln(gdp)$ increases the investment growth by 0.36 percent approximately. The estimated coefficient of IC, PVC, and OF4 are economically significant (sign consistent) but statistically insignificant. In an economic sense, it indicates that the movement of the variables such as IC, PVC and OF4 from a low level to high levels produces 0.3, 0.4, and 0.3 unit change in investment model respectively. The estimated coefficient of $\Delta \ln(ir)$ is found to be negative as expected. The interest rate has (correct sign) but statistically insignificant. The variables PBC, OF2, and OF3 are economically significant (negative sign) in

the total investment function but statistically insignificant. The variable OF1 and OF4 are economically significant (sign consistent) and also statistically significant at 10 percent level in the private investment. It implies OF1 and OF4 are the real barriers to total investment in PPP infrastructural investment. The (R^2) only explains 34 percent of the total variation in the private investment model due to nonlinearity of private investment model.

However, all explanatory variables $\Delta \ln(gdp)$, $\Delta \ln(ir)$, IC, PBC, PVC, OF1, OF2, OF3, and OF4 are jointly statistically significant by the Wald chi-square test (p-value < .01). Based on the test results the private investment model can adequately be used for infrastructural policy decision-making in the context of Pakistan.

Joint tests of quantitative variables including GDP, interest rate, and the qualitative (exogenous) variables namely IC, PVC, PBC and OF, OF2, OF3, OF4 are also performed for joint significance. The qualitative variables are split into two groups: i) qualitative variables including IC, PVC and PBC and ii). the other factors including OF1, OF2, OF3 and OF4.

Joint test for quantitative variables – total investment model

$\chi^2(2) = 16.16$

$p-\text{value} = 0.0003$

The quantitative variables ($\Delta \ln(gdp)$ and $\Delta \ln(ir)$) in the total infrastructure investment model are jointly statistically significant at the 5 percent level which implies that the quantitative variables do have joint impact on total infrastructure investment for PPP implementation in Pakistan.

Joint test for qualitative variables – total investment model

$\chi^2(3) = 11.34$

$p-\text{value} = 0.0100$

The joint effect of quantitative variables (IC, PVC and PBC) in the total infrastructure investment model is statistically significant at the 5 percent level which indicates that the quantitative variables do have joint impact on total infrastructure investment for PPP implementation in Pakistan.

Other factors – total investment

$\chi^2(4) = 8.10$

$p-\text{value} = 0.0878$

The joint effect of other factors (OF1, OF2, OF3 and OF4) is statistically significant at 10 percent level in the total infrastructure investment model. It implies that the other factors do have impact on total infrastructure investment for PPP implementation in Pakistan.

6.4.1.2 Random effects panel regression with log differenced series and exogenous variable private investment– The GLS estimation

$\Delta \ln(invl) = -0.219 + 1.394\,\Delta\ln(gdp) + .0176\,\Delta\ln(ir) + 0.013\ IC - 0.018\ PBC + .016\ PVC + 0.025\ OF1 - 0.005\ OF2 - 0.006\ OF3 - 0.006\ OF4$

P-value = (0.022) (0.016) (0.837) (0.195) (0.134) (0.176) (0.176) (0.674) (0.634) (0.052)

n = 69

$\hat{\sigma}^2 = .08131,\ R^2 = 0.2104$

$\chi^2(9) = 15.72\ (0.0729)$

Note: Output of data estimation is placed in Appendix – XII.

The estimated coefficient of $\Delta \ln(gdp)$ is sign consistent with economic theory and also statistically significant in the private investment model. In economic sense, it indicates that a 1 percentage point increase in $\Delta \ln(gdp)$ increases the private investment by 1.4 percent approximately. The estimated coefficient of $\Delta \ln(ir)$ is found to be positive, which is inconsistent with economic theory. It is reflected by the insignificant coefficient of the interest rate variable with a wrong sign. The variable is also statistically insignificant. The estimated coefficient of IC, PVC, are economically significant (sign consistent) but statistically insignificant. In economic sense, it indicates that the movement of the variables IC, and PVC from a low level to high levels produces 1.3, 1.6, and 2.1 unit change in investment respectively. The variables PBC, OF2 and OF3 are negatively economically significant in the private investment function but statistically insignificant. The variable OF1 and OF4 are economically significant (sign consistent) and also statistically significant at the 10 percent level in the private infrastructure investment model, implying OF1 and OF4 are real barriers to private investment for PPP infrastructure investment in Pakistan. The (R^2) indicates that only 21 percent of the total variation in private investment explained the regressors.

However, all explanatory variables $\Delta \ln(gdp)$, $\Delta \ln(ir)$, IC, PBC, PVC, OF1, OF2, OF3, and OF4 are jointly statistically significant by the Wald chi-square test (p-value<.01). Therefore, the model is overall adequate for PPP infrastructural private investment policy making.

Joint test for quantitative variables – private investment

$\chi^2(2) = 6.24$

$p - \text{value} = 0.0441$

The joint effect of quantitative variables is statistically significant at the 5 percent level in the private infrastructure investment model. It implies that the quantitative variables do have an impact on private infrastructure investment for PPP implementation in Pakistan

Joint test for qualitative variables – private investment

$\chi^2(3) = 6.23$

$p - \text{value} = 0.1010$

The joint effect of quantitative variables is statistically significant at marginally higher than the 10 percent level in the private infrastructure investment model. It implies that the quantitative variables do have impact on private infrastructure investment for PPP implementation in Pakistan.

Other factors – private investment

$\chi^2(4) = 7.89$

$p - \text{value} = 0.0958$

The joint effect of other factors is statistically significant at the 10 percent level in the private infrastructure investment model. It implies that the other factors do have impact on private infrastructure investment for PPP implementation in Pakistan.

6.4.1.3 Random effects panel regression with log differenced series and exogenous public investment– The GLS estimation

$\Delta \ln(inv2) =$ 0.008+0.1364 $\Delta \ln(gdp)$ -0.008 $\Delta \ln(ir)$ + .001 IC-.001 PBC+.002 PVC+.001OF1-.001OF2+.001OF3-.001OF4

P-value = (0.264) (0.009) (0.291) (0.608) (0.575) (0.21) (0.667) (0.711) (0.465) (0.535)

n = 69

$\hat{\sigma}^2 = .00749$, $R^2 = 0.1671$

$\chi^2(9) = 11.84$ (0.2226)

Note: Output of data estimation is placed in Appendix – XIII.

The estimated coefficient of $\Delta \ln(gdp)$ is sign consistent with economic theory and also statistically significant in the public sector investment growth model. In an economic sense, it indicates that a 1 percent increase in $\Delta \ln(gdp)$ increases the investment by 0.14 percent

approximately. The investment is inelastic. The estimated coefficient of IC, PVC, OF1, and OF3 are economically significant (sign consistent) but statistically insignificant. In an economic sense, it indicates that the movement of the variables such as IC, PVC, OF1 and OF3 from a low level to high levels produces 0.05, 0.2, 0.05- and 0.08- unit change in investment respectively. The estimated coefficient of $\Delta \ln(ir)$ is found to be negative as expected. The interest rate elasticity is economically significant (correct sign) but statistically insignificant. The variables PBC, OF2 and OF3 are negatively economically significant in the public investment function but statistically insignificant. The (R^2) indicates that only 17 percent of the total variation in public investment is explained by the regressors. This is a quite low value of goodness-of-fit. However, the panel models usually show the small value of the coefficient of determination. The results of this section provide information that the growth rate of GDP only significantly contributes to investment growth.

Joint test for quantitative variables – public investment

$\chi^2(2) = 7.17$

$p - \text{value} = 0.0277$

The joint effect of quantitative variables is statistically significant at the 5 percent level in the public infrastructure investment model. It implies that quantitative variables do have an impact on public infrastructure investment for PPP implementation in Pakistan

Joint test for qualitative variables – public investment

$\chi^2(3) = 2.44$

$p - \text{value} = 0.4857$

The joint effect of quantitative variables is statistically insignificant in the public infrastructure investment model. It implies that quantitative variables do not have an impact on public infrastructure investment for PPP implementation in Pakistan.

*Other factors – public investmen*t

$\chi^2(4) = 1.39$

$p - \text{value} = 0.8467$

The joint effect of other factors is statistically insignificant in the public infrastructure investment model. It implies that the other factors do not have an impact on public infrastructure investment for PPP implementation in Pakistan.

The panel regression approach was applied in the previous section. In the following section, all numerical variables are treated as endogenous variables and a PVAR modelling approach is applied to the same research questions of the thesis. In this form one can evaluate the proportion of the movement in one variable due to its "own" shocks versus shocks to other variable by using variance decomposition analysis. Further, the causality of the variables can be established by the Granger causality test.

6.5 Estimation of PVAR model

In the previous section panel regression was analysed for the investment functions. In this section a PVAR framework was considered for estimation of investment functions. In fact, two different modelling approaches are used for establishing a research hypothesis. The economic variables under study are meant to be interdependent and were modelled within the PVAR framework. The panel series were nonstationary of order one, and they are not cointegrated (Section 6.2.1.1 refers). The PVAR model was estimated as described below.

6.5.1 Estimation of PVAR in difference with historical variables

Prior to estimating the PVAR, the order of PVAR was determined by applying the multivariate Akaike Information Criterion (AIC) in STATA. This AIC selects PVAR of order one. The PVAR (1) was estimated by GMM estimation method.

6.5.1.1 Estimation of PVAR – with total investment as a variable in the list of variables

The estimated PVAR results (investment, GDP, and interest rate) are produced below.

Matrix equation – I

$$\begin{pmatrix} \widehat{\Delta\ln(inv_{it})} \\ \Delta\ln(gdp_{it}) \\ \Delta\ln(ir_{it}) \end{pmatrix} = \begin{pmatrix} 0.0652 & 0.2034 & -0.0263 \\ (0.52) & (1.89) & (-2.25) \\ 0.0877 & 0.4712 & -0.0354 \\ (0.50) & (2.22) & (-2.72) \\ 1.3005 & 0.9548 & 0.2798 \\ (1.33) & (2.02) & (3.42) \end{pmatrix} \begin{pmatrix} \Delta\ln(inv_{it-1}) \\ \Delta\ln(gdp_{it-1}) \\ \Delta\ln(ir_{it-1}) \end{pmatrix}$$

Note: The t-value is in parentheses.

The growth rate of the total investment is influenced by both the past growth rate of GDP (which is statistically significant at the 5 percent level by one-tail test) and past growth rate of interest rate (which is statistically significant at the 5 percent level) individually, implying GDP growth and interest rate growth are individually causally related to the growth rate of total investment. Further, bi-directional causality between GDP and interest rate exists. Given the p-value of the test, GDP and interest rate individually are causally related to total investment.

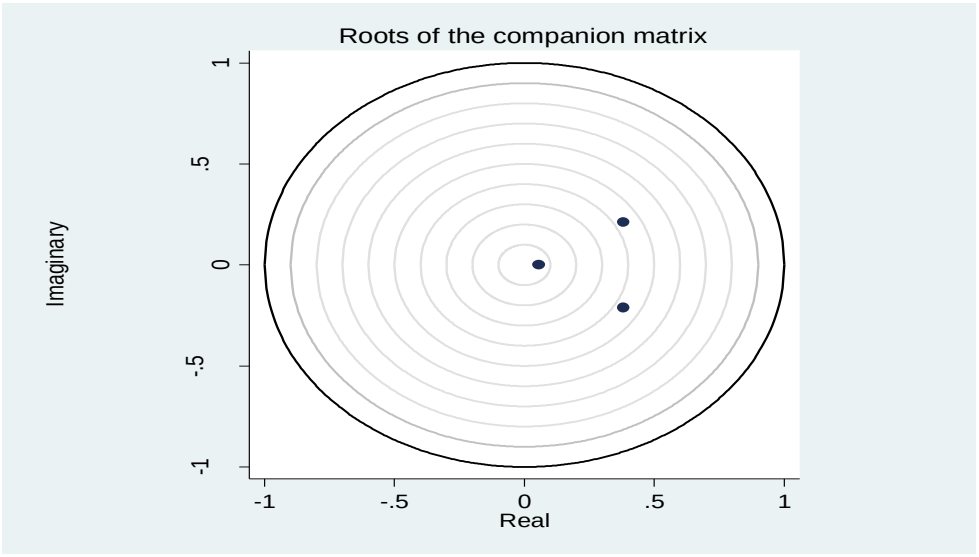
The test results indicate that GDP and interest rate have an impact on total investment in the context of Pakistan.

Parameter stability test of the PVAR model is provided below in Table 6.7.

Table 6.7: Eigenvalue for stability condition

Eigenvalue		
Real	Imaginary	Modulus
3807456	.2108542	.4352318
.3807456	-.2108542	.4352318
.0547988	0.00000	.0547988

Figure 6.2: Eigenvalue for stability condition



Since all the eigenvalues lie inside the unit circle, therefore the PVAR model satisfies the stability condition.

6.5.1.2 Estimation of PVAR– with private investment in the variable list

The estimated PVAR results (private investment, GDP, and interest rate) are produced below.

Matrix equation – II

$$\begin{pmatrix} \Delta\ln(inv1_{it}) \\ \Delta\ln(gdp_{it}) \\ \Delta\ln(ir_{it}) \end{pmatrix} = \begin{matrix} -0.0426 & 2.5055 & -0.0866 \\ (-0.30) & (2.90) & (-1.10) \\ -0.0009 & 0.6992 & -0.0363 \\ (0.06) & (3.80) & (-2.89) \\ -0.0577 & 1.5288 & 0.2674 \\ (-0.50) & (3.15) & (3.48) \end{matrix} \begin{pmatrix} \Delta\ln(inv1_{it-1}) \\ \Delta\ln(gdp_{it-1}) \\ \Delta\ln(ir_{it-1}) \end{pmatrix}$$

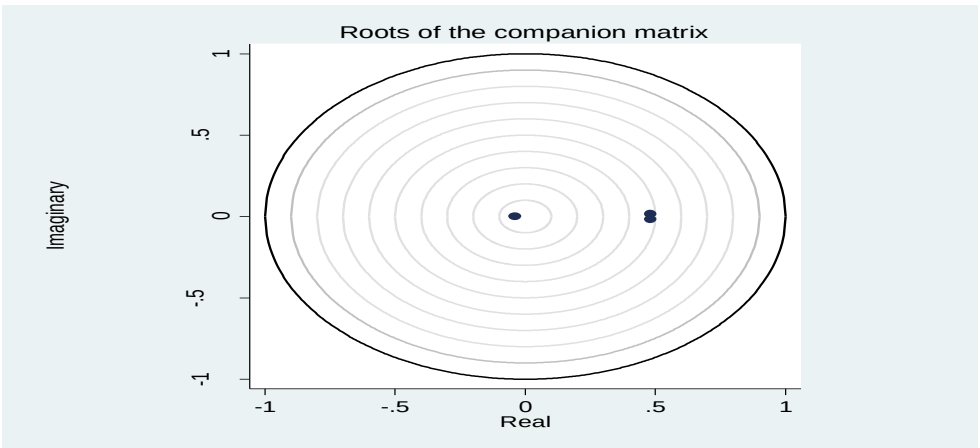
Note: The t-value is in parentheses.

The growth rate of private investment is influenced by both past growth rate of GDP (by one-sided t-test) implying there is causality running from GDP to private investment. There is no effect of growth rate of interest rate on private investment. However, bi-directional causality between GDP and interest rate exists. Given the p-value of the test GDP individually causally related to private investment, the test results indicate that GDP has an impact on private investment. Eigenvalue for stability condition is provided in Table 6.8 and Figure 6.3.

Table 6.8: Eigenvalue for stability condition

Eigenvalue		
Real	Imaginary	Modulus
.4820594	-.0166264	.482346
.4820594	.0166264	.482346
-.0401468	0.00000	.0401468

Figure 6.3: Eigenvalue for stability condition



All the eigenvalues lie inside the unit circle. Therefore, PVAR model satisfies the stability condition.

6.5.1.3 Estimation of PVAR– with public investment in the variable list

The estimated PVAR (1) is produced below.

Matrix equation – III

$$\begin{pmatrix} \Delta\ln(inv2_{it}) \\ \Delta\ln(gdp_{it}) \\ \Delta\ln(ir_{it}) \end{pmatrix} = \begin{pmatrix} 0.0952 & -0.1623 & -0.0095 \\ (0.76) & (-3.87) & (-1.46) \\ 0.8310 & 0.7013 & -0.0427 \\ (1.19) & (3.07) & (-2.\ 48) \\ 7.0538 & 0.8309 & 0.3310 \\ (3.10) & (1.48) & (3.78) \end{pmatrix} \begin{pmatrix} \Delta\ln(inv2_{it-1}) \\ \Delta\ln(gdp_{it-1}) \\ \Delta\ln(ir_{it-1}) \end{pmatrix}$$

Note: The t-value is in parentheses.

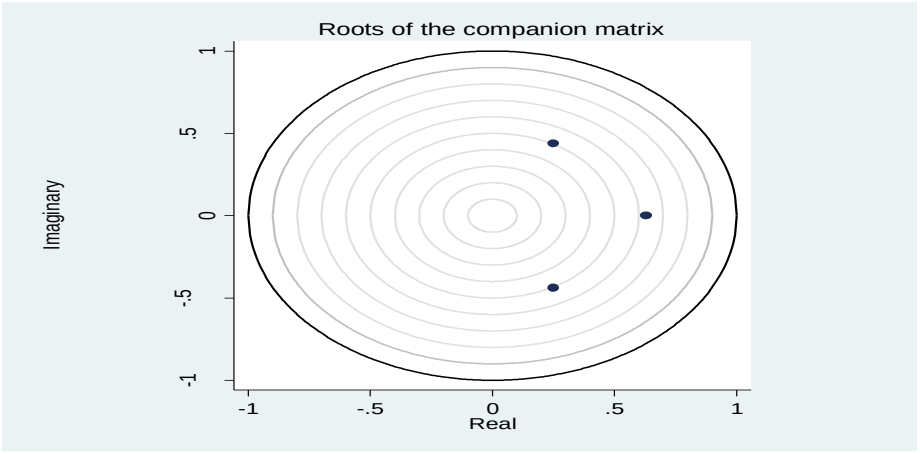
The growth rate of public investment is not influenced by both past growth rate of GDP and growth rate of interest rate (by one-sided t-test) implying there is no causality running from GDP to public investment. But GDP is influenced by the growth of interest rate. However, bi-directional causality between GDP and interest rate does not exist. Given the p-value of the test, GDP and interest rate individually are not causally related to public investment.

The test results indicate that GDP and interest rate do not have an impact on public investment. Eigenvalue for stability condition is provided in Table 6.9 and Figure 6.4.

Table 6.9: Eigenvalue for stability condition

Eigenvalue		
Real	Imaginary	Modulus
.6276696	0.00000	.6276696
.2499819	-.4383561	.5046256
.2499819	.4383561	.5046256

Figure 6.4: Eigenvalue for stability condition



All the eigenvalues lie inside the unit circle. Therefore, PVAR satisfies stability condition.

6.6 Estimation of PVAR in difference with exogenous variables (PVAR-X)

Estimation of PVAR – X is reported in this section.

6.6.1 Empirical results PVAR – X total investment

Table 6.10: Empirical results of PVAR – X (investment, GDP, and IR are the dependent variables list with exogenous variables) model estimated by GMM

	Coefficient	Standard error	z	P>|z|	[95% confidence interval]	
$\Delta\ln(inv)$						
$\Delta\ln(inv_{it-1})$	-.02430	.12662	-0.19	0.848	-.27247	.22387
$\Delta\ln(gdp_{it-1})$	.01827	.07865	0.23	0.816	-.13588	.17243
$\Delta\ln(ir_{it-1})$	-.02204	.01270	-1.73	0.083	-.04693	.00286
IC	.02008	.01163	1.73	0.084	-.00272	.04288
PBC	-.00147	.00148	-1.00	0.319	-.00437	.00142
PVC	-.00654	.00544	-1.20	0.229	-.01719	.00412
OF1	.01973	.00742	2.66	0.008	.00518	.03427
OF2	.00015	.00197	0.08	0.939	-.00371	.00401
OF3	.00207	.00153	1.36	0.174	-.00092	.00506
OF4	-.00264	.00154	-1.71	0.087	-.00565	.00038
$\Delta\ln(gdp)$						
$\Delta\ln(inv_{it-1})$	-.01116	.12482	-0.09	0.929	-.25581	.23348
$\Delta\ln(gdp_{it-1})$	.33967	.12118	2.80	0.005	.10217	.57716
$\Delta\ln(ir_{it-1})$	-.04994	.01984	-2.52	0.012	-.08883	-.01106
IC	.01899	.00701	2.71	0.007	.00527	.03272
PBC	.00045	.00219	0.21	0.837	-.00386	.00476
PVC	-.00439	.00423	-1.04	0.299	-.01268	.00389
OF1	.01921	.01027	1.87	0.061	-.00092	.03933
OF2	-.00266	.00367	-0.73	0.468	-.00985	.00453
OF3	.00015	.00194	0.08	0.937	-.00365	.00396
OF4	-.00231	.00211	-1.10	0.273	-.00645	.00183
$\Delta\ln(ir)$						
$\Delta\ln(inv_{it-1})$	.85227	.80082	1.06	0.287	-.71732	2.42189
$\Delta\ln(gdp_{it-1})$	1.79718	.58929	3.05	0.002	.64218	2.95218
$\Delta\ln(ir_{it-1})$	.13464	.08617	1.56	0.118	-.03424	.30352
IC	-.04519	.04463	-1.01	0.311	-.13266	.04227
PBC	-.01169	.00957	-1.22	0.222	-.03043	.00706
PVC	.05463	.02386	2.29	0.022	.00787	.10139
OF1	.04782	.06266	0.76	0.445	.07499	.17063
OF2	-.00685	.01609	-0.43	0.670	-.03838	.02468
OF3	7.62e-06	.01034	0.00	0.999	-.02025	.02027
OF4	.00924	.01174	0.79	0.431	-.01377	.03225

a. Total investment as dependent variable

The estimated coefficient of $\Delta\ln(inv_{it-1})$, PBC and PVC are statistically and economically insignificant (negative sign) in total investment function. In economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv_{it-1})$ decreases total investment by 0.66 percent and a one level increase in PBC and PVC from low to high level decreases investment by 2.43 percent and 0.14 percent respectively. The estimated coefficients of $\Delta\ln(gdp_{it-1})$, OF2 and OF3

are sign consistent with economic theory but statistically insignificant in the investment model. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(gdp_{it-1})$ increases total investment by 18.27 percent and a one level increase from low to high level in OF2 and OF3 increases total investment by 0.02 percent and 0.21 percent respectively. The results indicate that $\Delta\ln(inv_{it-1})$, PVC, OF2 and OF3 are inelastic. The estimated coefficient of $\Delta\ln(ir_{it-1})$ is found to be negative as expected. The variable $\Delta\ln(ir_{it-1})$ and IC are economically significant (sign consistent) and also statistically significant at 10 percent in the investment function. The variable OF1 is economically and statistically significant. OF4 is economically insignificant but statistically significant at 10 percent.

b. Real GDP as dependent variable

The estimated coefficient of $\Delta\ln(inv_{it-1})$, PVC, OF2 and OF4 are economically and statistically insignificant in total investment model. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv_{it-1})$ decreases $\Delta\ln(gdp)$ by 1.12 percent, and a one level increase from low to high level in PVC, OF2 and OF4 decreases $\Delta\ln(gdp)$ by 0.44 percent, 0.27 percent and 0.23 percent respectively. The estimated coefficients of $\Delta\ln(gdp_{it-1})$, IC and OF1 are economically and statistically significant in the total investment model. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(gdp_{it-1})$ increases GDP by 34 percent and one level increase in OF1 and IC from low to high increases GDP by 2 percent and 0.02 per cent respectively. PBC and OF3 are economically significant but statistically insignificant. The results indicate that IC, PVC, OF2 and OF4 are inelastic. The estimated coefficient of $\Delta\ln(ir_{it-1})$ is found to be negative as expected. The interest rate has corrected sign, which is economically and statistically significant.

c. Interest rate as dependent variable

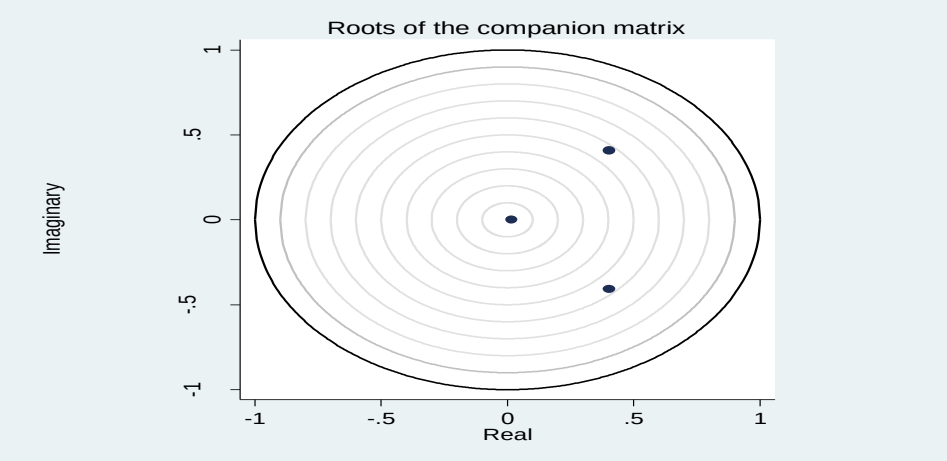
The estimated coefficient of $\Delta\ln(inv_{it-1})$, OF1, OF3 and OF4 are economically significant but statistically insignificant in the total investment model function. In economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv_{it-1})$ increases $\Delta\ln(ir)$ by 85.22 percent and one level increase from low to high level in OF1, OF3 and OF4 increases $\Delta\ln(ir_{it-1})$ by 4.78 percent, 762 percent and .924 percent respectively. The estimated coefficient of $\Delta\ln(gdp_{it-1})$ and PVC are economically and statistically significant. In economic sense, it indicates that a 1 percent increase in $\Delta\ln(gdp_{it-1})$ and a one level increase from low to high level in PVC increases the interest rate by 180 percent and 5.46 percent respectively. The

estimated coefficient of $\Delta\ln(ir_{it-1})$, IC and OF2 are found to be statistically and economically insignificant (not sign consistent). The variable PBC is economically insignificant but statistically significant. The results indicate that OF4 is inelastic. Based on the above test results the investment model can be used for infrastructural development policy decisions making in the context of Pakistan. Eigenvalue for stability condition is provided in Table 6.11 and Figure 6.5.

Table 6.11: Eigenvalue for stability condition

Eigenvalue		
Real	Imaginary	Modulus
.4028191	.4089433	.574019
.4028191	-.4089433	.574019
.0158212	0.000000	.0158212

Figure 6.5: Eigenvalue for stability condition



All the eigenvalues lie inside the unit circle. Therefore, PVAR satisfies stability condition.

The tools employed for PVAR-X analysis are (i) Granger causality, (ii) variance decomposition and, (iii) impulse response analysis.

i. Granger causality test of the variables in panel VAR

Granger causality test describes whether a variable is causally related to another. This test is used to measure the cause and effect relationship. Granger causality tests are provided in Table 6.12. For instance, a variable y_{t1} is Granger-caused by y_{t2} if current and past information on y_{t2} helps to improve the forecasts on y_{t1}.

Granger causality was tested by testing the following null (H_0) against the alternative (H_1) hypotheses:

H_0: Excluded variable does not Granger-cause the dependent variable
H_1: Excluded variable Granger-causes the dependent variable

Table 6.12: Granger causality test in PVAR investment

Equation \ Excluded		χ^2	df	$p-$value
$\Delta\ln(inv)$				
	$\Delta\ln(gdp)$	0.054	1	0.816
	$\Delta\ln(ir)$	3.010	1	0.083
	All	3.105	2	0.212
$\Delta\ln(gdp)$				
	$\Delta\ln(inv)$	0.008	1	0.929
	$\Delta\ln(ir)$	6.337	1	0.012
	All	6.355	2	0.042
$\Delta\ln(ir)$				
	$\Delta\ln(inv)$	1.133	1	0.287
	$\Delta\ln(gdp)$	9.301	1	0.002
	All	12.235	2	0.002

In the total investment equation, the real interest causes the total investment at 10 percent level of significance. However, interest rate and GDP do not jointly cause the total investment by the Granger causality test. In the GDP equation the real interest rate is statically significant at the 5 percent level. Further, both the real interest rate and total investment jointly causes the GDP. Similarly, the total investment and real GDP jointly Granger-cause real interest rate thus, total investment, GDP and interest rate are interlinked by the Granger causality test.

ii. Variance decomposition in panel VAR investment model

The variance decomposition is a technique used for PVAR analysis. It tells us the proportion of the movements in a sequence due to its "own" shocks versus stocks to others variables. The variance decomposition results of the total investment model are presented in Table 6.13.

Table 6.13: Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variables		
		$\Delta\ln(inv)$	$\Delta\ln(gdp)$	$\Delta\ln(ir)$
$\Delta\ln(inv)$				
	1	1	0	0
	5	.98037	.00352	.01618
	10	.98031	.00352	.01618
$\Delta\ln(gdp)$				
	1	.27797	.72204	0
	5	.25793	.67299	.06908
	10	.25793	.67298	.06912
$\Delta\ln(ir)$				
	1	.03436	0	0
	5	.10591	.12119	.77290
	10	.10592	.12123	.77285

The response of investment, real GDP and interest rate due to shock to investment:

A one standard deviation shock to investment in the short run (5 years) and long run (10 years) causes approximately 98 percent fluctuation to the variance in its own shock, 0.35 percent in real GDP and 1.61 percent in short run and long run in the interest rate. This means due to shock to investment over the periods of 5 years and 10 years causes no change to its own, real GDP and interest rate.

The response of investment, real GDP and interest rate due to shock to real GDP:

A one standard deviation shock to real GDP in short run and long run causes 67.3 percent fluctuation in the variance in its own shock, approximately 25.8 percent in investment and 6.9 percent in the interest rate. This means due to shock to real GDP over the periods of 5 years and 10 years causes no change to its own, investment and interest rate.

The response of investment, real GDP and interest rate due to shock to interest rate:

A one standard deviation shock to the interest rate in short run (5 years) and long run (10 years) causes approximately 77.3 percent fluctuation to the variance in its own shock, 10.6 percent in total investment and 12.2 percent in the change in real GDP. This means due to shock to the interest rate over the periods of 5 years and 10 years causes no change to its own, investment and real GDP.

iii. Impulse response analysis

Impulse response function describes the effects of shocks on the adjustment path of the variables, for instance, the effect of a variable on other variables.

The results from the impulse response function are presented in Table 6.14:

Table 6.14: Responses of investment, real GDP and interest rate due to shock in investment

Shock to $\Delta\ln(inv)$	$\Delta\ln(gdp)$	$\Delta\ln(inv)$	$\Delta\ln(ir)$
1	0.23604	.1802944	-.0318013
2	.0639513	.0346113	-.0253107
3	-.0282499	-.0280599	-.0099079
4	-.0438626	-.0339557	.0003577
5	-.0260296	-.0181095	.0035528
6	-.0065178	-.0034013	.0027444
7	.0033257	.0032268	.0010404
8	.0048269	.0037204	-.0000661
9	.0027929	.001934	-.0003961
10	.0006596	.0003323	-.0002973
11	-.0003888	-.0003696	-.000109
12	-.0005306	-.0004072	.0000101
13	-.0002994	-.0002063	.0000441
14	-.0000663	-.000032	.0000322
15	.0000452	.0000422	.0000114

A one standard deviation shock to the investment increases real GDP to 0.236 and in period 3-6 the pattern of movement begins to decrease to -0.043 in period 5. Then between periods 7-10 it begins to increase to 0.0048 in period 8. From period 11 it starts to decrease and finally closes to 0.001. A one standard deviation shock to the investment decreases its own to 0.180 and between periods 3-6, the pattern of movement begins to decrease to -0.035 in period 5. The pattern has increased again between periods 7-10 to 0.0037 in period 8. Then the pattern has decreased between periods 11-14 to -0.00041 in period 12. After slight variation, it eventually closes to 0.001. A one standard deviation shock to the investment decreases interest rate to -0.032 and in periods 4-7 the pattern of movement begins to increase to 0.035 in period 5. However, in periods 8-11 it decreases to -0.001 in period 8. However, after period 12 it begins to increase and eventually closes to 0.001. Graphs of impulse response function are presented in Appendix – XIV, which explains the time path of all multipliers. Responses of investment, interest rate and real GDP due to shock in real GDP are provided in Table 6.15.

Table 6.15: Responses of investment, interest rate and real GDP due to shock in real GDP

Shock to $\Delta\ln(gdp)$	$\Delta\ln(gdp)$	$\Delta\ln(inv)$	$\Delta\ln(ir)$
1	.4313302	.290329	-.0546691
2	.1163323	.0633839	-.0442847
3	-.0468449	-.0472961	-.017668
4	-.0760466	-.0590311	.0003577
5	-.0458304	-.0319744	.0061097
6	-.0118655	-.0063092	.0048044
7	.0055417	.0054526	.0018574
8	.0083743	.0064717	-.0000866
9	.0049207	.0034172	-.0006818
10	.001205	.0006206	-.0005207
11	-.0006506	-.000626	-.0001949
12	-.0009212	-.0007088	.0000146
13	-.0005278	-.0003648	.000076
14	-.0001217	-.0000603	.0000564
15	.0000759	.0000716	.0000204

A one standard deviation shock to the real GDP increases its own to 0.432 and after slight variation from periods 3-6 the pattern of movement decreased to -0.0761 in period 4. Then after periods 7-10 it begins to increase to 0.00838 in period 8. From period 11 it starts to decrease and finally to 0.001. Then the pattern has decreased between periods 11-14 to -0.00092 in period 12 and eventually closes to 0.001. A one standard deviation shock to the real GDP increases total investment to 0.291 and after slight variation from periods 3-6 the pattern of movement begins to decrease to -0.0591 in period 4. Then between periods 7-10 it begins to increase to 0.00647 in period 8. A one standard deviation shock to the real GDP decreases interest rate to -0.0547. Between periods 4-7 the pattern of movement begins to increase to 0.00611. Then between periods 8-11 the pattern of movement begins to decrease to 0.00068 in period 8. However, after period 12 it begins to increase and eventually closes to 0.001. Graphs of impulse response function are presented in Appendix – XV, which explains the time path of all multipliers. Responses of investment, real GDP and interest rate due to shock in interest rate are provided in Table 6.16.

Table 6.16: Responses of investment, real GDP and interest rate due to shock in interest rate

Shock to $\Delta\ln(ir)$	$\Delta\ln(gdp)$	$\Delta\ln(inv)$	$\Delta\ln(ir)$
1	2.528718	2.088721	.209835
2	2.114347	1.549031	-.160636
3	.871412	.5576143	-.1985577
4	.0053892	-.0612006	-.1070365
5	-.2827863	-.2330388	-.0208084
6	-.2295992	-.1675795	.0185043
7	-.0917964	-.0582227	.0217641
8	.0016977	.0083107	.0114368
9	.0316145	.0258797	.0020427
10	.0249104	.0181113	-.0021227
11	.0096519	.0060639	-.0023832
12	-.000432	-.0010824	-.0012206
13	-.0035283	-.00287	-.0001981
14	-.0027002	-.0019556	.0002426
15	-.0010128	-.0006298	.0002607

A one standard deviation shock to the interest rate increases real GDP to 2.529. In the periods 2-4 real GDP decreased to .0053. During the periods 5-7 the pattern of movement begins to decrease to -.2828 in period 5. Then after slight variation between periods 8-11 it increases to 0.03162 in period 9. However, after period 12 it begins to decrease and eventually closes to -0.0011. A one standard deviation shock to the interest rate increases total investment to 2.089. After slight variation from periods 4-7 the pattern of movement decreased to -0.2331 in period 5. Then between the periods 8-11 it increases to .0258797 in period 9. However, after period 12 it begins to decrease and eventually closes to -0.00063. A one standard deviation shock to the interest rate increases its own to 0.2098. Then between periods 2-5 the pattern of movement begins to decrease to -0.1985577 in period 3. Then between periods 6-9 increased to 0.02177 in period 7. Then the pattern decreased between periods 10-13 to -0.00238 in period 11. After slight variation, it eventually closes to 0.00026. Graphs of impulse response function are presented in Appendix – XVI, which explains the time path of all multipliers.

6.6.2 Empirical results PVAR – X private investment

Table 6.17: Empirical results PVAR – X (private investment, GDP, and IR are in the dependent variable list) with exogenous variables estimated by GMM

	Coefficient	Standard error	z	P>|z|	[95% confidence interval]	
$\Delta\ln(inv1)$						
$\Delta\ln(inv1_{it-1})$	.0048706	.1332849	0.04	0.971	-.256363	.2661042
$\Delta\ln(gdp_{it-1})$	.941823	.7418183	1.27	0.204	-.5121141	2.3957
$\Delta\ln(ir_{it-1})$	-.0789858	.1002864	-0.79	0.431	-.2755435	.117572
IC	.0402946	.0587684	0.69	0.493	-.0748893	.1554784
PBC	-.0103568	.0101335	-1.02	0.307	-.0302181	.0095046
PVC	-.0335506	.0313025	-1.07	0.284	-.0949024	.0278012
OF1	.0620708	.0563988	1.10	0.271	-.0484689	.1726105
OF2	.0025974	.0147366	0.18	0.860	-.0262858	.0314805
OF3	.0101238	.0111463	0.91	0.364	-.0117225	.0319702
OF4	-.0083542	.0109767	-0.76	0.447	-.0298681	.0131597
$\Delta\ln(gdp)$						
$\Delta\ln(inv1_{it-1})$	.015578	.0180915	0.86	0.389	-.0198808	.0510367
$\Delta\ln(gdp_{it-1})$	.313959	.1216667	2.58	0.010	.0754967	.5524212
$\Delta\ln(ir_{it-1})$	-.0509222	.0195948	-2.60	0.009	-.0893272	-.0125171
IC	.0184467	.0075963	2.43	0.015	.0035581	.0333352
PBC	.0005834	.0022304	0.26	0.794	-.0037881	.004955
PVC	-.0036775	.0040596	-0.91	0.365	-.0116341	.0042791
OF1	.0220481	.0102223	2.16	0.031	0020127	.0420835
OF2	-.002914	.0037099	-0.79	0.432	-.0101852	.0043572
OF3	-.0002058	.001881	-0.11	0.913	-.0038926	.0034809
OF4	-.0028308	.0021557	-1.31	0.189	-.0070558	.0013943
$\Delta\ln(ir)$						
$\Delta\ln(inv1_{it-1})$	-.0881272	.1011392	-0.87	0.384	-.2863564	.110102
$\Delta\ln(gdp_{it-1})$	2.298148	.6073185	3.78	0.000	1.107826	3.48847
$\Delta\ln(ir_{it-1})$	.1232269	.088082	1.40	0.162	-.0494108	.2958645
IC	-.0519842	.0472683	-1.10	0.271	-.1446283	.04066
PBC	-.0093198	.0093	-1.00	0.316	-.0275475	.0089079
PVC	.055454	.0243159	2.28	0.023	.0077958	.1031123
OF1	.030586	.0667841	0.46	0.647	-.1003084	.1614803
OF2	-.0020408	.0165499	-0.12	0.902	-.034478	.0303965
OF3	-.0031637	.0107257	-0.29	0.768	-.0241857	.0178582
OF4	.0092031	.011808	0.78	0.436	-.0139402	.0323464

a. Private investment as dependent variable:

The estimated coefficients of $\Delta\ln(inv1_{it-1})$, $\Delta\ln(gdp_{it-1})$, IC, OF1, OF2 and OF3 are economically significant (sign consistent) but statistically insignificant in the private investment function. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv1_{it-1})$ and $\Delta\ln(gdp_{it-1})$ and a one level increase from low to high level in IC, OF1, OF2 and OF3 increases $\Delta\ln(inv1_{it-1})$ by 0.49 percent, 94.18 percent, 9.03 percent, 6.21 percent, 0.26 percent and 1.12 percent. A one level increase from low to high level in PBC and PVC decreases private investment by 1.04 percent and 3.36 percent. The results indicate that $\Delta\ln(inv1_{it-1})$ and OF2 are inelastic. The estimated coefficient of $\Delta\ln(ir_{it-1})$ is found to be

negative as expected. The interest rate has corrected sign, which is economically significant but statistically insignificant.

b. Real GDP as dependent variable

The estimated coefficient of $\Delta\ln(inv1_{it-1})$ and PBC are economically significant (sign consistent) but statistically insignificant in the private investment model function. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv1_{it-1})$ and PVC increases $\Delta\ln(gdp)$ by 1.56 percent and 0.06 percent respectively. The estimated coefficient of $\Delta\ln(gdp_{it-1})$, IC and OF1 are economically and statistically significant in the investment model. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(gdp_{it-1})$ the IC and OF1 increases the GDP by 31.40 percent and 2.21 percent respectively. The coefficients of PVC, OF2, OF3 and OF4 are statistically and economically insignificant (not sign consistent). The results indicate that PBC, OF2, OF3 and OF4 are inelastic. The estimated coefficient of $\Delta\ln(ir_{it-1})$ is found to be negative as expected. The interest rate has correct sign, which is economically and statistically significant.

c. Interest rate as dependent variable:

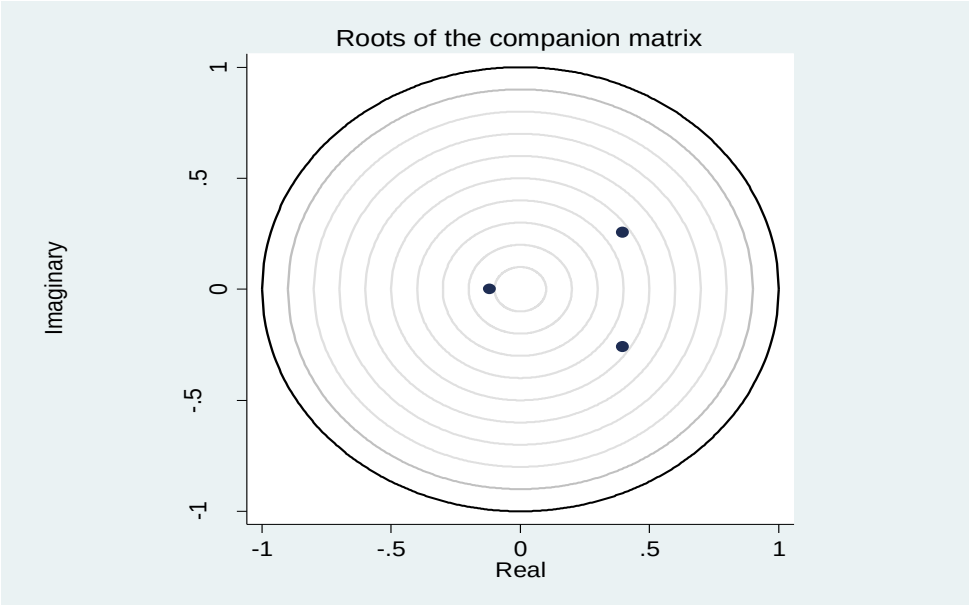
The estimated coefficients of $\Delta\ln(inv_{1it-1})$, IC, PBC, OF2 and OF3 are statistically and economically insignificant (not sign consistent) in the private investment model function. The coefficients of $\Delta\ln(gdp_{it-1})$ and PVC are economically and statistically significant. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(gdp_{it-1})$ and PVC increases interest rate by 229.84 percent and 5.55 percent respectively. The coefficients of OF1 and OF4 are economically significant but statistically insignificant. The results indicate that PBC, OF2, OF3 and OF4 are inelastic. The estimated coefficient of $\Delta\ln(ir_{it-1})$ is found to be statistically and economically insignificant (not sign consistent).

Based on the above test results the investment model can be used for infrastructural development policy decisions making in the context of Pakistan. Eigenvalue for stability condition is provided in Table 6.18 and Figure 6.6.

Table 6.18: Eigenvalue for stability condition

Eigenvalue		
Real	Imaginary	Modulus
.3962779	-.2569215	.4722762
.3962779	.2569215	.4722762
-.1205117	0.00000	.1205117

Figure 6.6: Eigenvalue for stability condition



All the eigenvalues lie inside the unit circle. Therefore, PVAR satisfies stability condition.

i. Granger causality test of the variables in panel VAR

Granger causality can be tested by the following null (H_0) against the alternative (H_1) hypotheses:

H_0: Excluded variable does not Granger-cause the dependent variable

H_1: Excluded variable Granger-causes the dependent variable

Granger causality test results are provided in Table 6.19.

Table 6.19: Granger causality test in PVAR: private investment

Equation \ Excluded		χ^2	df	$p-$value
$\Delta\ln(inv1)$				
	$\Delta\ln(gdp)$	1.612	1	0.204
	$\Delta\ln(ir)$	0.620	1	0.431
	All	2.565	2	0.277
$\Delta\ln(gdp)$				
	$\Delta\ln(inv1)$	0.741	1	0.389
	$\Delta\ln(ir)$	6.754	1	0.009
	All	7.158	2	0.028
$\Delta\ln(ir)$				
	$\Delta\ln(inv1)$	0.759	1	0.384
	$\Delta\ln(gdp)$	14.319	1	0.000
	All	14.347	2	0.001

In the change of private investment equation $\Delta\ln(gdp)$ and $\Delta\ln(ir)$ variables do not cause$\Delta\ln(inv1)$ neither individually nor jointly. In the change in real GDP equation the variable $\Delta\ln(inv1)$ does not cause $\Delta\ln(gdp)$. Whereas, the variables $\Delta\ln(inv1)$ and $\Delta\ln(ir)$ jointly cause $\Delta\ln(gdp)$. In the change in interest rate equation the variable $\Delta\ln(inv1)$ does not cause $\Delta\ln(ir)$ individually. However, the variable $\Delta\ln(gdp)$ do cause $\Delta\ln(ir)$ individually and jointly with the variables $\Delta\ln(inv1)$.

ii. Variance decomposition in panel VAR investment model

The results from the variance decomposition in panel VAR private investment model are presented in the following table.

Table 6.20: Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variables		
		$\Delta\ln(inv1)$	$\Delta\ln(gdp)$	$\Delta\ln(ir)$
$\Delta\ln(inv1)$				
	1	1	0	0
	5	.9427437	.0463912	.0108651
	10	.9427231	.0464022	.0108747
$\Delta\ln(gdp)$				
	1	.0632559	.9367441	0
	5	.0764661	.8549083	.0686256
	10	.0764712	.8548692	.0686597
$\Delta\ln(ir)$				
	1	.006789	.108008	.885203
	5	.0107622	.2276572	.7615806
	10	.0107694	.2277227	.7615079

The response of private investment, real GDP and interest rate due to shock to private investment:

A one standard deviation shock to private investment both in the short run (period 5) and long run (period 10) causes 94.2 percent fluctuation to the variance in its own shock, approximately 4.63 percent in the change in real GDP and 1.09 percent in the change in interest rate. This means due to shock to private investment over the periods of 5 years and 10 years causes no change to its own, real GDP and interest rate.

The response of private investment, real GDP and interest rate due to shock to real GDP:

A one standard deviation shock to real GDP in short run and long run causes 85.5 percent fluctuation in the variance in its own shock, approximately 7.7 percent in private

investment and 6.9 percent in the interest rate. This means due to shock in real GDP over the periods of five years and 10 years causes no change to its own, private investment and interest rate.

The response of private investment, real GDP and interest rate due to shock to interest rate:

A one standard deviation shock to the interest rate in the short and long run causes a 1.08 percent fluctuation in the variance in its own shock, approximately 1.07 percent in private investment and 22.77 percent in real GDP. This means due to shock in interest rate over the periods of five years and 10 years causes no change to its own, private investment and real GDP.

iii. Impulse response analysis

The results from the impulse response function are presented in Table 6.21, Table 6.22 and Table 6.23:

Table 6.21: Responses of private investment, real GDP and interest rate due to shock in private investment

Shock to $\Delta\ln(inv1)$	$\Delta\ln(gdp)$	$\Delta\ln(inv1)$	$\Delta\ln(ir)$
1	.9418231	.0048706	-.0789858
2	.9418231	.0048706	-.0789858
3	-.0757887	.0070737	-.0149148
4	-.0514087	.0001682	.0014627
5	-.0126203	-.0009289	.0027848
6	.0015627	-.0004465	.0010592
7	.0025042	-.0000712	.0000862
8	.0009173	.0000311	-.0001113
9	.0000615	.0000242	-.0000629
10	-.0001023	6.62e-06	-.0000128
11	-.0000553	-4.34e-07	3.11e-06
12	-.0000106	-1.14e-06	3.23e-06
13	3.03e-06	-4.56e-07	1.03e-06
14	2.89e-06	-4.58e-08	8.76e-09
15	8.83e-07	4.40e-08	-1.42e-07

A one standard deviation shock to the private investment increases real GDP to .942. Then in periods 3-5 the pattern of movement begins to decrease to -.0758 in step 3 and during periods 6-9 it increases to 0.0025 in period 7 and during periods 10-12 it again decreased to -0.00011. Eventually, it approaches zero. (8.83e-07). A one standard deviation shock to the private investment increases to .00488 of its own shock. Then in periods 5-7 the pattern of movement decreased to -0.00093 in period 5. During the periods 8-10 it again approaches zero

(-06.62e-06) in period 10. However, after variation, the pattern of movement eventually closes to zero (4.40e-08). A one standard deviation shock to the private investment decreases interest rate to -0.07898 and during the periods 4-7 the pattern of movement increases to 0.00278 in period 5. Between periods 8-10 it decreased to -0.00012 in period 8. After periods 11 the pattern of movement approaches zero (8.76e-09) in period 14 and eventually approaches zero (-1.42e-07) in period 15. Graphs of impulse response function are presented in Appendix – XVII, which explains the time path of all multipliers.

Table 6.22: Responses of private investment, interest rate and real GDP due to shock in real GDP

Shock to $\Delta\ln(gdp)$	$\Delta\ln(gdp)$	$\Delta\ln(inv1)$	$\Delta\ln(ir)$
1	.3139589	.015578	-.0509222
2	-.0037848	.0094543	-.0234929
3	-.0462741	.0020575	-.003449
4	-.0205167	-.0004069	.0017689
5	-.0027595	-.0004775	.0012949
6	.0016597	-.0001594	.0003378
7	.0011472	-4.69e-06	-.0000303
8	.0002861	.0000205	-.0000618
9	-.0000328	.00001	-.0000238
10	-.0000556	1.64e-06	-2.05e-06
11	-.0000206	-6.77e-07	2.45e-06
12	-1.49e-06	-5.40e-07	1.41e-06
13	2.25e-06	-1.50e-07	2.92e-07
14	1.24e-06	8.70e-09	-6.71e-08
15	2.42e-07	2.52e-08	-7.19e-08

A one standard deviation shock to the real GDP increases its own to 0.31396. Then during periods 2-5, the pattern of movement begins to decrease to -0.0462741 in period 3. Between periods 6-8 the pattern of movement increases to .00166 and during periods 9-12 the pattern of movement decreases to zero (-1.49e-06) and closes to zero (2.42e-07). A one standard deviation shock to the real GDP decreases private investment to .015578 and during periods 4-7 the pattern of movement decreases to zero (-4.69e-06) in period 7. Between periods 8-10 it increased to zero (1.64e-06) in period 10. During periods 11-13 it again decreases to negative zero (-6.77e-07) in period 11. However, it eventually closes to zero (2.52e-08). A one standard deviation shock to the real GDP decreases interest rate to -.05093 and during periods 4-6 it increases to .0017689 in period 4, then during periods 7-10 it decreases to zero (-2.05e-06) in period 10. However, after period 11 the pattern of movement begins to increase to zero (2.92e-07) in period 13 and finally approaches zero (-7.19e-08) in period 15. Graphs of impulse

response function are presented in Appendix – XVIII, which explains the time path of all multipliers.

Table 6.23: Responses of private investment, real GDP and interest rate due to shock in interest rate

Shock to $\Delta\ln(ir)$	$\Delta\ln(gdp)$	$\Delta\ln(inv1)$	$\Delta\ln(ir)$
1	2.298148	-.0881272	.1232269
2	.9217175	.0245116	-.094881
3	.0944165	.0228395	-.0605638
4	-.088031	.0069194	-.014075
5	-.0534676	-.0000973	.0022018
6	-.0118182	-.0010274	.0030017
7	.0022202	-.0004536	.0010529
8	.0026894	-.0000604	.0000525
9	0009082	.000037	-.0001257
10	.000031	.0000254	-.0000647
11	-.0001149	6.31e-06	-.0000116
12	-.0000567	-7.41e-07	3.93e-06
13	-9.47e-06	-1.23e-06	3.43e-06
14	3.75e-06	-4.56e-07	1.00e-06
15	3.05e-06	-3.21e-08	-3.14e-08

A one standard deviation shock to the interest rate increases real GDP to 2.298. During periods 4-6 the pattern of movement decreases to -0.0880 in period 5. During periods 7-10 it increases to .00269 in period 8. Thereafter, the pattern of movement decreases to zero (-9.47e-06) and eventually closes to zero (3.05e-06) in period 15. A one standard deviation shock to the interest rate decreases private investment to -0.0881272. Between periods 2-4 the pattern of movement increases to 0.02452 in period 2. During periods 58 it decreases to -.00103 in period 6. However, the pattern of movement increases to zero (6.31e-06) in period 11 and eventually closes to zero (-3.21e-08) in period 15. A one standard deviation shock to the interest rate increases its own to .12322. Then after periods 2-4 the pattern of movement decreased to -0.09488 in period 2. During the period 5-8 it increases to 0.0030 in period 6. However, after period 9 to 14 there was variation in the pattern and eventually closes to zero (-3.14e-08) in period 15. Graphs of impulse response function are presented in Appendix – XIX, which explains the time path of all multipliers.

6.6.3 Empirical results PVAR – X public investment

Table 6.24: Empirical results of PVAR – X (public investment, GDP, and IR are the dependent variables with exogenous variables) model estimated by GMM.

	Coefficient	Standard error	z	P>|z|	[95% confidence interval]	
$\Delta\ln(inv2)$						
$\Delta\ln(inv2_{it-1})$	-.0213319	.2600302	-0.08	0.935	-.5309818	.4883179
$\Delta\ln(gdp_{it-1})$	-.1102619	.0877743	-1.26	0.209	-.2822963	.061772
$\Delta\ln(ir_{it-1})$	-.006144	.0118231	-0.52	0.603	-.0293169	.0170288
IC	.0114822	.0074919	1.53	0.125	-.0032016	.026166
PBC	.0000349	.0010186	0.03	0.973	-.0019615	.0020314
PVC	-.0036282	.0032914	-1.10	0.270	-.0100793	.0028228
OF1	.0065198	.0051224	1.27	0.203	-.0035199	.0165595
OF2	-.0003488	.0022348	-0.16	0.876	-.0047289	.0040313
OF3	.0006531	.0013174	0.50	0.620	-.001929	.0032353
OF4	-.0013256	.0011796	-1.12	0.261	-.0036375	.0009863
$\Delta\ln(gdp)$						
$\Delta\ln(inv2_{it-1})$	-1.11361	.4445307	-2.51	0.012	-1.984874	-.2423457
$\Delta\ln(gdp_{it-1})$	.5513185	.1667712	3.31	0.001	.2244529	.8781841
$\Delta\ln(ir_{it-1})$	-.0528224	.0276189	-1.91	0.056	-.1069544	.001309
IC	.0237651	.0136003	1.75	0.081	-.0028909	.0504212
PBC	.0009441	.0029113	0.32	0.746	-.0047619	.0066501
PVC	-.0027927	.0061056	-0.46	0.647	-.0147595	.0091741
OF1	.0136735	.0148444	0.92	0.357	-.015421	.042768
OF2	-.0000856	.0049849	-0.02	0.986	-.0098558	.0096846
OF3	-.0003678	.0028279	-0.13	0.897	-.0059104	.0051747
OF4	-.0029835	.0031018	-0.96	0.336	-.0090628	.0030959
$\Delta\ln(ir)$						
$\Delta\ln(inv2_{it-1})$	5.862355	2.381199	2.46	0.014	1.195291	10.52942
$\Delta\ln(gdp_{it-1})$	1.098554	.5755739	1.91	0.056	-.0295498	2.226659
$\Delta\ln(ir_{it-1})$	.1998075	.0794644	2.51	0.012	.0440602	.3555548
IC	-.0703649	.0501291	-1.40	0.160	-.1686161	.0278862
PBC	-.0203911	.0095576	-2.13	0.033	-.0391238	-.0016585
PVC	.0565129	.0268713	2.10	0.035	.003846	.1091797
OF1	.0658925	.0651996	1.01	0.312	-.0618964	.1936814
OF2	-.0253661	.0166169	-1.53	0.127	-.0579346	.0072024
OF3	-.0017669	.0112039	-0.16	0.875	-.0237261	.0201924
OF4	.0042375	.0114248	0.37	0.711	-.0181546	.026629

a. Public investment as dependent variable:

The estimated coefficients of $\Delta\ln(inv2_{it-1})$, $\Delta\ln(gdp_{it-1})$, PVC, OF2 and OF4 are statistically and economically insignificant (negative sign) in the public investment function. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv2_{it-1})$, $\Delta\ln(gdp_{it-1})$, PVC, OF2 and OF4 decreases public investment by 2.14 percent, 11.03 percent, 0.36 percent, 0.04 percent and .014 percent. The estimated coefficients of IC, PBC, OF1 and OF3 are sign consistent with economic theory but statistically insignificant in the public investment model function. In an economic sense, it indicates that a 1 percent increase in IC, PBC, OF1 and OF3 increases public investment by 1.15 percent, 0.01 percent, 0.65 percent and 0.07 percent. The

results indicate that PBC, PVC, OF2, OF3 and OF4 are inelastic. The estimated coefficient of $\Delta\ln(ir_{it-1})$ is found to be negative as expected. The variable $\Delta\ln(ir_{it-1})$ is economically significant (sign consistent) but statistically insignificant.

b. Real GDP as dependent variable:

The estimated coefficient of $\Delta\ln(inv2_{it-1})$ is economically insignificant but statistically significant in public investment model function. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv2_{it-1})$ decreases $\Delta\ln(gdp)$ by 111.36 percent. The estimated coefficient of $\Delta\ln(gdp_{it-1})$ is economically and statistically significant in the public investment model function. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(gdp_{it-1})$ increases GDP by 55.13 percent. The estimated coefficient of IC is economically and statistically significant at 10 percent. The estimated coefficients of PBC and OF1 are economically significant but statistically insignificant. The estimated coefficients of PVC, OF2, OF3 and OF4 are economically and statistically insignificant. The results indicate that $\Delta\ln(inv2_{it-1})$, $\Delta\ln(gdp_{it-1})$ and IC are elastic. The estimated coefficient of $\Delta\ln(ir_{it-1})$ is found to be negative as expected. The interest rate has corrected sign, which is economically and statistically significant.

c. Interest rate as dependent variable:

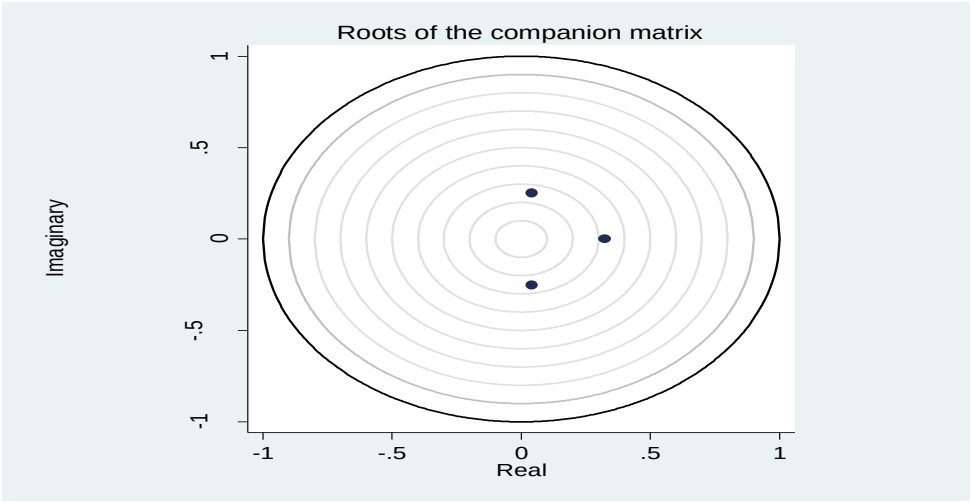
The estimated coefficient of $\Delta\ln(inv2_{it-1})$, $\Delta\ln(gdp_{it-1})$ and PVC are economically and statistically significant in the public investment model function. In an economic sense, it indicates that a 1 percent increase in $\Delta\ln(inv2_{it-1})$, $\Delta\ln(gdp_{it-1})$ and PVC increases $\Delta\ln(ir_{it-1})$ by 586.23 percent, 109.86 percent, and 5.65 percent respectively. The estimated coefficients of IC, OF2, OF3 and OF4 are economically and statistically insignificant. The estimated coefficient of PBC is economically insignificant but statistically significant. The estimated coefficient of OF1 is economically significant but statistically insignificant. The estimated coefficients of $\Delta\ln(ir_{it-1})$, IC and OF2 are found to be economically insignificant (not sign consistent) but statistically significant. The results indicate that OF3 and OF4 are inelastic.

Based on the above test results the investment model can be used for infrastructural development policy decisions making in the context of Pakistan. Eigenvalue for stability condition is provided in Table 6.25 and Figure 6.7.

Table 6.25: Eigenvalue for stability condition

Eigenvalue		
Real	Imaginary	Modulus
.3217607	0	.3217607
.0406357	.2515947	.2548552
.0406357	-.2515947	.2548552

Figure 6.7: Eigenvalue for stability condition



All the eigenvalues lie inside the unit circle. Therefore, PVAR satisfies stability condition.

i. Granger causality test of the variables in panel VAR

Granger causality was tested by the following null (H_0) hypothesis against the alternative (H_1) hypothesis:

H_0: Excluded variable does not Granger-cause the dependent variable

H_1: Excluded variable Granger-causes the dependent variable

Granger causality test results are provided in Table 6.26.

Table 6.26: Granger causality test in PVAR

Equation \ Excluded	χ^2	df	$p-$value
$\Delta\ln(inv2)$			
$\Delta\ln(gdp)$	1.578	1	0.209
$\Delta\ln(ir)$	0.270	1	0.603
All	2.089	2	0.352
$\Delta\ln(gdp)$			
$\Delta\ln(inv2)$	6.276	1	0.012
$\Delta\ln(ir)$	3.658	1	0.056
All	9.363	2	0.009
$\Delta\ln(ir)$			
$\Delta\ln(inv2)$	6.061	1	0.014
$\Delta\ln(gdp)$	3.643	1	0.056
All	11.667	2	0.003

In the change of public investment equation $\Delta\ln(gdp)$ and $\Delta\ln(ir)$ variables do not cause $\Delta\ln(inv2)$ neither individually nor jointly. In the change in real GDP equation variable $\Delta\ln(inv2)$ does cause the $\Delta\ln(gdp)$ and $\Delta\ln(ir)$ does not cause $\Delta\ln(gdp)$. But both variables $\Delta\ln(inv2)$ and $\Delta\ln(ir)$ do not cause jointly. In the change in interest rate equation $\Delta\ln(inv2)$ variable does cause$\Delta\ln(ir)$. While $\Delta\ln(gdp)$ variable does not cause $\Delta\ln(ir)$ individually. Both variables$\Delta\ln(inv2)$ and $\Delta\ln(gdp)$ do cause $\Delta\ln(ir)$ jointly.

ii. Variance decomposition in the panel VAR investment model

The results from variance decomposition in panel VAR model are shown in Table 6.27.

Table 6.27: Forecast-error variance decomposition

Response variable	Forecast horizon	Impulse variables		
		$\Delta\ln(inv2)$	$\Delta\ln(gdp)$	$\Delta\ln(ir)$
$\Delta\ln(inv2)$				
	1	1	0	0
	5	.9280679	.0643796	.0075524
	10	.9244767	.0675527	.0079707
$\Delta\ln(gdp)$				
	1	.1205283	.8794717	0
	5	.1838891	.7615433	.0545674
	10	.1861610	.7583685	.0554705
$\Delta\ln(ir)$				
	1	.0042033	.0798368	.9159599
	5	.2656674	.0718565	.6624761
	10	.2656584	.0719843	.6623573

The response of public investment, real GDP and interest rate due to shock to public investment:

A one standard deviation shock to public investment in the short and long run causes approximately 92 percent fluctuation in the variance in its own shock, approximately 6 percent in real GDP and .8 percent in the interest rate. This means due to shock in the change in public investment over the periods of 5 years and 10 years causes no change to its own, real GDP and interest rate.

The response of public investment, real GDP and interest rate due to shock to real GDP:

A one standard deviation shock to real GDP in short and long run causes approximately 18 percent fluctuation in the variance in its own shock, 75 percent in public investment and 6 percent in the interest rate. This means due to shock in real GDP over the periods of 5 years and 10 years causes no change to its own, public investment and interest rate.

The response of public investment, real GDP and interest rate due to shock to interest rate:

A one standard deviation shock to the interest rate in short and long run causes 27 percent fluctuation in the variance in its own shock, 7.1 percent in public investment and 66 percent in real GDP. This means due to shock to the interest rate over the periods of 5 years and 10 years causes no change to its own, public investment and real GDP.

iii. Impulse response analysis

The impulse response analysis results are provided in Table 6.28, Table 6.29 and Table 6.30.

Table 6.28: Responses of public investment, real GDP and interest rate due to shock in public investment

Shock to $\Delta\ln(inv2)$	$\Delta\ln(gdp)$	$\Delta\ln(inv2)$	$\Delta\ln(ir)$
1	-.1102619	-.0213319	-.006144
2	-.0651869	.0872255	.0047277
3	-.0403627	.0984478	.0038521
4	-.028876	.0654303	.0022969
5	-.0206111	.0442259	.0015822
6	-.0145016	.0312849	.0011331
7	-.0101997	.0221246	.0008002
8	-.0071837	.0155776	.0005627
9	-.0050599	.0109665	.0003962
10	-.0035636	.0077235	.0002791
11	-.0025097	.0054397	.0001965
12	-.0017675	.003831	.0001384
13	-.0012448	.0026981	.0000975
14	-.0008767	.0019002	.0000687
15	-.0006174	.0013382	.0000484

A one standard deviation shock to the public investment increases real GDP to -0.11026 and after periods 2-14 the pattern of movement begins to decrease to -0.06519 in period 2 and eventually closes to -0.00062. A one standard deviation shock to the public investment decreases its own to -.02134. During the periods 2-14 with a slight variation, the pattern of movement increases to 0.0984478 in period 3 and finally closes to 0.00134. A one standard deviation shock to the public investment decreases interest rate to -0.00615. In the periods 2-14 the pattern of movement increases to 0.00356. In period 5 it decreases to -0.00027. During the periods 614 with variation the pattern of movement increases to 0.00473 in period 2 and eventually closes to 0.000048. Graphs of the impulse response function are presented in Appendix – XX, which explains the time path of all multipliers.

Table 6.29: Responses of public investment, interest rate and real GDP due to shock in real GDP

Shock to $\Delta\ln(gdp)$	$\Delta\ln(gdp)$	$\Delta\ln(inv2)$	$\Delta\ln(ir)$
1	.5513185	-1.11361	-.0528224
2	.3687125	-.8998622	-.0328343
3	.2664283	-.5838923	-.0205081
4	.1887387	-.4044673	-.0145836
5	.1326316	-.2870476	-.0103985
6	.0933493	-.2025363	-.00732
7	.0657558	-.1425467	-.0051491
8	.0463133	-.1003717	-.0036264
9	.0326167	-.0706931	-.0025543
10	.0229709	-.0497884	-.0017989
11	.0161779	-.0350645	-.0012669
12	.0113937	-.024695	-.0008923
13	.0080243	-.017392	-.0006284
14	.0056513	-.0122488	-.0004426
15	.00398	-.0086265	-.0003117

A one standard deviation shock to the real GDP increases its own to 0.53132. Between the periods 2-14 the pattern of movement begins to increase to 0.36872 in period 2 and finally closes to 0.00398. A one standard deviation shock to the real GDP increases public investment to -1.1136. Between the periods 2-14 the pattern of movement decreases to -0.89986 in period 2 and closes to -0.00863. A one standard deviation shock to the real GDP decreases the interest rate to -0.05283. Then between periods 2-14 the pattern of movement begins to decrease to -0.03284 in the period 2 and eventually closes to -0.00032. Graphs of the impulse response function are presented in Appendix – XXI, which explains the time path of all multipliers.

Table 6.30: Responses of public investment, real GDP and interest rate due to shock in interest rate

Shock to $\Delta\ln(ir)$	$\Delta\ln(gdp)$	$\Delta\ln(inv2)$	$\Delta\ln(ir)$
1	1.098554	5.862355	.1998075
2	.1787582	-.1770738	-.0541236
3	.0586195	-.5125815	-.0191688
4	.0677782	-.1667192	-.0037772
5	.0516007	-.0940653	-.0033106
6	.0351834	-.0748644	-.0028092
7	.0245659	-.0540522	-.0019598
8	.0173506	-.0376928	-.0013571
9	.0122309	-.0264736	-.0009561
10	.0086119	-.0186606	-.0006744
11	.0060645	-.013146 -	.000475
12	.0042712	-.0092577	-.0003345
13	.0030081	-.0065198	-.0002356
14	.0021185	-.0045917	-.0001659
15	.001492	-.0032339	-.0001168

A one standard deviation shock to interest rate increases real GDP to 1.0986. Then during periods 2-14 the pattern of movement increases to 0.178758 in period 2 and eventually closes to 0.00149. A one standard deviation shock to interest rate increases public investment to 5.8624. Then during the periods 2-14 with a slight variation the pattern of movement decreases -0.51259 in period 3 and finally closes to -0.00324. A one standard deviation shock to the interest rate decreases its own to .19981. Then during the periods 2-14 the pattern of movement decreases to -0.05412 in period 2 and finally closes to -0.000117. Graphs of impulse response function are presented in Appendix – XXII, which explains the time path of all multipliers.

6.7 Hypotheses tests for the research questions

As mentioned earlier, two estimation approaches were used to test the research hypotheses of this thesis, namely the random effects panel regression by using GLS and panel VAR regression by using GMM in STATA. The research hypotheses test results are presented below.

6.7.1 Hypotheses test results of random effects Panel regression model

Question 1. Does institutional capacity have an effect on PPP implementation in Pakistan?

This research question can be translated into the following econometrically testable hypothesis.

$$H_0: \beta_{IC} = 0$$

$$H_1: \beta_{IC} \neq 0$$

In the total investment function

The null hypothesis is rejected at the 10 percent level of significance, implying that institutional capacity has an impact on total investment function (both public and private jointly).

a. While in the Private investment function

The null hypothesis is not rejected (p-value of the test is of 0.19), which means institutional capacity is not statistically significant at the conventional 5 percent level of significance. Based on the test result it is concluded that the institutions do not have the capacity/framework to influence the private sector to invest in PPP infrastructure development in Pakistan. That is, the private sector does not have a favourable institutional framework for investing in PPP infrastructure. This is expected for Pakistan's PPP infrastructure investment.

b. In the public investment function

Institutional capacity is not statistically significant. The results indicate that the public sector does not have the capacity to manage PPP programs in Pakistan effectively.

Question 2. Does the private sector have the capacity to implement PPP programs in Pakistan?

This research question can be translated into the following econometrically testable hypothesis

$$H_0: \beta_{PVC} = 0$$

$$H_1: \beta_{PVC} \neq 0$$

a. In the total investment function

The null hypothesis is rejected at the 7 percent (P-Value=0.061) level of significance, implying that private-sector capacity has an impact on total investment function. It means

private-sector capacity can affect total PPP investment (public and private investment) in Pakistan.

b. In the private investment function

The null hypothesis is not rejected (p-value of 0.176) which means private-sector capacity is not statistically significant at the conventional level. Thus, the private sector does not have the capacity for investing in PPP infrastructure procurement in Pakistan. This is what was expected for Pakistan's PPP infrastructure investment.

c. In the public investment function

The null hypothesis is not rejected (p-value of 0.22), which means private-sector capacity is not significant statistically. Thus, the public sector does not have the capacity for influencing private sector to invest in PPP infrastructure in Pakistan.

Question 2.1. Do other factors have an effect on PPP implementation in Pakistan?

This research question can be translated into the following econometrically testable hypothesis.

$H_0: \beta OF_1 = \beta OF_2 = \beta OF_3 = \beta OF_4 = 0$

$H_0: \beta OF_1 \neq \beta OF_2 \neq \beta OF_3 \neq \beta OF_4 \neq 0$

a. In the total investment function

The null hypothesis is rejected at 10 percent level of significance. Thus, other factors have significant effects jointly in the total investment function. For the purpose of policy, the government should review its policy for implementation of PPP programs in Pakistan.

b. In the private investment function

The null hypothesis is rejected at 10 percent level of significance. Thus, other factors are deterring the private sectors from investment in PPP infrastructure. Therefore, the government should review its policy for implementation of PPP programs in Pakistan.

c. In the public investment function

The null hypothesis is not rejected at the 10 percent level of significance. Furthermore, the joint effect of other factors is statistically insignificant at convention level in the public

infrastructure investment model. The test result indicates that other factors are discouraging the public sector from investment in PPP infrastructure. These results suggest that the Government of Pakistan should review its policies for implementation of PPP programs in Pakistan.

Other factors are not significant under private- and public-sector investment as well as under total investment (private and public). It means other factors do have an impact on investments and should be promoted for PPP infrastructure investment in Pakistan.

Question 3. Does the public sector have the capacity to implement PPP programs in Pakistan?

The influence of the public sector capacity (PBC) on undertaking PPP for infrastructure development can be tested by the following hypotheses:

$$H_0: \beta_{\text{PBC}} = 0$$

$$H_1: \beta_{\text{PBC}} \neq 0$$

a. In the total investment function

The null hypothesis is rejected at the 10 percent level of significance (p-value of 0.066), implying that the public sector capacity has an impact on total investment function. It means public sector capacity can affect total PPP investment (public and private investment) in Pakistan. In other words, the public sector can use its capacity much better where joint investment (public and the private investment) exists.

b. In the private investment function

The null hypothesis cannot be rejected at the conventional level of significance (p-value of 0.134) which means the private sector does not have the capacity for investing in PPP infrastructure procurement in Pakistan. This is what was expected for Pakistan's PPP infrastructure investment.

c. In the public investment function

The null hypothesis cannot be rejected at the conventional significance level, which means the public sector does not have an independent capacity for implementing PPP infrastructural investment in Pakistan. This may not be a surprise because of poor governance for public investment.

6.7.2 Hypotheses test results in Panel vector auto regression combining with survey data (PVAR-X) model

Question 1. Does institutional capacity have an effect on PPP implementation in Pakistan?

This research question can be translated into an econometrically testable hypothesis as follows.

$$H_0: \beta_{IC} = 0$$

$$H_1: \beta_{IC} \neq 0$$

a. In total investment function

The null hypothesis is rejected at the 10 percent level of significance, implying that institutional capacity has an impact on total investment (public and private) function.

b. In the private investment function

The null hypothesis is not rejected (p-value of 0.493) as institutional capacity is not statistically significant at a conventional level of significance. It indicates that institutions do not have the capacity/framework for influencing the private sector for investing in PPP infrastructure development in Pakistan. It means the private sector does not have a favourable institutional framework for investing in infrastructure. This is what we expected for Pakistan's PPP infrastructure investment.

c. In the public investment function

The public sector institutional capacity is not significant statistically at the conventional level of significance. It implies that the public sector does not have the capacity for facilitating PPP infrastructure investment in Pakistan.

Question 2. Does the private sector have the capacity to implement PPP programs in Pakistan?

This research question is translated into the following econometrically testable hypothesis.

$$H_0: \beta_{PVC} = 0$$

$$H_1: \beta_{PVC} \neq 0$$

a. In the total investment function

The null hypothesis is not rejected at the conventional level of significance (p-value of 0.229). It implies that the private sector does not have the capacity for investing in PPP

infrastructure in Pakistan. It means that some variation in the private sector capacity can affect total PPP investment (public and private investment) in Pakistan.

b. In the private investment function

The null hypothesis is not rejected (p-value of 0.284) at the conventional level of significance. It indicates that private sectors do not have the capacity for investing in PPP infrastructure procurement in Pakistan.

c. The public investment function

The null hypothesis is not rejected at the conventional level of significance (p-value of 0.270). It implies that the public sector does not have the capacity for investing in PPP infrastructure in Pakistan.

Question 2.1. Do other factors have an effect on PPP implementation in Pakistan?

The research question is translated into the following econometrically testable hypothesis.

$H_0: \beta OF_1 = \beta OF_2 = \beta OF_3 = \beta OF_4 = 0$

$H_0: \beta OF_1 \neq \beta OF_2 \neq \beta OF_3 \neq \beta OF_4 \neq 0$

Other factors are found to be significant for private- and public sector investment as well as under total investment (private and public). It indicates that other factors do have an impact on investments. It means other factors should be implemented for promoting PPP infrastructre investment in Pakistan.

a. In the total investment function

The null hypothesis is rejected at the conventional level of significance. It shows that other factors have significant effects on total investment. For the purpose of policy, the government should review its policy for implementation of PPP programs in Pakistan with reference to other factors as stated in this thesis.

b. In the private investment function

The null hypothesis is rejected at the conventional level of significance. This indicates that other factors are useful determinants for private-sector investment in PPP infrastructure. It

implies that the government should review its policy for implementation of PPP programs in Pakistan.

c. In the public investment function

The null hypothesis is not rejected at a conventional level of significance. This indicates that other factors are discouraging public-sector investment in PPP infrastructure. These results suggest that other factors do have an impact on investments and should be addressed for promoting PPP infrastructrual investment in Pakistan. It means that the Government of Pakistan should review its policies for implementation of PPP programs in Pakistan.

Question 3. Does the public sector have the capacity to implement PPP programs in Pakistan?

This research question is translated into the following econometrically testable hypothesis.

$$H_0: \beta_{\text{PBC}} = 0$$

$$H_1: \beta_{\text{PBC}} \neq 0$$

a. In the total investment function

The null hypothesis is not rejected at the conventional significant level (p-value of 0.319). It shows that the public sector does not have the capacity to implement PPP programs in Pakistan. This is a surprise. One can take some variations in the public sector capacity that can affect total PPP investment (public and private investment) in Pakistan. In other words, the public sector can use its capacity much better where a joint investment (public and the private investment) exists.

b. In the private investment function

The null hypothesis cannot be rejected at the conventional significance level (p-value of 0. 307). Thus, the public sector does not have the capacity for investing in PPP infrastructure procurement in Pakistan.

c. In the public investment function

The null hypothesis cannot be rejected at the conventional significance level (p-value of 0.973) which means public-sector capacity is not statistically significant. Thus, the public sector does not have the capacity for investing in PPP infrastructure in Pakistan. This may not

be a surprise because of poor governance in public investment. The next section summarises the empirical results of this chapter.

6.8 Summary of empirical results

This section summarises the empirical results of this chapter. As a first step factor analysis was used to test the suitability and reliability of the survey data. The results of factor analysis determined the dimensionality of the variables of the questionnaire. Then Cronbach alpha (α) was used to measure the reliability and internal intensity of a set of questions. It was found that the reliability of all questions in the survey questionnaire satisfies internal consistency of the items by Cronbach alpha criterion. Cronbach alpha (α) also found no inadequacy of the survey response.

The historical variables including $inv, inv1, inv2, gdp, ir$ were tested for stationarity by the Levin-Lin and Chu (LLC) (2002), Im, Pesaran and Shin (1997) and Maddala and Wu (1999) (Fisher-type test) panel unit root tests and found that these variables were first differenced stationary i.e. the series were level nonstationary of order 1. Then the cointegration of the nonstationarity series was tested by utilising Persyn & Westerlund (2008) and found that the variables were not cointegrated. Consequently, differenced series used for further analysis.

For estimation of panel regression models the random effects versus fixed effects was tested by utilising Hausman (1978) test. The test supported the use of random effects model. From the panel random effects results it was found that GDP has significant effects on investment, while insignificant effects found for the interest rate variable. Similar results found for private investment and the public investment as well. Later, additional exogeneous variables obtained from the survey data included in the panel regression random effects model and revealed the same conclusion for GDP data in each of the model. It was also found from the estimated results that other factors were the barriers to PPP infrastructure investment in Pakistan.

The panel vector auto regression models were also considered for estimating the model of interest by using GMM estimation method. The results of panel vector auto regression found that GDP has significant effects on investment. It was also found that the institutions, public- and private sector do not have the capacity to manage PPP infrastructure projects/investment and are barriers against taking part for public infrastructure development on PPP modality. Besides, the other factors were found to have an impact on PPP implementation and in some

cases the factors are found to be barriers for implementing a successful PPP program in Pakistan. The same conclusion was revealed upon inclusion of the additional exogeneous variables obtained from the survey data into the panel vector auto regression model. The empirical results of this chapter contain valuable information on the issues of infrastructural development in Pakistan.

Chapter Seven Conclusions

The final chapter is organised as follows: Section 7.1 summarises key findings of the study and conclusions drawn from the data analyses. In Section 7.2 the significance and contributions of the study are highlighted. This is followed by a discussion of the implementations of the findings of the study in Section 7.3. Finally, in Section 7.4, the limitations of the study are discussed and recommendations are made for future research in the PPP sector.

Drastic increases in population growth and urbanisation in Pakistan demands more infrastructure facilities. Conversely, the country is unable to develop required infrastructure services due to financial constraints. In this context, private-sector involvement in terms of PPP is crucial for provision of infrastructure facilities. However, the business environment is not conducive to developing PPP projects, and organisational capacity and the country's institutional framework are ineffective and inefficient for monitoring and regulating PPP projects prudently and successfully. This thesis has identified the essential ingredients for a successful implementation of PPP programs in Pakistan. The findings and conclusions of the econometric estimation results are provided below. The next section summaries the findings in relation to the research questions (Section 1.5).

7.1 Findings and conclusions

7.1.1 Findings

The estimation of the panel regression model was carried out by using generalised least squares (GLS) and the panel VAR (PVAR) model of this by the Generalised Method of Moment (GMM) estimation. Utilising the post-estimation analyses that includes Hausman (1978) tests for model selection (between fixed effects and random effects models) and a Lagrange multiplier (LM), tests for serial correlation were performed to check: (i) economic theory consistency; (ii) sign consistency; (iii) statistical significance of policy variables; (iv) model adequacy; (v) goodness-of-fit tests; and (vi) classical testing framework (t-test and F-test) applied by Wald testing approaches for comparing the growth parameter among panel and their interaction. The PVAR and PVAR-X models were estimated using Abrigo and Love (2015) in STATA, while the panel regression is estimated in STATA.

The study that underpins this thesis investigated whether the total investment (public and private) was dependent on GDP, interest rate, institutional capacity, public sector capacity, private sector capacity and other factors. The estimated results from Granger causality tests revealed that all variables are interrelated and have feedback affects. The total investment jointly with public and private investment are causally related to GDP and interest rates (changes in GDP and interest rates do have their joint effects on total investment, public investment and private investment). Further, total investment, public and private investment are also individually causally related to GDP and interest rates (changes in GDP and interest rates do have their individual effects on total investment, public investment and private investment). Interest rates were found to be economically insignificant in a public investment model but they were found to affect the total investment, private investment and GDP. Conversely, public investment and GDP have an impact on interest rates. Private investment and interest rate were found to be jointly causally related to GDP (changes in private investment and interest rates do have their joint effects on GDP). The estimated results of the analyses indicate that an increase in GDP increases the interest rate. But shocks to interest rates over short- and long-term periods cause no change to its own and to the public investment (changes in interest rates did not have an effect on interest rates and public investment).

The research studies also investigated whether institutions and the public and private sectors have the capacity to implement PPP programs in Pakistan. The studies also explored whether other factors including: factor 1 (admin/rules and regulations); factor 2 (delay in project execution); factor 3 (public and private sectors experience and qualification); and factor 4 (unrealistic feasibility study) have an impact on Pakistan's PPP programs by applying PVAR models. The PVAR model was extended to a PVAR – X model by combining the survey data within the panel data to address the objectives of this thesis. The indicators such as investment, GDP, interest rate, institutional capacity, public sector capacity, private sector capacity and other factors were included in the model.

Within the panel data analysis presented above, institutional capacity was found to be an important determinant of PPP implementation. The results of public- and private-sector capacity suggest that total investment, public sector investment and private sector investment have a significant relationship at 10 percent level of significance in most cases. It is concluded that institutions do not have the capacity for managing PPP programs in Pakistan. However, the institutional capacity level has been increasing gradually since 1991 and was at its highest level

in 2014. The public and the private sectors not only lack the capacity for participating and managing PPP infrastructure projects/investment but also are the barriers against taking part for public infrastructure development on PPP modality. On the whole, the results of this thesis revealed that the other factors have an impact on PPP implementation and are statistically significant at the 10 percent level. Therefore, other factors in some cases are barriers for implementing a successful PPP program in Pakistan.

7.1.2 Conclusions

The estimation of the results revealed that institutional capacity has been increasing over the time and was at its peak in 2014. However, institutional capacity is insufficient to manage PPP programs effectively. In other words, institutional capacity is an impediment for implementing PPP programs in Pakistan. The private sector lacks experience and expertise for carrying out PPP programs in Pakistan. The public sector in Pakistan also does not have the capacity for maximising benefits from the use of PPP procurement methods for developing infrastructure in Pakistan.

The econometric test results have also revealed that poor public administration, rigid rules and regulations cause delays in project execution, lack of public- and private-sector PPP experience and qualifications, and unrealistic PPP feasibility studies and projections are the major barriers in PPP implementation in Pakistan. Overall, a lack of institutional capacity, public- and private-sector capacity and the lack of a PPP conducive environment are the impediments in PPP program implementation in Pakistan.

7.2 Significance and contributions

This study makes a significant contribution to the PPP literature, methodological approaches and particularly to identifying the impediments in implementing PPP programs in Pakistan and largely in developing countries.

There are no standard criteria or a general framework available for identifying the determents of PPP implementation. However, the assessment criteria are developed in the light of a number of methods and techniques used by various researchers and multilateral agencies such as: Vieitez Martinze, 2008; Chan et al., 2009; Economists' Intelligence Unit's (2009); Jooste & Raymond, 2009; Regan et al., 2009; Nisar, 2011; UNESCAP, 2010 The World Bank Institute's (2011); and Research findings of Klijn and Teisman, 2003; NAO, 2003; Chan et al., 2009;

Stephan and Raymond, 2009; Yuan et al., (2009); Jin and Zhang, 2010; UNESCAP-PPP Network, 2010; and Tahir, 2011. Different approaches are offered typically by multilateral agencies in the public sector perspective. However, this study provides a mechanism that can help in exploring major barriers for implementing PPP programs in Pakistan. Based on this mechanism, this study concentrated on attaining key elements and investigating their contributions for implementing a successful PPP program in Pakistan. These constituents include total investment (public and private), real GDP, interest rate, institutional capacity, public- and private-sector capacity and other factors/possible barriers for implementing PPP programs in Pakistan.

This thesis aimed to compare the role of state institutions, and public- and private-sector capacity for strengthening PPP infrastructure procurement methods in Pakistan. The research analyses provided a comprehensive survey of major obstructions in undertaking PPP in Pakistan. The estimated test statistics found that there is a statistically significant relationship between institutions and public- and private-sector capacity for implementing a successful PPP program. In other words, this thesis presents a valuable insight on how the institutional impediments, lack of both public- and private-sector capacity and other possible factors may have deterred the adoption of a successful PPP program in Pakistan.

This thesis is one of the first studies to explore institutional and organisational capabilities (public- and private-sector capacity) and possible barriers in adoption of PPP in the perspective of Pakistan. In fact, this thesis is the first attempt at compiling a comprehensive framework that examines how a successful PPP program can be implemented in Pakistan. It is an important addition to the literature and helps in understanding how and why PPP models may or may not work effectively in different institutional and organisational settings.

7.2.1 Contribution to research methodology

This thesis contributes to increased sophistication in research methodology by building up and estimating panel multiple regression models within the panel vector autoregression framework. All quantitative variables were treated as endogenous and modelled as a panel vector autoregression (PVAR) model and extending it to PVAR – X combining the qualitative and quantiative data.

7.2.2 Contribution to the policy debate

The private-sector capacity for implementing PPP programs has not been assessed in developing countries until now. The evaluation/importance of private-sector capacity for implementing an effective and efficient PPP program has been ignored by previous researchers.Therefore, no previous methods and techniques have been available for evaluating this aspect of PPP performance. This thesis contributes to the policy debate by including private-sector capacity for determining PPP performance and implementing PPP programs. Furthermore, it also provides a valid method and technique for evaluating private-sector capacity for implementing PPP programs in Pakistan.

7.3 Implications

This thesis provides important information for, and inputs into, government policy development and implementation such as: (i) removing the identified barriers for implementing and encouraging PPP undertakings in Pakistan for infrastructure development; (ii) valuable insights on how institutional impediments may have deterred the adoption of PPP in Pakistan; and (iii) understanding how and why the PPP model may or may not work effectively in different institutional settings.

Just as developed countries are reaping the benefits of PPP by improving and providing infrastructure facilities, Pakistan can benefit from efficient and effective PPP procurement methods for developing infrastructure facilities without placing a burden on the public budget.

7.4 Limitations and future research

The focus of this thesis is limited to the determinants of PPP implementation in Pakistan only. Other determinants of PPP implementation i.e. openness of the economy and financial sector etc., were not investigated or identified. Some issues that were more related to other aspects of infrastructure development were not taken into the consideration. However, further data is needed to understand the dynamic economic effects of infrastructure development. The study findings provide guidelines for PPP implementation in Pakistan and can be extended to other developing countries and/or multi-country studies for generating useful comparisons and revealing more useful information that have application well beyond the countries studied.

Appendices

Appendix I: Credit rating tiers

Moody's		S&P		Fitch		Rating description	
Long-term	Short-term	Long-term	Short-term	Long-term	Short-term		
Aaa	P-1	AAA	A-1+	AAA	F1+	Prime	Investment grade
Aa1		AA+		AA+		High grade	
Aa2		AA		AA			
Aa3		AA−		AA−			
A1		A+	A-1	A+	F1	Upper medium grade	
A2		A		A			
A3	P-2	A−	A-2	A−	F2		
Baa1		BBB+		BBB+		Lower medium grade	
Baa2	P-3	BBB	A-3	BBB	F3		
Baa3		BBB−		BBB−			
Ba1	Not prime	BB+	B	BB+	B	Non-investment grade speculative	Non-investment grade AKA high-yield bonds AKA junk bonds
Ba2		BB		BB			
Ba3		BB−		BB−			
B1		B+		B+		Highly speculative	
B2		B		B			
B3		B−		B−			
Caa1		CCC+	C	CCC	C	Substantial risks	
Caa2		CCC				Extremely speculative	
Caa3		CCC−				Default imminent with little prospect for recovery	
Ca		CC					
		C					
C		D	/	DDD	/	In default	
/				DD			
				D			

Appendix II: Rating tier definitions

Moody's	Standard & Poor's	Fitch	Credit worthiness
Aaa	AAA	AAA	An obligor has EXTREMELY STRONG capacity to meet its financial commitments.
Aa1	AA+	AA+	An obligor has VERY STRONG capacity to meet its financial commitments. It differs from the highest-rated obligors only to a small degree.
Aa2	AA	AA	
Aa3	AA−	AA−	
A1	A+	A+	An obligor has STRONG capacity to meet its financial commitments but is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligors in higher-rated categories.
A2	A	A	
A3	A−	A−	
Baa1	BBB+	BBB+	An obligor has ADEQUATE capacity to meet its financial commitments. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitments.
Baa2	BBB	BBB	
Baa3	BBB−	BBB−	
Ba1	BB+	BB+	An obligor is LESS VULNERABLE in the near term than other lower-rated obligors. However, it faces major ongoing uncertainties and exposure to adverse business, financial, or economic conditions which could lead to the obligor's inadequate capacity to meet its financial commitments.
Ba2	BB	BB	
Ba3	BB−	BB−	
B1	B+	B+	An obligor is MORE VULNERABLE than the obligors rated 'BB', but the obligor currently has the capacity to meet its financial commitments. Adverse business, financial, or economic conditions will likely impair the obligor's capacity or willingness to meet its financial commitments.
B2	B	B	
B3	B−	B−	
Caa	CCC	CCC	An obligor is CURRENTLY VULNERABLE, and is dependent upon favourable business, financial and economic conditions to meet its financial commitments.
Ca	CC	CC	An obligor is CURRENTLY HIGHLY-VULNERABLE.
	C	C	The obligor is CURRENTLY HIGHLY-VULNERABLE to non-payment. May be used where a bankruptcy petition has been filed.
C	D	D	An obligor has failed to pay one or more of its financial obligations (rated or unrated) when it became due.
e, p	pr	Expected	Preliminary ratings may be assigned to obligations pending receipt of final documentation and legal opinions. The final rating may differ from the preliminary rating.
WR			Rating withdrawn for reasons including: debt maturity, calls, puts, conversions, etc., or business reasons (e.g. change in the size of a debt issue), or the issuer defaults. [3]
Unsolicited	Unsolicited		This rating was initiated by the ratings agency and not requested by the issuer.
	SD	RD	This rating is assigned when the agency believes that the obligor has selectively defaulted on a specific issue or class of obligations but it will continue to meet its payment obligations on other issues or classes of obligations in a timely manner.
NR	NR	NR	No rating has been requested, or there is insufficient information on which to base a rating.

1. *Jahan, Sarwat. "Inflation Targeting: Holding the Line". International Monetary Funds, Finance & Development. Retrieved 28 December 2014.*
2. **Jump up^** *"Monetary Policy". Federal Reserve Board. January 3, 2006.*
3. **Jump up^** *"Monetary and Exchange Rate Policies". Handbook of Development Economics, Elsevier. 2010.*

Appendix III: Public sector survey questionnaire

Determinants of public private partnership performance: the case of Pakistan

1. Personal information:

- Name: _____
- Job title: _____
- Gender: 1. Male 2. Female
- Age range: 1. ≤ 30 2. 31-40 3. 41-50 4. ≥ 51
- Qualifications 1. PhD 2. Master 3. Graduate 4. Intermediate
- No. of years of work: 1. 1-5 2. 6-10 3. 11-15 4. ≥ 16
- Years in the current job: 1. 1-5 2. 6-10 3. 11-15 4. ≥ 16

2. Organisation:

- Name: _____
- Address: _____
- Date of inception: _____
- Business line: 1. Telecommunication 2. Power 3. Transport
- Involved in PPP: 1. No 2. Yes if yes, when _____

3. The importance of infrastructure.

A. Infrastructure and the performance of your organisation.

(Please indicate to what extent you agree or disagree with each of the statements: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4= Agree and 5= Strongly Agree or Not Applicable)

Better infrastructure helps your organisation to:

	Strongly Disagree **1**	Disagree **2**	Neutral **3**	Agree **4**	Strongly Agree **5**
1. Reduce operating costs	○	○	○	○	○
2. Bring forward investment	○	○	○	○	○
3. Improve capital productivity	○	○	○	○	○
4. Improve labour productivity	○	○	○	○	○
5. Increase revenue	○	○	○	○	○
6. Improve service delivery	○	○	○	○	○
7. Create business opportunities	○	○	○	○	○
8. Improve operational networks	○	○	○	○	○
9. Improve profitability	○	○	○	○	○
Other benefits. Please specify:	○	○	○	○	○
	○	○	○	○	○

_____

_____

_____

B. Infrastructure and the economic growth of Pakistan.

Better infrastructure helps Pakistan to:	Strongly Disagree **1**	Disagree **2**	Neutral **3**	Agree **4**	Strongly Agree **5**
1. Create employment opportunities	○	○	○	○	○
2. Increase public revenue	○	○	○	○	○
3. Increase market size	○	○	○	○	○
4. Increase public capital stocks	○	○	○	○	○
5. Increase productivity	○	○	○	○	○
6. Improve people's standard of living	○	○	○	○	○
Other benefits. Please specify:	○	○	○	○	○

_____

_____

_____

4. The public sector capacity and PPP programme.

(Note: Please write down the score as given in the attached Scoring Criteria – Public Sector Capacity Assessment)

Public Sector Capacity Assessment scores as per scoring criteria					
Year	**Does the Chief Executive of your organisation have PPP awareness and ownership?**	**Does your organisation have PPP experience?**	**Does your organisation have financial capacity to implement PPP?**	**Does your organisation have managerial skills to implement PPP?**	**Does your organisation have the capacity to select right PPP model and project?**
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
2006					
2007					
2008					
2009					
2010					

Scoring Criteria - Public Sector Capacity Assessment

(1=lowest capacity and 5=highest capacity)

Sr. No.	Description	Scoring				
		1	2	3	4	5
1	**Does the Chief Executive of your organisation have PPP awareness and ownership?**	• No awareness • No ownership • No support for PPP • No expertise	• Has PPP awareness; **but**, • No ownership • No support for PPP • No expertise	• Has PPP awareness • Ownership • Support for PPP; **but**, • No expertise	• Has PPP awareness • Ownership • Support for PPP • Expertise to some extent; **but**, • PPP is not on priority	• Has PPP awareness • Ownership • Support for PPP • Expertise to implement PPP
2	**Does your organisation have PPP experience?**	• No PPP experience; **but**, • Developing expertise	• Has limited expertise and PPP-related experience • 1-4 years' experience	• Has reasonable expertise and PPP-related experience • 5-8 years' experience	• Has sufficient expertise and PPP-related experience • 9-12 years' experience	• Has ample expertise and PPP-related experience • ≥ 13 years' experience
3	**Does your organisation have financial capacity to implement PPP?**	• No financial capacity • No long-term lending facilities • No mechanisms for financial risk management	• Has limited financial capacity; **but**, • No long-term lending facilities • No mechanisms for financial risk management	• Has reasonable financial capacity; **but**, • No long-term lending facilities • No mechanisms for financial risk management	• Has required financial capacity; **but**, • Needs effective control on projects cost overrun • Has mechanisms for financial risk management; **but**, need improvement	• Has financial capacity to deliver PPP projects successfully • Has capacity to mitigate financial risk effectively
4	**Does your organisation have managerial skills to implement PPP?**	• No managerial capacity • No mechanisms to mitigate projects related risks	• Has limited managerial capacity; **but**, • No mechanisms to mitigate projects related risks	• Has reasonable managerial capacity; **but**, • No mechanisms to mitigate projects related risks	• Has necessary expertise; **but**, • Mechanisms to mitigate project-related risks needs improvement	• Has operational and managerial capacity to deliver PPP projects successfully • Has capacity to mitigate project-related risks effectively
5	**Does your organisation have the capacity to select right PPP model and project?**	• No expertise and experience to select right PPP model and project • No services monitoring mechanisms	• Has limited expertise and experience to select right PPP model and project; **but**, • No services monitoring mechanisms	• To some extent has expertise and experience to select right PPP model and project; **but**, • No services monitoring mechanisms	• Has necessary expertise and experience to select right PPP model and project; **but**, • Services monitoring mechanisms needs improvement	• Has expertise and experience to select right PPP model and project • Has effective services monitoring mechanisms

5. Present institutional arrangements and PPP programme in Pakistan.

(Note: Please write down the Score as given in the attached Scoring Criteria – Institutional Capacity Assessment)

Institutional Capacity Assessment **scores as per scoring criteria**						
Year	**Does PPP unit/board exist in your organisation?**	**Are procurement methods transparent?**	**Are PPP contracts enforced?**	**Do dispute-resolution mechanisms exist?**	**Does your organisation allow private sector participation in projects development?**	**Are DCMs capable of providing finance for infrastructure projects?**
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						

Scoring Criteria – Institutional Capacity

Sr. No.	Description	Scoring				
		1	2	3	4	5
1	**Does PPP unit/board exist in your organisation?**	• No PPP unit/ board exists • No accountability • Not independent from rent seekers • Ineffective monitoring system	• PPP unit/board exists; **but**, • No accountability • Not independent from rent seekers • Ineffective monitoring system	• PPP unit/board exists • Accountable • Independent from rent seekers; **but**, • Ineffective monitoring system	• PPP unit/board exists • Accountable • Independent from rent seekers • Monitoring system is operative; **but**, • Needs improvements	• PPP unit/board exists • Accountable • Independent from rent seekers • Monitoring system is effective
2	**Are procurement methods transparent?**	• Project selection and bidding process is not transparent • Regulations are ambiguous • Negotiation process is poor • Financial and economic factors are disregarded during project procurement process	• Project selection and bidding process is fair; **but**, • Regulations are ambiguous • Negotiation process is poor • Financial and economic factors are disregarded during project procurement process	• Project selection and bidding process is fair • Regulations are clearly defined; **but**, • Negotiation process is poor • Financial and economic factors are disregarded during project procurement process	• Project selection and bidding process is fair • Regulations are clearly defined • Negotiation process is satisfactory; **but**, • Financial and economic factors occasionally considered during project procurement process	• Project selection and bidding process is fair • Regulations are clearly defined • Negotiation process is fair • Financial and economic factors are taken care of during project procurement process
3	**Are PPP contracts enforced?**	• Weak enforcement of PPP contract • Investors' right are disregarded • No effective appeal process	• Judiciary occasionally upholds PPP contracts; **but**, • Investors' right are disregarded • No effective appeal process	• Judiciary usually upholds PPP contracts • Investors' rights are protected; **but**, not in effective way • No effective appeal process	• Judiciary consistently upholds PPP contracts; **but**, • Needs improvement • Investors' rights are protected • Appeals process is satisfactory	• PPP contracts are effectively enforced • Investors' rights are protected • Appeals process is acceptable
4	**Do dispute-resolution mechanisms (DMRs) exist?**	• Dispute-resolution systems for PPP are undefined and insufficient • Not transparent or ineffective • Arbitration and appeals are lengthy and complex	• DRMs exist; **but**, • Not transparent and ineffective • Arbitration and appeals are lengthy and complex	• DRMs exist • Transparent and effective; **but**, • Arbitration and appeals are lengthy and complex	• Comprehensive DRMs exist • Transparent and effective; **but**, • Arbitration and appeals process needs improvements	• Comprehensive transparent and effective DRMs (established independent arbitration system) exists • Disputes are resolved according to law and contracts without lengthy appeals.
5	**Does your organisation allow private sector participation (PSP) in projects development?**	• PSP not allowed • Regulations and procedures are restricted	• Limited opportunity for PSP; **but**, • Regulations and procedures are restricted	• Has opportunity for PSP; **but**, • Regulations and procedures are ambiguous	• Has opportunity for PSP • Selected projects have been completed with PSP; **but**, • Regulations need improvement	• Organisation has enabling environment for PSP • Few projects have been completed with PSI and several are in pipeline
6	**Are domestic capital markets (DCMs) capable of providing finance for infrastructure projects?**	• DCMs are underdeveloped • Risk-hedging instruments are not robust	• DCMs are slowly developing; **but**, • Risk-hedging instruments are no robust	• DCMs are limited to finance infrastructure projects; **but**, • Risk-hedging instruments are not robust	• DCMs have capacity to provide sufficient financing; **but**, • Needs improvement • Risk-hedging instruments are limited/developing	• DCMs have capacity to provide reliable financing and risk-hedging instruments

6. Availability of guidance materials:

PPP standard documents/sector specific guidance	1. Yes	2. No
PPP standard model contracts	1. Yes	2. No
PPP project preparation guidelines	1. Yes	2. No

7. Barriers to PPP programme implementations in Pakistan.

Possible barriers:	Strongly Disagree **1**	Disagree **2**	Neutral **3**	Agree **4**	Strongly Agree **5**
1. Governance – bureaucratic approvals and formalities are involved in project initiative	○	○	○	○	○
2. Lengthy delays due to lack of PPP awareness	○	○	○	○	○
3. Lengthy delays due to political debates	○	○	○	○	○
4. Lengthy delays in negotiations between contracting parties	○	○	○	○	○
5. Delay due to resistance from community groups	○	○	○	○	○
6. Delay due to resistance from environmentalists	○	○	○	○	○
7. Delay due to modifications in original project design	○	○	○	○	○
8. Modifications in original project design increase costs	○	○	○	○	○
9. Lack of coordination at the federal level	○	○	○	○	○
10. Lack of coordination at the provincial level	○	○	○	○	○
11. Lack of coordination at the municipal level	○	○	○	○	○
12. Lack of unidirectional policy framework	○	○	○	○	○
13. Apprehension of the government agencies to lose public control over project management	○	○	○	○	○
14. Inconsistency of public polices	○	○	○	○	○
15. Investment policies framework has its focus only to attract investment rather than any defined objectives	○	○	○	○	○
16. Excessive regulations and complex legal framework	○	○	○	○	○
17. Judicial system is not supportive to PPP	○	○	○	○	○
18. No use of public sector competitor/ benchmark PPP model prior to request for bids	○	○	○	○	○
19. Lack of experience and appropriate skills to implement PPP projects by the public sector	○	○	○	○	○
20. Lack of experience and appropriate skills to implement PPP projects by the private sector	○	○	○	○	○
21. Lack of specialised research for PPP in Pakistan	○	○	○	○	○
22. Lack of on-the-job training opportunities for PPP					

	Neutral **3**	Strongly Disagree **1**	Disagree **2**	Agree **4**	Strongly Agree **5**
23. Inflexible tariff adjustment (tariff is not adjusted according to change in consumer price index)	○	○	○	○	○
24. Unrealistic financial models (unrealistic revenue and expenditure)	○	○	○	○	○
25. Unrealistic assumptions in feasibility studies	○	○	○	○	○
Additional possible barriers:					
26. _____	○	○	○	○	○
27. _____	○	○	○	○	○
28. _____	○	○	○	○	○
29. _____	○	○	○	○	○

8. In your opinion, what are the key factors that can drive successful PPP programme in Pakistan? *(Please use additional sheet if required)*

_____

_____

9. Please suggest changes in laws, regulations and administrative procedures required for successful implementation of PPP in Pakistan, if any.

_____

_____

10. Private sector investment and the performance of your organisation.
Increased private investment helps your organisation to:

	Strongly Disagree **1**	Disagree **2**	Neutral **3**	Agree **4**	Strongly Agree **5**
1. Introduce modern technology	○	○	○	○	○
2. Reduce operating costs	○	○	○	○	○
3. Increase revenue	○	○	○	○	○
4. Bring forward public investment	○	○	○	○	○
5. Create job opportunities	○	○	○	○	○
6. Improve capital productivity	○	○	○	○	○
7. Improve labour productivity	○	○	○	○	○
8. Improve public amenity	○	○	○	○	○
9. Improve service delivery	○	○	○	○	○
10. Improve operational networks	○	○	○	○	○

Appendix IV: Private sector survey questionnaire

Determinants of public private partnership performance: the case of Pakistan

1. Personal information:

- Name: _____
- Job title: _____
- Gender: 1. Male 2. Female
- Age range: 1. ≤ 30 2. 31-40 3. 41-50 4. ≥ 51
- Qualifications 1. PhD 2. Master 3. Graduate 4. Intermediate
- No. of years of work: 1. 1-5 2. 6-10 3. 11-15 4. ≥ 16
- Years in the current job: 1. 1-5 2. 6-10 3. 11-15 4. ≥ 16

2. Organisation:

- Name: _____
- Address: _____
- Date of inception: _____
- Business line: 1. Telecommunication 2. Power 3. Transport
- Involved in PPP: 1. No 2. Yes if yes, when _____

3. The importance of infrastructure.

B. Infrastructure and the performance of your organisation.

(Please indicate to what extent you agree or disagree with each of the statements: 1=Strongly Disagree, 2=Disagree, 3=Neutral, 4= Agree and 5= Strongly Agree or Not Applicable)

Better infrastructure helps your organisation to:

	Strongly Disagree **1**	Disagree **2**	Neutral **3**	Agree **4**	Strongly Agree **5**
11. Reduce operating costs	○	○	○	○	○
12. Bring forward investment	○	○	○	○	○
13. Improve capital productivity	○	○	○	○	○
14. Improve labour productivity	○	○	○	○	○
15. Increase revenue	○	○	○	○	○
16. Improve service delivery	○	○	○	○	○
17. Create business opportunities	○	○	○	○	○
18. Improve operational networks	○	○	○	○	○
19. Improve profitability	○	○	○	○	○
Other benefits. Please specify:	○	○	○	○	○

_____

_____

_____

B. Infrastructure and the economic growth of Pakistan.

Better infrastructure helps Pakistan to:	Strongly Disagree **1**	Disagree **2**	Neutral **3**	Agree **4**	Strongly Agree **5**
7. Create employment opportunities	○	○	○	○	○
8. Increase public revenue	○	○	○	○	○
9. Increase market size	○	○	○	○	○
10. Increase public capital stocks	○	○	○	○	○
11. Increase productivity	○	○	○	○	○
12. Improve people's standard of living	○	○	○	○	○
Other benefits. Please specify:	○	○	○	○	○

_____

_____

_____

4. The public sector capacity and PPP programme.

(Note: Please write down the score as given in the attached Scoring Criteria – Public Sector Capacity Assessment)

Public Sector Capacity Assessment scores as per scoring criteria					
Year	**Does the Chief Executive of your organisation have PPP awareness and ownership?**	**Does your organisation have PPP experience?**	**Does your organisation have financial capacity to implement PPP?**	**Does your organisation have managerial skills to implement PPP?**	**Does your organisation have the capacity to select right PPP model and project?**
1991					
1992					
1993					
1994					
1995					
1996					
1997					
1998					
1999					
2000					
2001					
2002					
2003					
2004					
2005					
2006					
2007					
2008					
2009					
2010					

Scoring Criteria - Public Sector Capacity Assessment

(1=lowest capacity and 5=highest capacity)

Sr. No.	Description	Scoring				
		1	2	3	4	5
1	**Does the Chief Executive of your organisation have PPP awareness and ownership?**	• No awareness • No ownership • No support for PPP • No expertise	• Has PPP awareness; **but**, • No ownership • No support for PPP • No expertise	• Has PPP awareness • Ownership • Support for PPP; **but**, • No expertise	• Has PPP awareness • Ownership • Support for PPP • Expertise to some extent; **but**, • PPP is not on priority	• Has PPP awareness • Ownership • Support for PPP • Expertise to implement PPP
2	**Does your organisation have PPP experience?**	• No PPP experience; **but**, • Developing expertise	• Has limited expertise and PPP-related experience • 1-4 years' experience	• Has reasonable expertise and PPP-related experience • 5-8 years' experience	• Has sufficient expertise and PPP-related experience • 9-12 years' experience	• Has ample expertise and PPP-related experience • ≥ 13 years' experience
3	**Does your organisation have financial capacity to implement PPP?**	• No financial capacity • No long-term lending facilities • No mechanisms for financial risk management	• Has limited financial capacity; **but**, • No long-term lending facilities • No mechanisms for financial risk management	• Has reasonable financial capacity; **but**, • No long-term lending facilities • No mechanisms for financial risk management	• Has required financial capacity; **but**, • Needs effective control on projects cost overrun • Has mechanisms for financial risk management; **but**, need improvement	• Has financial capacity to deliver PPP projects successfully • Has capacity to mitigate financial risk effectively
4	**Does your organisation have managerial skills to implement PPP?**	• No managerial capacity • No mechanisms to mitigate projects related risks	• Has limited managerial capacity; **but**, • No mechanisms to mitigate projects related risks	• Has reasonable managerial capacity; **but**, • No mechanisms to mitigate projects related risks	• Has necessary expertise; **but**, • Mechanisms to mitigate project-related risks needs improvement	• Has operational and managerial capacity to deliver PPP projects successfully • Has capacity to mitigate project-related risks effectively
5	**Does your organisation have the capacity to select right PPP model and project?**	• No expertise and experience to select right PPP model and project • No services monitoring mechanisms	• Has limited expertise and experience to select right PPP model and project; **but**, • No services monitoring mechanisms	• To some extent has expertise and experience to select right PPP model and project; **but**, • No services monitoring mechanisms	• Has necessary expertise and experience to select right PPP model and project; **but**, • Services monitoring mechanisms needs improvement	• Has expertise and experience to select right PPP model and project • Has effective services monitoring mechanisms

5. Present institutional arrangements and PPP programme in Pakistan.

(Note: Please write down the Score as given in the attached Scoring Criteria – Institutional Capacity Assessment)

Institutional Capacity Assessment **scores as per scoring criteria**						
Year	**Does PPP unit/board exist in your organisation?**	**Are procurement methods transparent?**	**Are PPP contracts enforced?**	**Do dispute-resolution mechanisms exist?**	**Does your organisation allow private sector participation in projects development?**	**Are DCMs capable of providing finance for infrastructure projects?**
1991						
1992						
1993						
1994						
1995						
1996						
1997						
1998						
1999						
2000						
2001						
2002						
2003						
2004						
2005						
2006						
2007						
2008						
2009						
2010						

Scoring Criteria – Institutional Capacity

Sr. No.	Description	Scoring				
		1	2	3	4	5
1	**Does PPP unit/board exist in your organisation?**	• No PPP unit/ board exists • No accountability • Not independent from rent seekers • Ineffective monitoring system	• PPP unit/board exists; **but**, • No accountability • Not independent from rent seekers • Ineffective monitoring system	• PPP unit/board exists • Accountable • Independent from rent seekers; **but**, • Ineffective monitoring system	• PPP unit/board exists • Accountable • Independent from rent seekers • Monitoring system is operative; **but**, • Needs improvements	• PPP unit/board exists • Accountable • Independent from rent seekers • Monitoring system is effective
2	**Are procurement methods transparent?**	• Project selection and bidding process is not transparent • Regulations are ambiguous • Negotiation process is poor • Financial and economic factors are disregarded during project procurement process	• Project selection and bidding process is fair; **but**, • Regulations are ambiguous • Negotiation process is poor • Financial and economic factors are disregarded during project procurement process	• Project selection and bidding process is fair • Regulations are clearly defined; **but**, • Negotiation process is poor • Financial and economic factors are disregarded during project procurement process	• Project selection and bidding process is fair • Regulations are clearly defined • Negotiation process is satisfactory; **but**, • Financial and economic factors occasionally considered during project procurement process	• Project selection and bidding process is fair • Regulations are clearly defined • Negotiation process is fair • Financial and economic factors are taken care of during project procurement process
3	**Are PPP contracts enforced?**	• Weak enforcement of PPP contract • Investors' rights are disregarded • No effective appeal process	• Judiciary occasionally upholds PPP contracts; **but**, • Investors' rights are disregarded • No effective appeal process	• Judiciary usually upholds PPP contracts • Investors' rights are protected; **but**, not in effective way • No effective appeal process	• Judiciary consistently upholds PPP contracts; **but**, • Needs improvement • Investors' rights are protected • Appeals process is satisfactory	• PPP contracts are effectively enforced • Investors' rights are protected • Appeals process is acceptable
4	**Do dispute-resolution mechanisms (DMRs) exist?**	• Dispute-resolution systems for PPP are undefined and insufficient • Not transparent or ineffective • Arbitration and appeals are lengthy and complex	• DRMs exist; **but**, • Not transparent and ineffective • Arbitration and appeals are lengthy and complex	• DRMs exist • Transparent and effective; **but**, • Arbitration and appeals are lengthy and complex	• Comprehensive DRMs exist • Transparent and effective; **but**, • Arbitration and appeals process needs improvements	• Comprehensive transparent and effective DRMs (established independent arbitration system) exists • Disputes are resolved according to law and contracts without lengthy appeals.
5	**Does your organisation allow private sector participation (PSP) in projects development?**	• PSP not allowed • Regulations and procedures are restricted	• Limited opportunity for PSP; **but**, • Regulations and procedures are restricted	• Has opportunity for PSP; **but**, • Regulations and procedures are ambiguous	• Has opportunity for PSP • Selected projects have been completed with PSP; **but**, • Regulations need improvement	• Organisation has enabling environment for PSP • Few projects have been completed with PSI and several are in pipeline
6	**Are domestic capital markets (DCMs) capable of providing finance for infrastructure projects?**	• DCMs are underdeveloped • Risk-hedging instruments are not robust	• DCMs are slowly developing; **but**, • Risk-hedging instruments are no robust	• DCMs are limited to finance infrastructure projects; **but**, • Risk-hedging instruments are not robust	• DCMs have capacity to provide sufficient financing; **but**, • Needs improvement • Risk-hedging instruments are limited/developing	• DCMs have capacity to provide reliable financing and risk-hedging instruments

6. Availability of guidance materials:

PPP standard documents/sector specific guidance	1. Yes	2. No
PPP standard model contracts	1. Yes	2. No
PPP project preparation guidelines	1. Yes	2. No

7. Barriers to PPP programme implementations in Pakistan.

Possible barriers:	Strongly Disagree **1**	Disagree **2**	Neutral **3**	Agree **4**	Strongly Agree **5**
30. Governance – bureaucratic approvals and formalities are involved in project initiative	○	○	○	○	○
31. Lengthy delays due to lack of PPP awareness	○	○	○	○	○
32. Lengthy delays due to political debates	○	○	○	○	○
33. Lengthy delays in negotiations between contracting parties	○	○	○	○	○
34. Delay due to resistance from community groups	○	○	○	○	○
35. Delay due to resistance from environmentalists	○	○	○	○	○
36. Delay due to modifications in original project design	○	○	○	○	○
37. Modifications in original project design increase costs	○	○	○	○	○
38. Lack of coordination at the federal level	○	○	○	○	○
39. Lack of coordination at the provincial level	○	○	○	○	○
40. Lack of coordination at the municipal level	○	○	○	○	○
41. Lack of unidirectional policy framework	○	○	○	○	○
42. Apprehension of the government agencies to lose public control over project management	○	○	○	○	○
43. Inconsistency of public polices	○	○	○	○	○
44. Investment policies framework has its focus only to attract investment rather than any defined objectives	○	○	○	○	○
45. Excessive regulations and complex legal framework	○	○	○	○	○
46. Judicial system is not supportive to PPP	○	○	○	○	○
47. No use of public sector competitor/ benchmark PPP model prior to request for bids	○	○	○	○	○
48. Lack of experience and appropriate skills to implement PPP projects by the public sector	○	○	○	○	○
49. Lack of experience and appropriate skills to implement PPP projects by the private sector	○	○	○	○	○
50. Lack of specialised research for PPP in Pakistan	○	○	○	○	○
51. Lack of on-the-job training opportunities for PPP					

	Neutral **3**	Strongly Disagree **1**	Disagree **2**	Agree **4**	Strongly Agree **5**
52. Inflexible tariff adjustment (tariff is not adjusted according to change in consumer price index)	○	○	○	○	○
53. Unrealistic financial models (unrealistic revenue and expenditure)	○	○	○	○	○
54. Unrealistic assumptions in feasibility studies	○	○	○	○	○
Additional possible barriers:					
55. _____	○	○	○	○	○
56. _____	○	○	○	○	○
57. _____	○	○	○	○	○
58. _____	○	○	○	○	○

8. In your opinion, what are the key factors that can drive successful PPP programme in Pakistan? *(Please use additional sheet if required)*

_____

_____

9. Please suggest changes in laws, regulations and administrative procedures required for successful implementation of PPP in Pakistan, if any.

_____

_____

_____

Appendix V: Information sheet of survey questionnaire

JAMES COOK UNIVERSITY AUSTRALIA

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Telephone +61 7 4781 4111
International +61 7 4781 4111
www.jcu.edu.au

Dear Sir/Madam

Determinants of public private partnership performance: the case of Pakistan

You are requested to kindly take part in my PhD research on the subject cited above. The attached questionnaire is a part of my PhD research, which examines the impact of institutional barriers to develop physical infrastructure including: telecommunication, power and transportation (railways, roadways, airports and seaports) through PPP in Pakistan. PPP is an arrangement in which the private sector supplies infrastructure assets and services traditionally provided by the governments. Today, various countries have achieved their infrastructure development by implementing PPP modality.

The objective of the study is to identify main obstacles, focusing on institutional impediments, to the implementation of PPP in Pakistan with a view of drawing policy implications to encourage greater adoption of PPP for infrastructure development. The valuable inputs from you will be worthwhile in investigating the critical factors that hinder the occurrence of PPP and the key factors that could drive successful PPP programme in Pakistan. The study is expected to provide important information and inputs towards government policy development to encourage PPP undertaking in Pakistan for meeting infrastructure demand.

If you have any questions about the study or in providing answers to the questions, please do not hesitate to contact me. If they could not be resolved via email or telephone, then I will organise to meet you personally on my next visit back to Pakistan. The survey is carried out on a voluntary and completely confidential basis. The information provided will be used as aggregated views of the survey participants and will not be attributed to a person or organisation.

The questionnaire will take about 30 minutes to complete. At the end of the study a copy of aggregated results will be provided to you, if so desired.

Many thanks for assisting this research.

Syed Azeem Ahmed Shah
PhD Candidate
School of Business
International +61 7 4781 3131
Facsimile +61 7 4781 4019
Email azeem.shah@my.jcu.edu.au

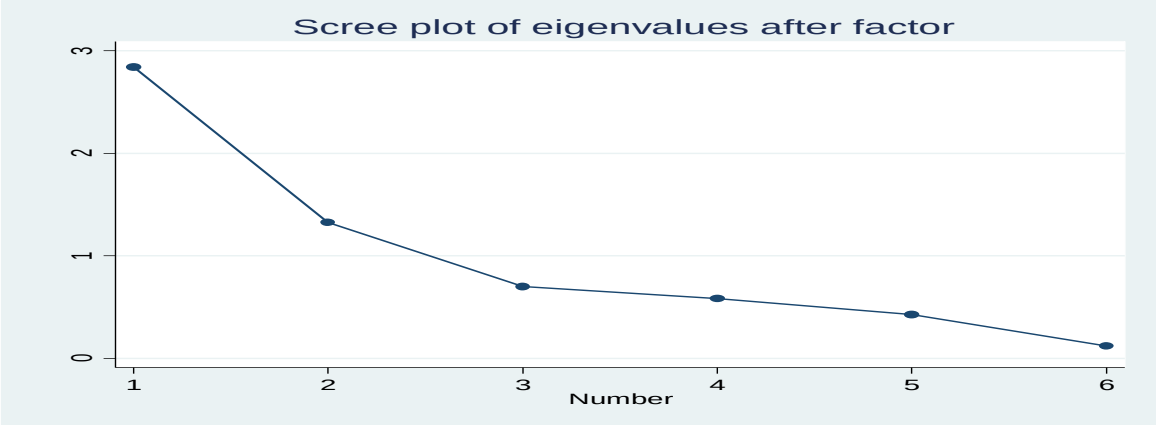
Appendix VI: Factor analysis results along with scree plots

X2: Infrastructure and the economic growth of Pakistan

Question X2 retains two factors.

Variable	Factor 1	Factor 2
q21: Create employment opportunities	0.58	0.44
q22: Increase public revenue	0.66	-0.46
q23: Increase market size	0.66	0.56
q24: Increase public capital stocks	0.52	0.59
q25: Increase productivity	0.87	-0.39
q26: Improve people's standard of living	0.79	-0.35

Reliability coefficient: alpha = 0.75



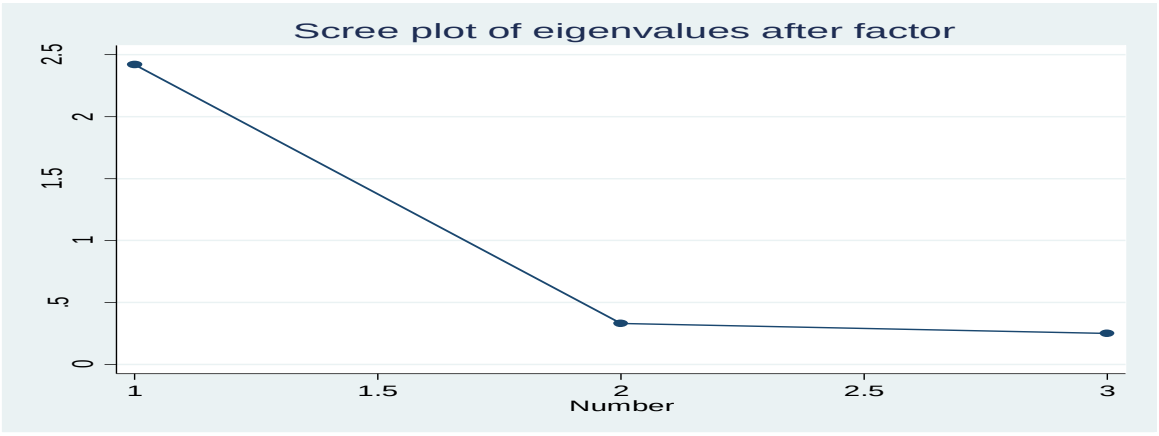
There are six (6) variables (sub-questions) in question X2. The factor analysis has chosen a mean of two factors to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X3: Availability of guidance materials

Question X3 retains one factor.

Variable	Factor 1
q31: PPP standard documents/sector specific guidance	0.92
q32: PPP standard model contracts	0.89
q33: PPP project preparation guidelines	0.88

Reliability coefficient: alpha = 0.99



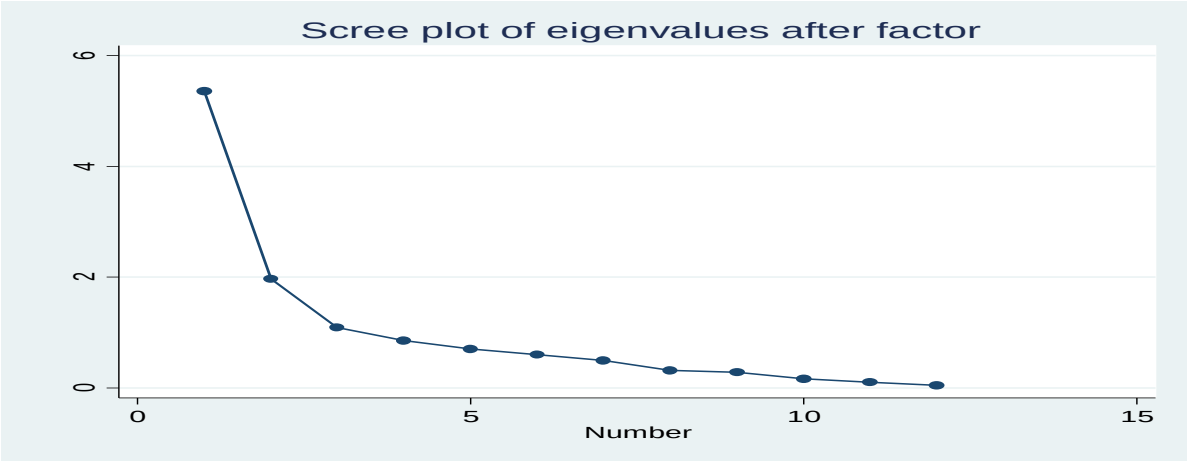
There are three (3) variables (sub-questions) in question X3. The factor analysis has chosen a mean of one factor to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X4: Barriers to PPP program implementations in Pakistan
(This question has been split into four sub-questions)
X4.1: Admin/Rules & Regulations
Question X4.1 retains three factors.

Variable	Factor 1	Factor 2	Factor 3
q411: Governance – bureaucratic approvals and formalities are involved	0.51	0.44	0.23
q412: Modifications in original project design increase costs	0.43	0.35	0.59
q413: Lack of coordination at the federal level	0.79	-0.52	0.13
q414: Lack of coordination at the provincial level	0.79	-0.56	0.13
q415: Lack of coordination at the municipal level	0.71	-0.47	0.30
q416: Lack of unidirectional policy framework	0.80	-0.22	-0.18
q417: Apprehension of the government agencies to lose public control over project management	0.65	0.33	-0.40
q418: Inconsistency of public polices	0.66	-0.059	-0.35
q419: Investment policies framework has its focus only to attract	0.66	0.55	-0.11
q4110: Excessive regulations and complex legal framework	0.72	0.25	0.26
q4111: Judicial system is not supportive of PPP	0.68	-0.06	-0.42
q4112: Inflexible tariff adjustment (tariff is not adjusted according to change in consumer price index)	0.54	0.57	0.02

Reliability coefficient: alpha = 0.87

Factor Loading

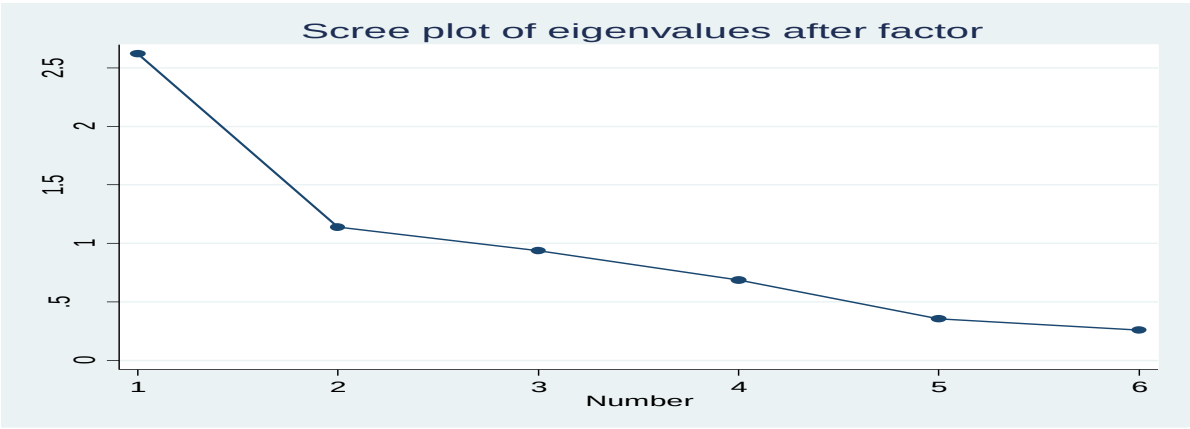


There are 12 variables (sub-questions) in question X4.1. The factor analysis has chosen a mean of three factors to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X4.2: Delay in Project execution
Question X4.2 retains two factors.

Variable	Factor 1	Factor 2
q421: Lengthy delays due to lack of PPP awareness	0.33	0.72
q422: Lengthy delays due to political debates	0.77	0.30
q423: Lengthy delays in negotiations between contracting parties	0.83	0.25
q424: Delay due to resistance from community groups	0.60	-0.59
q425: Delay due to resistance from environmentalists	0.74	-0.33
q426: Delay due to modifications in original project design	0.58	-0.15

Reliability coefficient: alpha = 0.73

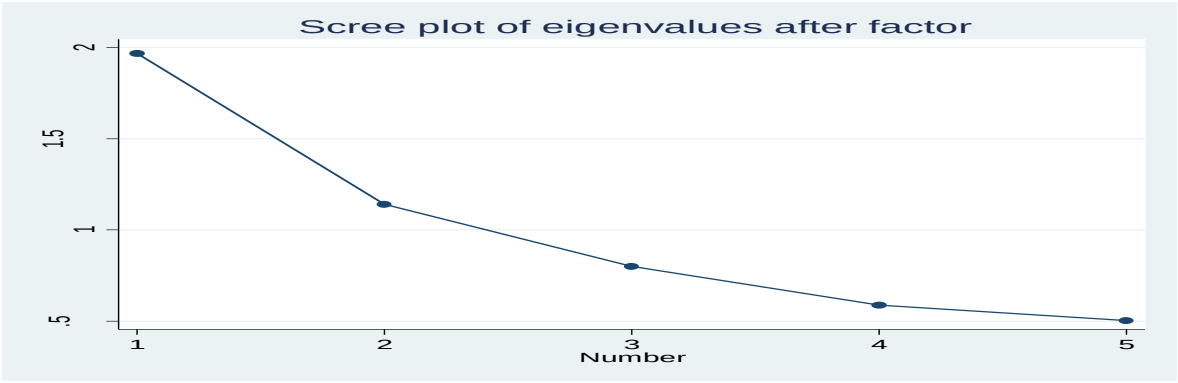


There are six (6) variables (sub-questions) in question X4.2. The factor analysis has chosen a mean of two factors to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X4.3: Public & Private Sectors' Experience and Qualification
Question X4.3 retains two factors.

Variable	Factor 1	Factor 2
q431: No use of public sector competitor/ benchmark PPP model prior to the request for bids	0.67	-0.54
q432: Lack of experience and appropriate skills to implement PPP	0.73	0.30
q433: Lack of experience and appropriate skills to implement PPP	0.32	0.86
q434: Lack of specialised research for PPP in Pakistan	0.66	-0.13
q435: Lack of on-the-job training opportunities for PPP	0.67	-0.09

Reliability coefficient: alpha = 0.53

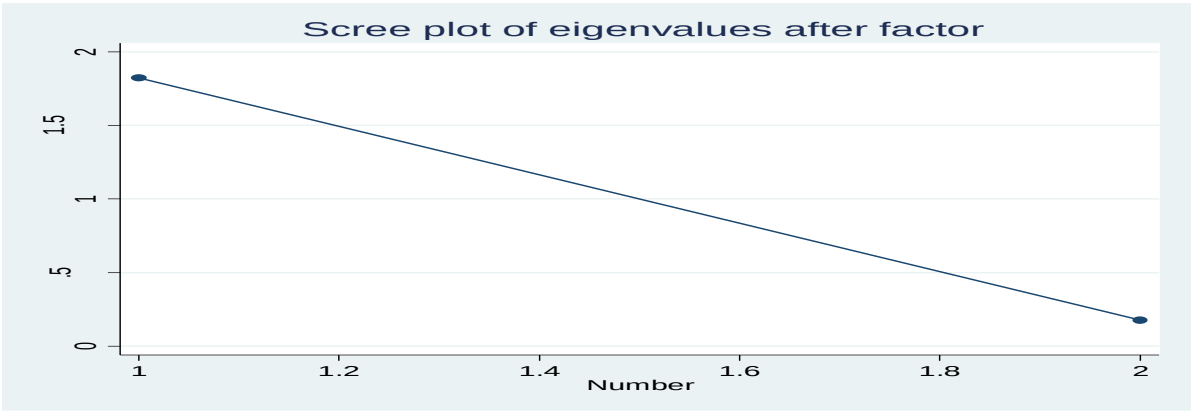


There are five (5) variables (sub-questions) in question X4.3. The factor analysis has chosen a mean of two factors to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X4.4: Unrealistic Feasibility Study
Question X4.4 retains one factor.

Variable	Factor 1
q441: Unrealistic financial models (unrealistic revenue and expenditure)	0.96
q442: Unrealistic assumptions in feasibility studies	0.96

Reliability coefficient: alpha = 0.90



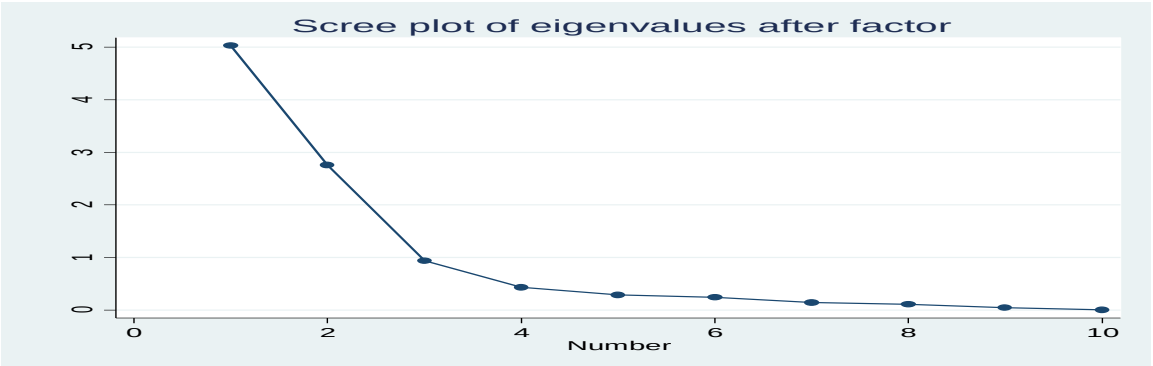
There are two (2) variables (sub-questions) in question X4.4. The factor analysis has chosen a mean of one factor to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X5: Private sector investment and the performance of your

Question X5 retains two factors.

Variable	Factor 1	Factor 2
q51: 1. Introduce modern technology	0.38	0.28
q52: Reduce operating costs	0.72	-0.56
q53: Increase revenue	0.69	-0.62
q54: Bring forward public investment	0.90	-0.19
q55: Create job opportunities	0.36	0.79
q56: Improve capital productivity	0.93	-0.31
q57: Improve labour productivity	0.90	-0.24
q58 Improve public amenity	0.66	0.63
q59: Improve service delivery	0.50	0.75
q510: Improve operational networks	0.77	0.43

Reliability coefficient: alpha = 0.89



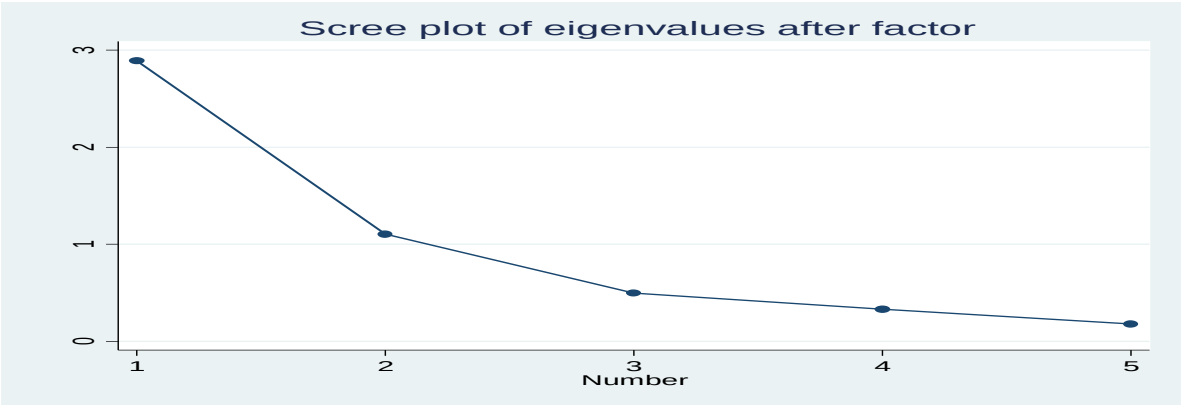
There are 10 (10) variables (sub-questions) in question X5. The factor analysis has chosen a mean of two factors to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X6: The public sector capacity and PPP program

Question X6 retains two factors.

Variable	Factor 1	Factor 2
q61: Does the Chief Executive of your organisation have PPP awareness and ownership?	0.79	-0.35
q62: Does your organisation have PPP experience?	0.85	0.045
q63: Does your organisation have the financial capacity to implement PPP?	0.21	0.94
q64: Does your organisation have managerial skills to implement PPP?	0.82	0.25
q65: Does your organisation have the capacity to select right PPP model and project?	0.91	-0.18

Reliability coefficient: alpha = 0.81



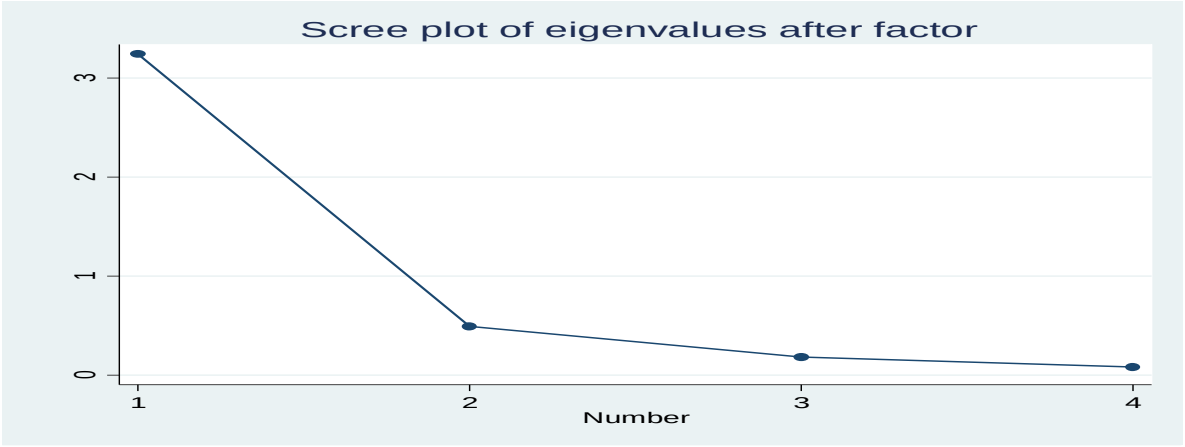
There are six (6) variables (sub-questions) in question X6. The factor analysis has chosen a mean of two factors to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X7: The private sector capacity and PPP program

Question X7 retains one factor.

Variable	Factor 1
q71: Does your organisation have PPP experience in the relevant sector?	0.95
q72: Does your organisation have competency and qualification (work plan and methodology)?	0.96
q73: Does your organisation have financial capacity?	0.78
q74: Does your organisation have managerial skills to implement PPP?	0.92

Reliability coefficient: alpha = 0.91



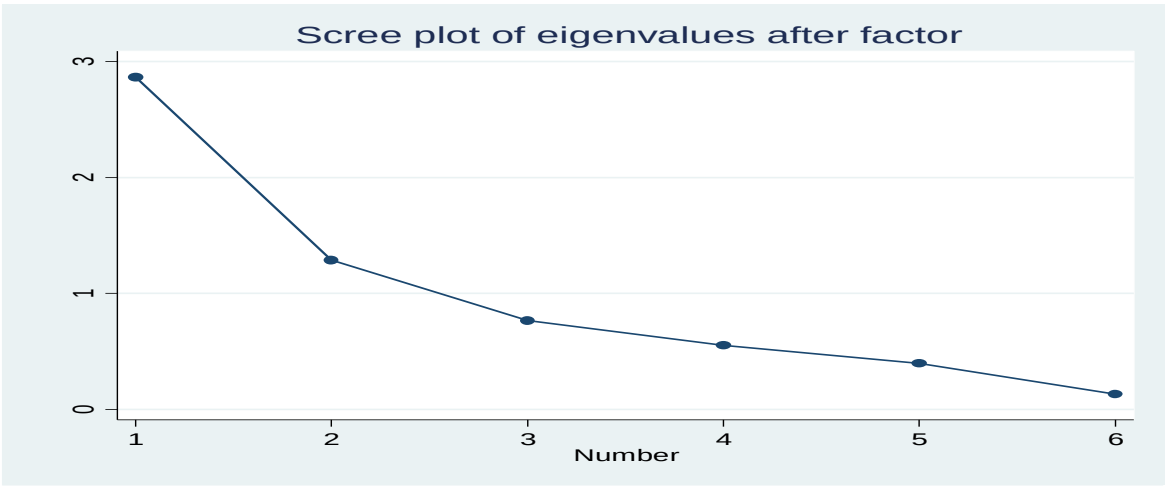
There are four (4) variables (sub-questions) in question X7. The factor analysis has chosen a mean of one factor to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

X8: Present institutional arrangements and PPP program in Pakistan.

Question X8 retains two factors.

Variable	Factor 1	Factor 2
q81: Does PPP unit/board exist in your organisation?	0.58	0.67
q82: Are procurement methods transparent?	0.84	-0.13
q83: Are PPP contracts enforced?	0.88	-0.05
q84: Do dispute-resolution mechanisms exist?	0.65	-0.50
q85: Does your organisation allow private sector participation in projects development?	0.55	0.63
q86: Are domestic capital markets capable of providing finance for infrastructure projects?	0.59	-0.43

Reliability coefficient: alpha = 0.89



There are six (6) variables (sub-questions) in question X8. The factor analysis has chosen a mean of two factors to sufficiently represent the question this question, as this set of questions is internally consistent and reliable.

Appendix VII: Panel unit root tests on log series

(The p-value of the respective tests is provided in parentheses)

Variables	***H₀: Panel variable is nonstationary*** ***H₁: Panel variable is stationary***						***H₀: Panel stationary*** ***H₁: Panel non-stationary***
	LLC Lags		**IPS Lags**		**Fisher Lags**		**Hadri**
	0	**1**	**0**	**1**	**0**	**1**	
Log of Real GDP (lnrgd_real)	-0.3956 (0.346)	1.541 (0.938)	2.718 (0.997)	4.401 (1.000)	0.061 (0.999)	0.113 (1.000)	28.681 (0.000)
Log of Investment (lninv)	-0.777 (0.219)	-0.263 (0.397)	0.059 (0.524)	0.823 (0.795)	6.196 (0.626)	3.369 (0.909)	14.441 (0.000)
Log of Private Investment (lninv1)	-1.102 (0.136)	-0.052 (0.479)	-1.202 (0.115)	0.986 (0.838)	15,669 (0.048)	9.671 (0.289)	14.453 (0.000)
Log of Public Investment (lninv2)	-1.839 (0.033)	-1.215 (0.113)	-2.201 (0.014)	-2.405 (0.008)	29.578 (0.001)	46.817 (0.000)	3.823 (0.001)
Log of Interest Rate 10 years (lnr)	0.139 (0.555)	-1.174 (0.121)	0.526 (0.701)	-0.616 (0.269)	3.608 (0.891)	7.749 (0.458)	10.863 (0.000)
Variables Differenced Series							
Δ Log of Real GDP (lnrgd_real)	-4.297 (0.000)	-1.572 (0.058)	-4.235 (0.000)	-2.137 (0.016)	37.242 (0.000)	17.584 (0.025)	-0.970 (0.834)
Δ Log of Investment (lninv)	-8.687 (0.000)	-2.655 (0.004)	-8.099 (0.000)	-3.600 (0.001)	95.139 (0.000)	34.049 (0.000)	-1.546 (0.939)
Δ Log of Private Investment (lninv1)	-10.601 (0.000)	-1.247 (0.106)	-10.511 (0.000)	-3.149 (0.000)	147.456 (0.000)	28.724 (0.000)	-1.638 (0.949)
Δ Log of Public Investment (Inv2)	-9.691 (0.000)	-6.733 (0.000)	-8.645 (0.000)	-6.785 (0.000)	103.286 (0.000)	89.051 (0.000)	-1.746 (0.959)
Δ Log of Interest Rate 10 years (lnr)	-4.794 (0.000)	-3.655 (0.001)	-4.259 (0.000)	-3.519 (0.000)	37.518 (0.000)	30.555 (0.000)	-0.191 (0.576)

Appendix VIII: Random effects panel regression estimation of log differenced of total investment – The GLS estimation

Number of observations = 69

Number of groups = 3

Overall R^2 = 0.1621

Wald $\chi^2(2)$ = 12.77 with a p-value of 0.0017

Dependent variable: $\Delta \ln(inv)$

	Coefficient	Standard error	z	P>|z|	[95% interval]	confidence
$\Delta \ln(gdp)$	.31403	.08809	3.56	0.000	.14138	.48668
$\Delta \ln(ir)$	-.00828	.01304	-0.64	0.525	-.03384	.01727
Constant	-.00954	.00382	-2.50	0.013	-.01702	-.00205
sigma_e	.01332					

Appendix IX: Random effects panel regression of log differenced of private investment – The GLS estimation

Number of observations = 69

Number of groups = 3

Overall R^2 = 0. 0626

Wald $\chi^2(2)$ = 4.40 with a p-value of 0.1106

Dependent variable: $\Delta \ln(invl)$

	Coefficient	Standard error	z	P>|z|	[95% interval]	confidence
$\Delta \ln(gdp)$	1.16097	.55835	2.08	0.038	.06663	2.2553
$\Delta \ln(ir)$	.00453	.08263	0.05	0.956	-.15743	.16648
Constant	-.03180	.02421	-1.31	0.189	-.07924	.01564
sigma_e	.08449					

Appendix X: Random effects panel regression of log differenced of public investment – The GLS estimation

Number of observations = 69

Number of groups = 3

Overall R^2 = 0.1084

Wald $\chi^2(2)$ = 8.02 with a p-value of 0.0181

Dependent variable: $\Delta \ln(inv2)$

	Coefficient	Standard error	z	P>|z|	[95% interval]	confidence
$\Delta \ln(gdp)$	.12966	.04803	2.70	0.007	.03552	.22379
$\Delta \ln(ir)$	-.00816	.00711	-1.15	0.251	-.02209	.00578
Constant	-.00383	.00208	-1.84	0.066	-.00791	.00026
sigma_e	.00732					

Appendix XI: Random effects panel regression of log differenced series and series and exogenous variable total investment– The GLS estimation

Number of observations = 69

Number of groups = 3

Overall R^2 = 0.3359

Wald $\chi^2(9)$ = 29.853 with p-value of 0.0005

Dependent variable: $\Delta \ln(inv)$

	Coefficient	Standard error	Z	P>|z|	[95% interval]	confidence
$\Delta \ln(gdp)$	.35381	.08815	4.01	0.000	.18102	.5266
$\Delta \ln(ir)$	-.00597	.01306	-0.46	0.648	-.03157	.01963
IC	.00276	.0015	1.84	0.066	-.00017	.0057
PBC	-.00344	.00187	-1.84	0.066	-.00712	.00022
PVC	.00345	.00184	1.88	0.061	-.00015	.00707
OF1	.00427	.00196	2.18	0.029	.00043	.00812
OF2	-.00127	.00189	-0.67	0.503	-.00499	.00245
OF3	-.00034	.00173	-0.2	0.843	-.00373	.00305
OF4	.00258	.00168	1.54	0.124	-.0007	.00588
Constant	-.04226	.01463	-2.89	0.004	-.07095	-.01356
sigma_e	.0123872					

Note: Δ represents the log differenced series. In this form, it can be used to measure the growth rate.

Appendix XII: Random effects panel regression with log differenced series and exogenous variable private investment– The GLS estimation

Number of observations = 69

Number of groups = 3

Overall R^2 = 0.2104

Wald $\chi^2(9)$ = 15.72 with p-value of 0.0729

Dependent variable: $\Delta \ln(invl)$

	Coefficient	Standard error	Z	P>|z|	[95% interval]	confidence
$\Delta \ln(gdp)$	1.39354	.57607	2.42	0.016	.26446	2.52263
$\Delta \ln(ir)$	.01759	.08535	0.21	0.837	-.1497	.1849
IC	.01272	.00981	1.3	0.195	-.0065	.03196
PBC	-.01834	.01224	-1.5	0.134	-.04235	.00565
PVC	.01628	.01204	1.35	0.176	-.00731	.03989
OF1	.02455	.01282	1.92	0.055	-.00056	.04968
OF2	-.00521	.01241	-0.42	0.674	-.02954	.01911
OF3	-.00538	.01132	-0.48	0.634	-.02758	.0168
OF4	.0214	.01099	1.95	0.052	-.00014	.04294
Constant	-.2191	.09566	-2.29	0.022	-.4066	-.03161
sigma_e	.08130177					

Appendix XIII: Random effects panel regression with log differenced series and exogenous public investment– The GLS estimation

Number of observations = 69

Number of groups = 3

Overall R^2 = 0.1671

Wald $\chi^2(9)$ = 11.84 with p-value of 0.2226

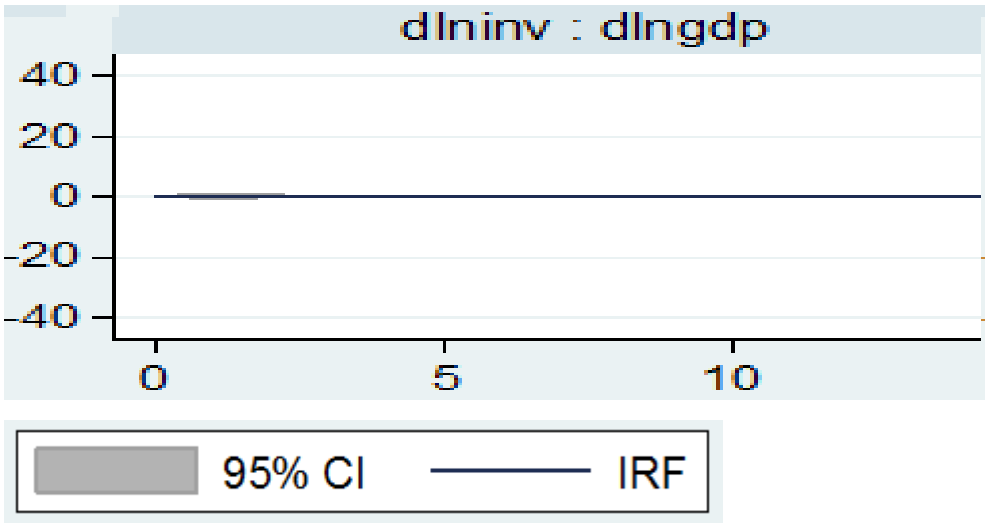
Dependent variable: $\Delta \ln(inv2)$

	Coefficient	Standard error	z	P>|z|	[95% interval]	confidence
$\Delta \ln(gdp)$	.13594	.05218	2.6	0.009	.03365	.23822
$\Delta \ln(ir)$	-.00816	.00773	-1.06	0.291	-.02332	.00699
IC	.00045	.00088	0.51	0.608	-.00128	.00219
PBC	-.00062	.0011	-0.56	0.575	-.00279	.00155
PVC	.00136	.00109	1.25	0.210	-.00077	.0035
OF1	.00049	.00116	0.43	0.667	-.00177	.00277
OF2	-.00041	.00112	-0.37	0.711	-.00262	.00178
OF3	.00074	.00102	0.73	0.465	-.00126	.00275
OF4	-.00061	.00099	-0.62	0.535	-.00256	.00133
Constant	-.00967	.00866	-1.12	0.264	-.02665	.00731
sigma_e	.00748655					

Appendix XIV: Impulse Response Function of PVAR – X Investment Shock to Total Investment

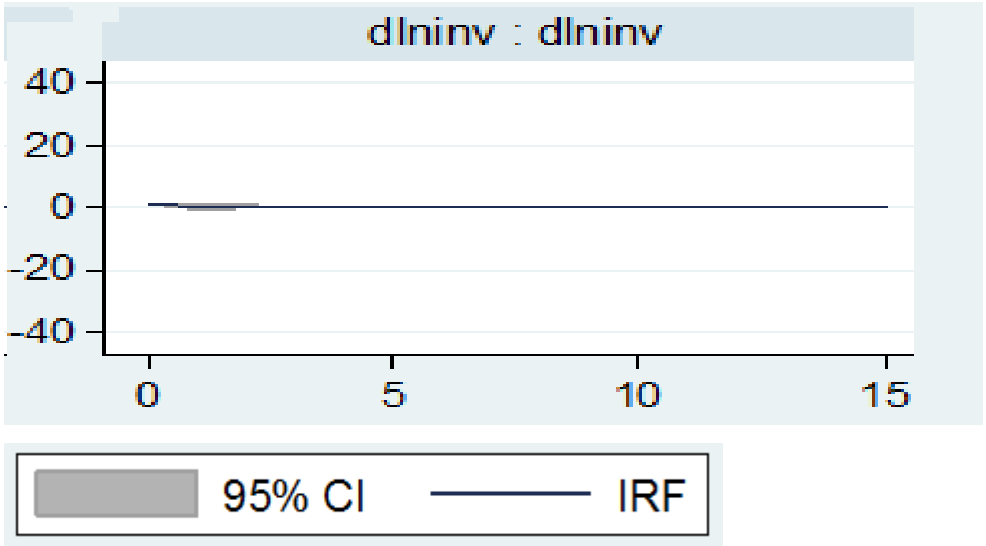
Graphs of impulse response function are presented below: -

The response of real GDP due to shock in total investment



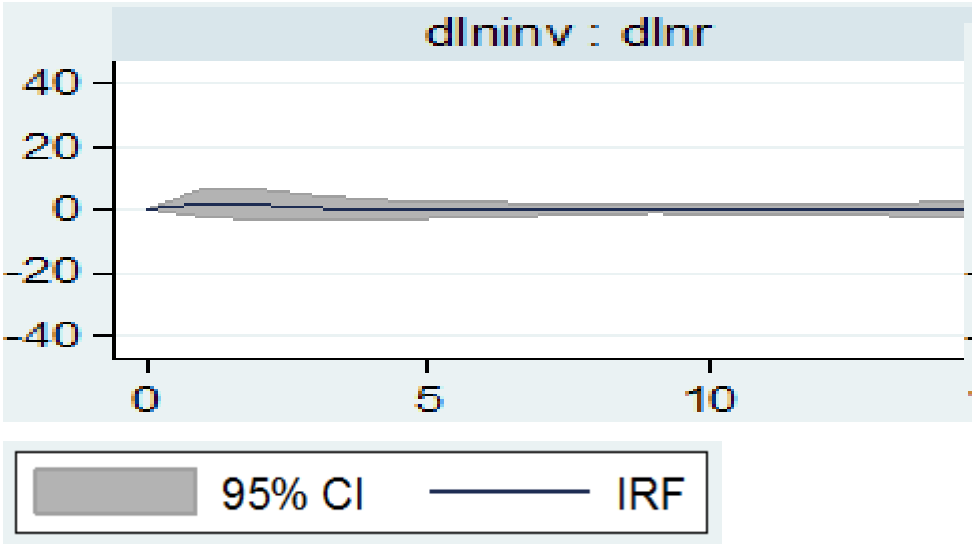
A one standard deviation shock to the investment increases real GDP to 0.236 and in periods 3 – 6 the pattern of movement begins to decrease to -0.043. Then after periods 7 – 10 it begins to increase, after slight variation it stables and then closes to 0.001.

The response of total investment due to shock in total investment



A one standard deviation shock to the investment increases its own to 0.180 and after periods 3 – 6 the pattern of movement begins to decrease to -0.035. The pattern has slight variation and eventually stable and then closes to 0.001.

The response of interest rate due to shock in total investment

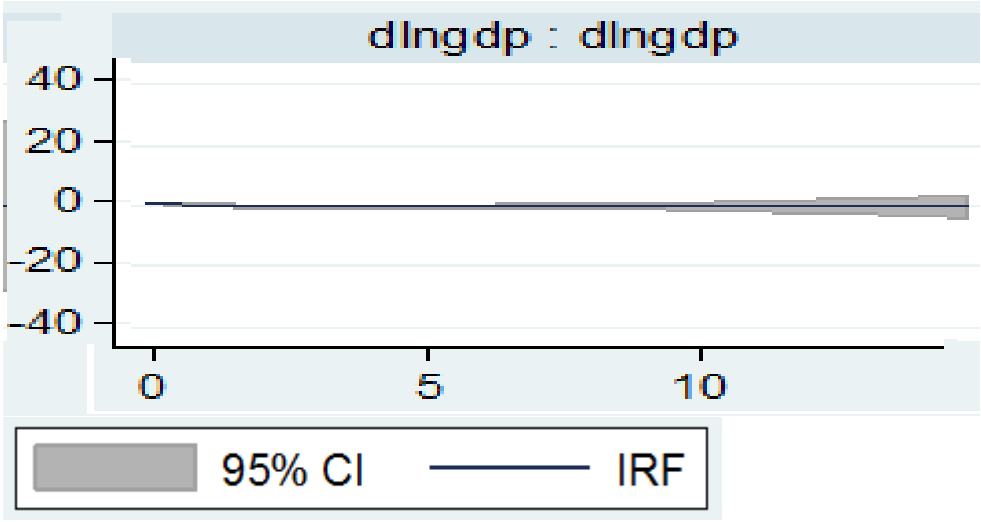


A one standard deviation shock to the investment decreases interest rate to -0.032 and in periods 4 – 7 the pattern of movement begins to increase to 0.035. But in periods 8 – 11 it decreases to -0.001. However, after periods 12 it begins to increase, stable and eventually closes to 0.001.

Appendix XV: Impulse Response Function of PVAR – X Investment Shock to Real GDP

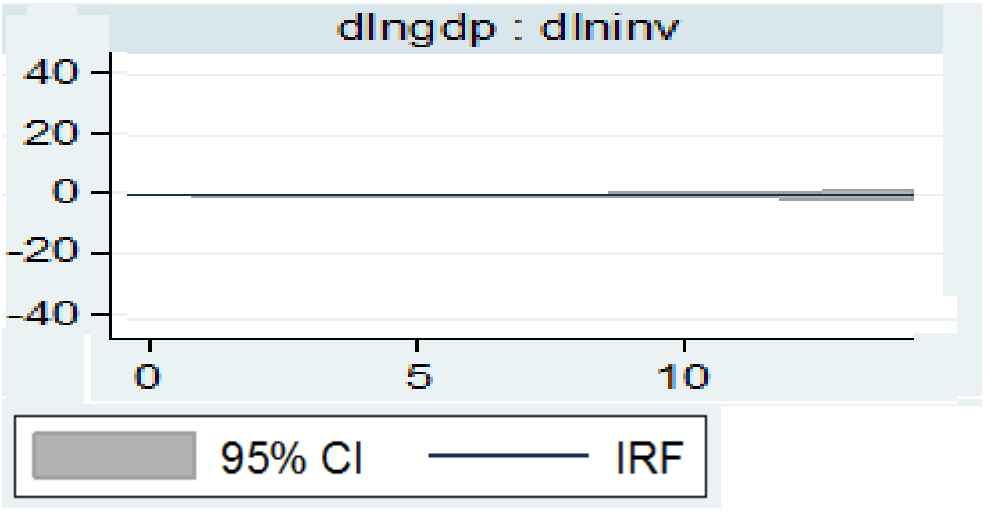
Graphs of impulse response function are presented below:-

The response of GDP due to Shock in real GDP



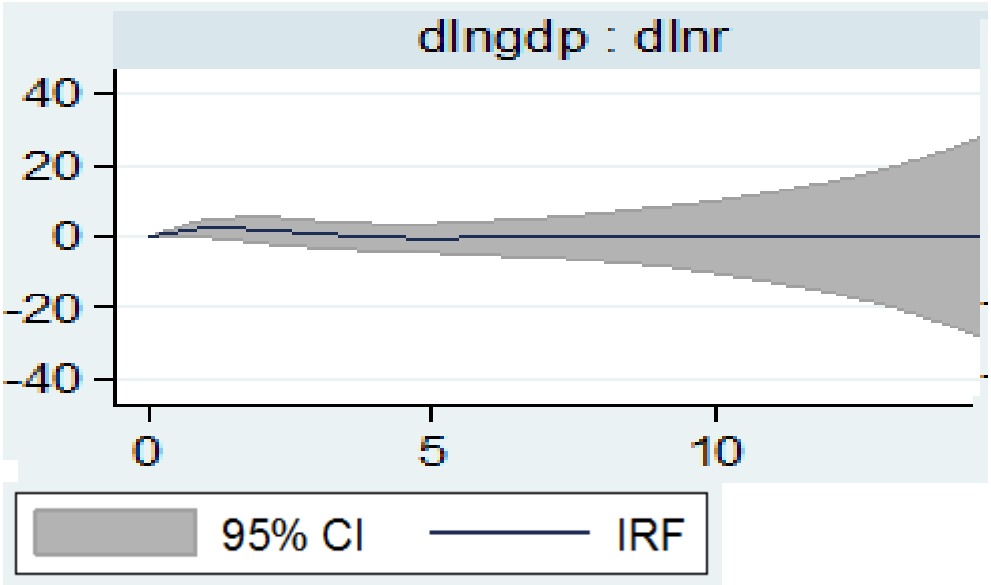
A one standard deviation shock to the real GDP increases its own to 0.432 and after slight variation from periods 3 – 6 the pattern of movement decreased, stable and eventually closes to -0.001.

The response of total investment due to shock in real GDP



A one standard deviation shock to the real GDP increases investment to 0.291 and after slight variation from periods 3 – 6 and 7 – 10 the pattern of movement decreased, stable and eventually closes to -0.001.

The response of interest rate due to Shock in real GDP

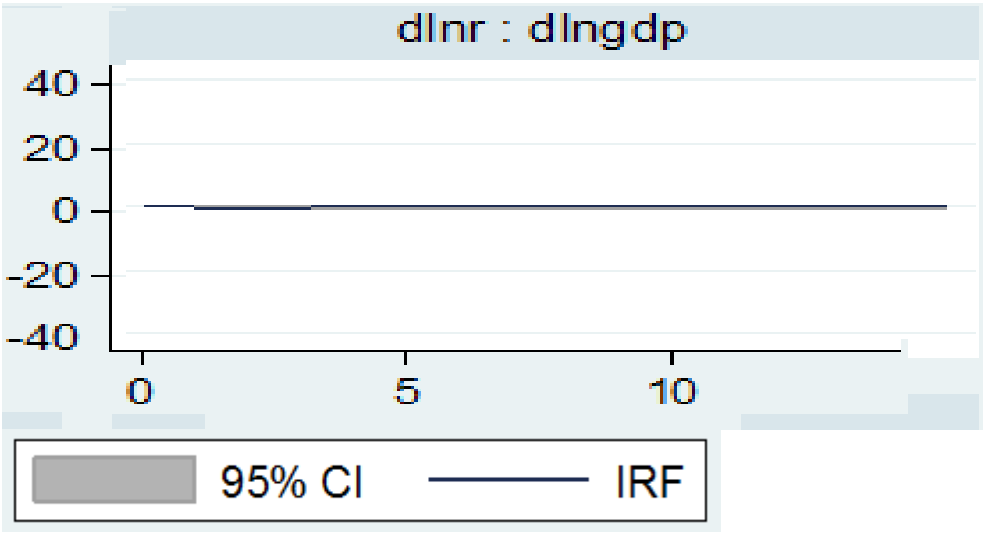


A one standard deviation shock to the real GDP decreases interest rate to -0.055. Then after periods 4 – 7 the pattern of movement begins to increase, stable. Then after periods 8 – 10 the pattern of movement begins to decrease and eventually closes to 0.001.

Appendix XVI: Impulse Response Function of PVAR – X Investment Shock to Interest Rate

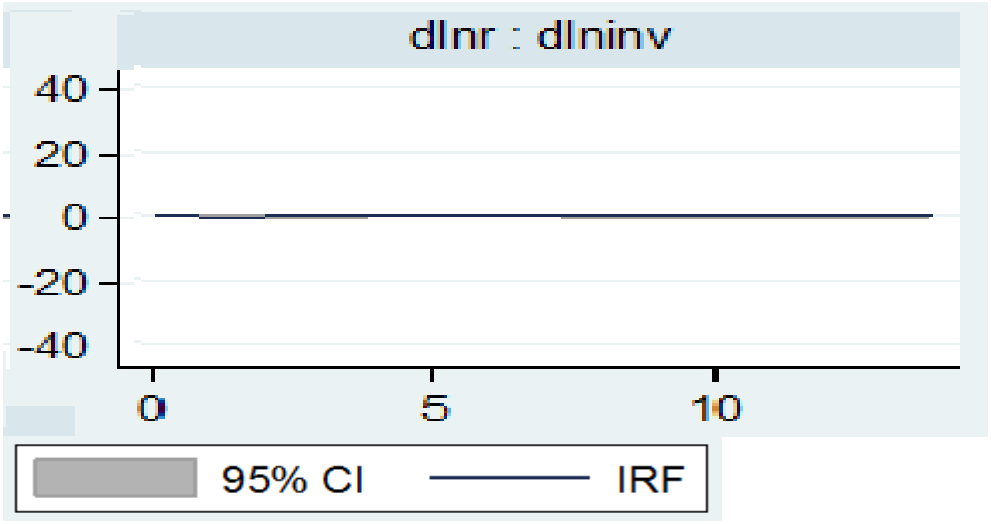
Graphs of impulse response function are presented below:-

The response of real GDP due to shock in interest rate



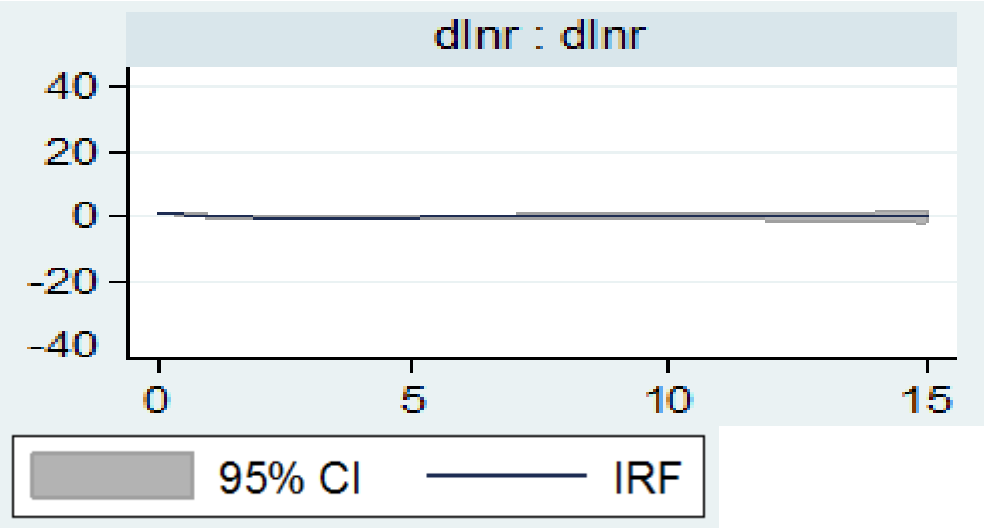
A one standard deviation shock to the interest rate increases real GDP to 2.529. Then after slight variation from periods 3 – 7 the pattern of movement decreased, stable and eventually closes to -0.001.

The response of total investment due to shock in interest rate



A one standard deviation shock to the interest rate increases investment to 2.089. After slight variation from periods 4 – 7 the pattern of movement decreased, stable and eventually closes to -0.001.

The response of interest rate due to shock in interest rate

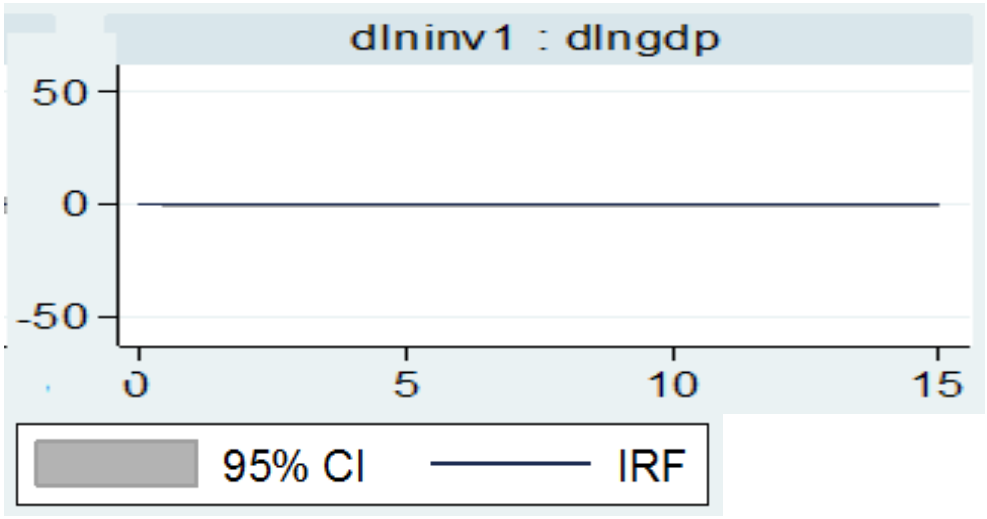


A one standard deviation shock to the interest rate increases its own to 0.209. Then after slight variation from periods 2 – 4 and from periods 10 – 13 the pattern of movement decreased, stable and eventually closes to 0.001.

Appendix XVII: Impulse Response Function of PVAR – X Private Investment Shock to Private Investment

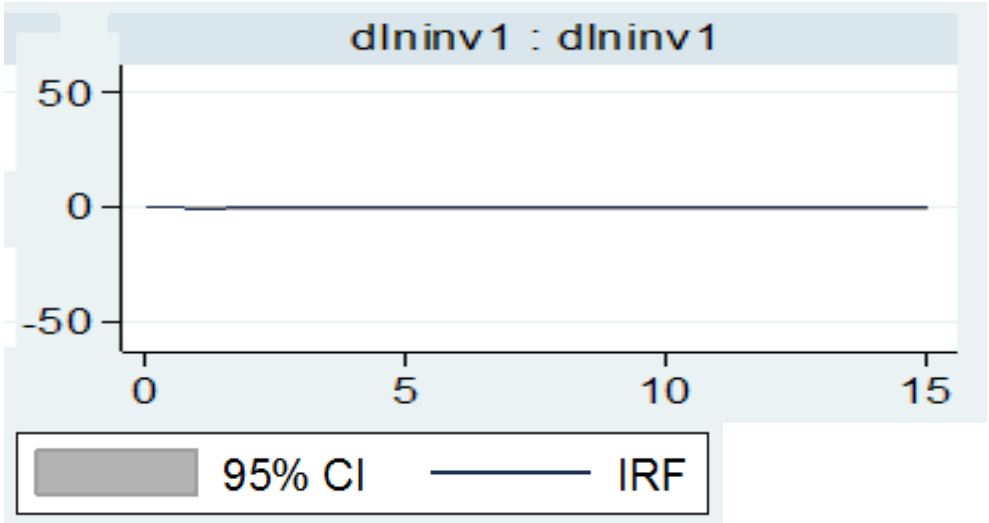
Graphs of impulse response function are presented below:-

The response of real GDP due to shock in private investment



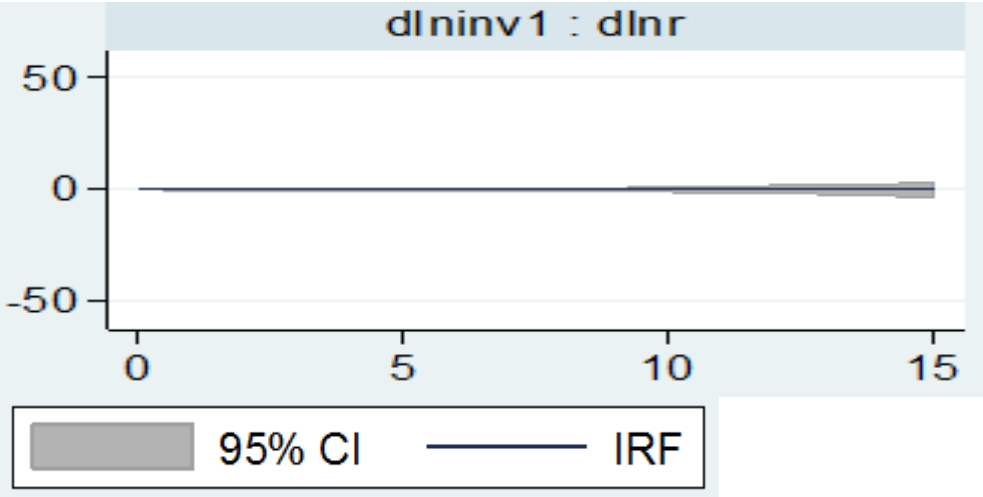
A one standard deviation shock to the real GDP increases real GDP to 1.590. Then in periods 4 – 9 the pattern of movement begins to decrease to -0.045 and after periods 10 – 14 the pattern of movement stable and eventually decreased to -8.54e-06.

The response of Private investment due to shock in private investment



A one standard deviation shock to the private investment decreases its own to -0.129 and after periods 3 - 9 the pattern of movement increased to 1.44e. After periods 10 – 14 it decreased to -66.53e. However, it eventually closes to 3.99e-08.

The response of interest rate due to shock in private investment

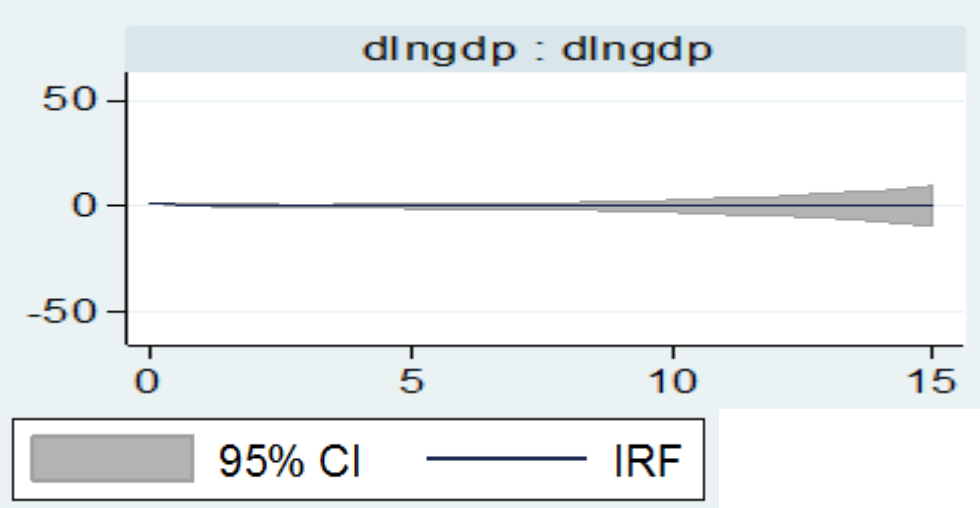


A one standard deviation shock to the private investment decreases interest rate to -0.820 and after Then after periods 6 – 10 it increased to -0.002. After periods 11 the pattern of movement stable and eventually decreased up to -8.17e-06.

Appendix XVIII: Impulse Response Function of PVAR – X Private Investment Shock to Real GDP

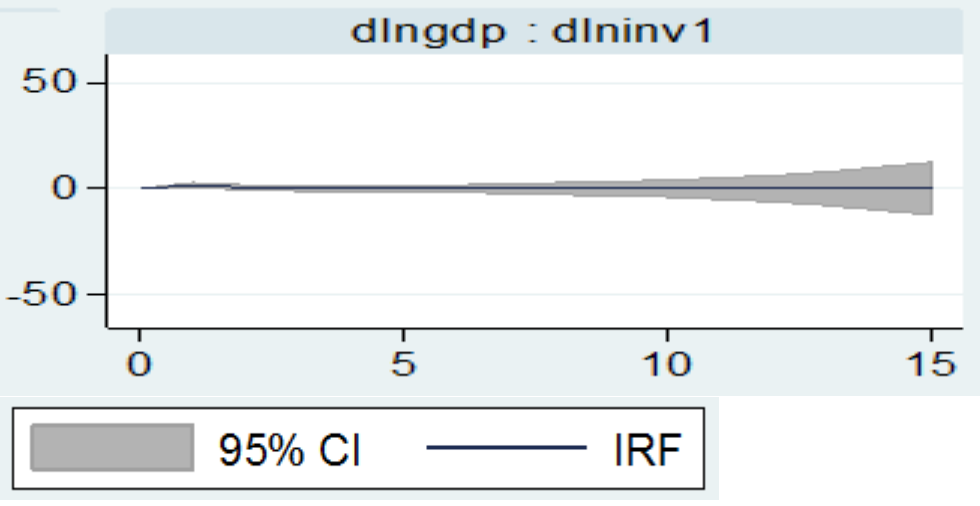
Graphs of impulse response function are presented below:-

The response of GDP due to Shock in real GDP



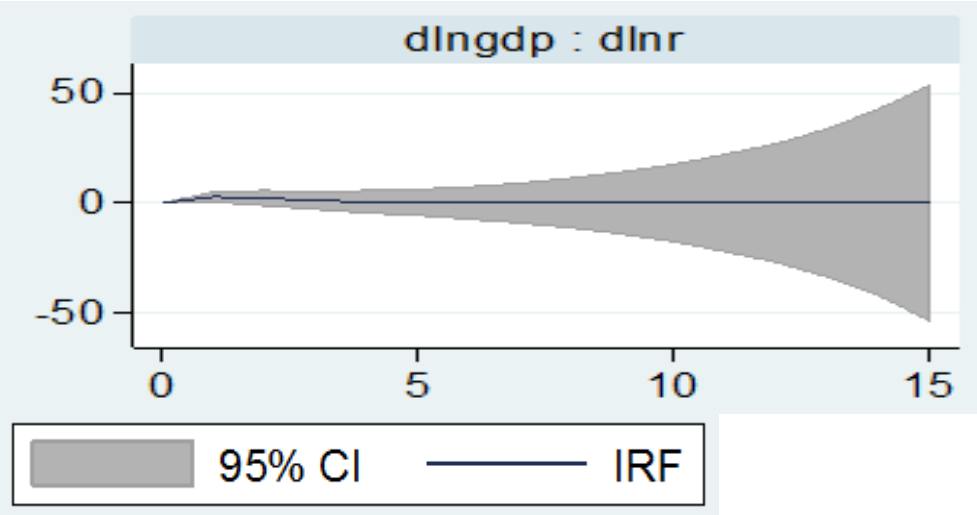
A one standard deviation shock to the real GDP increases its own to 0.564. Then in periods 4 – 9 the pattern of movement begins to decrease to -0.019 and after periods 10 – 14 with a slight variation the pattern of movement stable and increased to 0.001. However, the pattern eventually decreased to -3.33e-06.

The response of private investment due to shock in real GDP



A one standard deviation shock to the real GDP decreases investment to -0.004 and after periods 4 – 9 the pattern of movement increased to 9.50e. After periods 10 – 14 it decreased to -7.44e. However, it eventually closes to 1.54e-08.

The response of interest rate due to Shock in real GDP

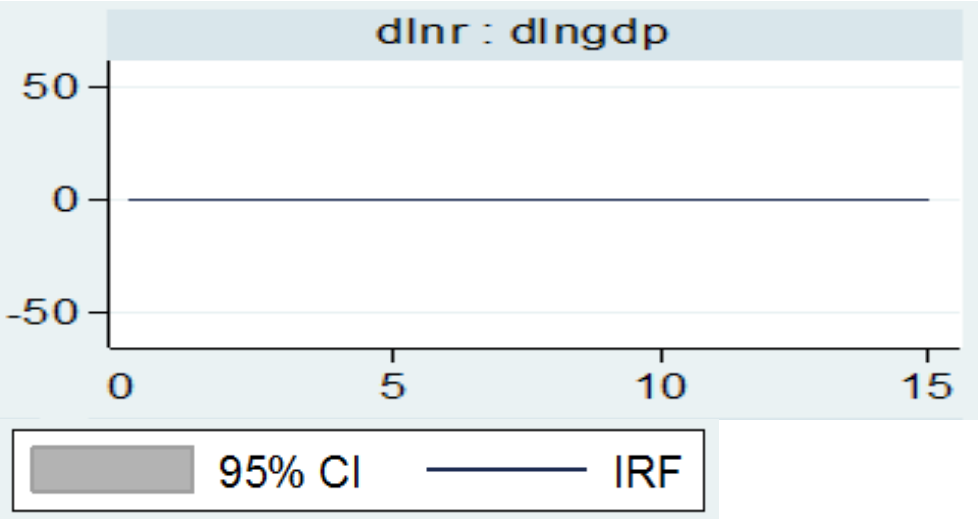


A one standard deviation shock to the real GDP decreases interest rate to -0.034 and then after periods 6 – 10 it increased to 0.002. However, after periods 11 the pattern of movement begins to decrease up to -9.41e-06.

Appendix XIX: Impulse Response Function of PVAR – X Private Investment Shock to Interest Rate

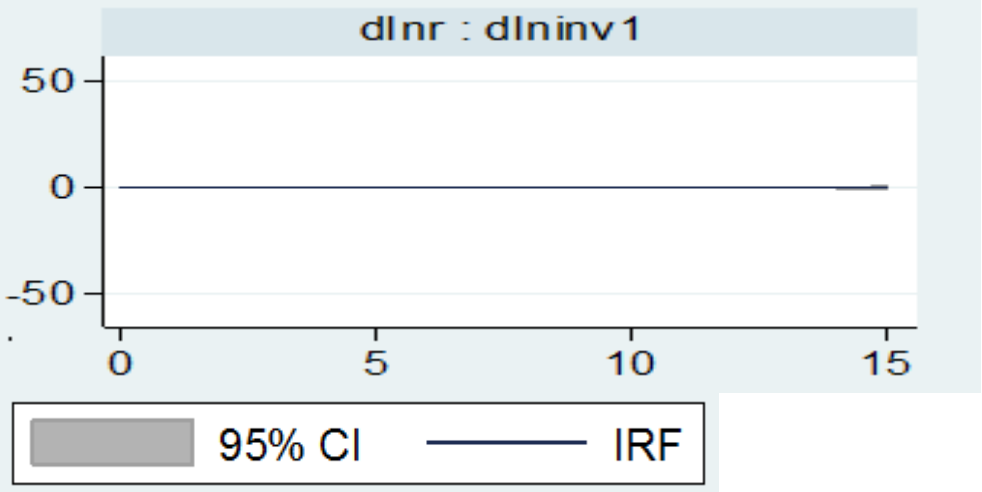
Graphs of impulse response function are presented below:-

The response of real GDP due to shock in interest rate



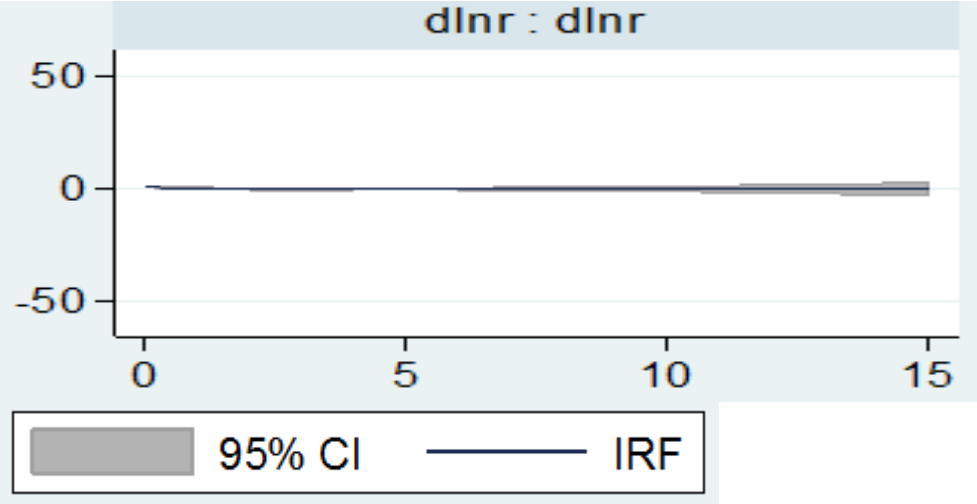
A one standard deviation shock to the interest rate increases real GDP to 2.740. After periods 6 – 10 the pattern of movement slightly decreased. Thereafter, the pattern stable and closes to 0.001.

The response of private investment due to shock in interest rate



A one standard deviation shock to the interest rate decreases private investment to -0.014. After periods 6 – 10 the pattern of movement slightly increased and stable. However, the pattern of movement decreased and closes to -5.12e-07.

The response of interest rate due to shock in interest rate

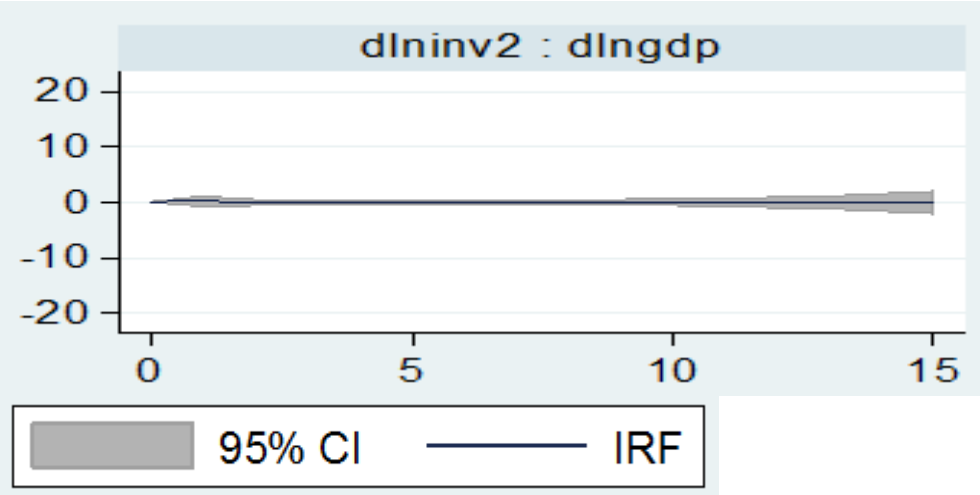


A one standard deviation shock to the interest rate increases its own to 0.237. Then after periods 2 – 7 the pattern of movement decreased to -0.081. Thereafter, the pattern slightly increased to 0.002 and stable. However, after periods 13 the pattern begins to decrease and eventually closes to -0.001.

Appendix XX: Impulse Response Function of PVAR – X Public Investment Shock to Public Investment

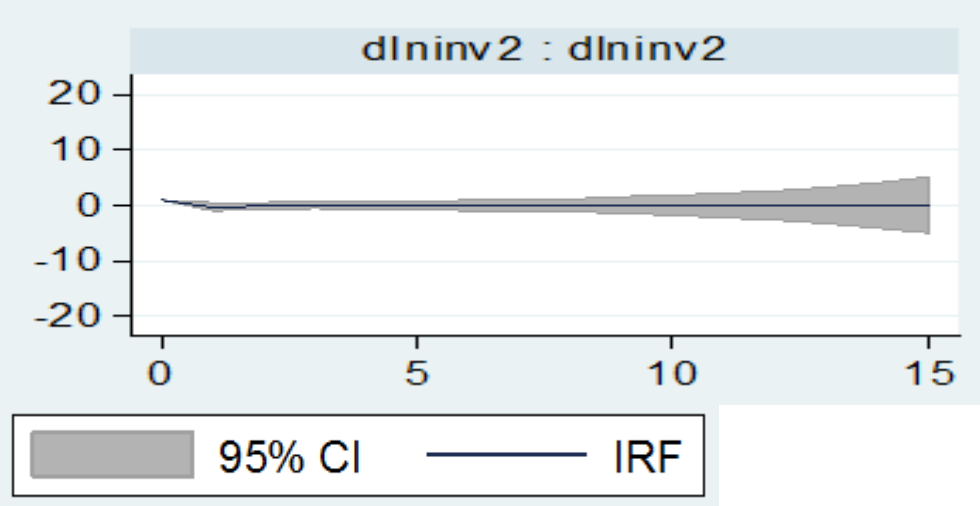
Graphs of impulse response function are presented below:-

The response of real GDP due to shock in public investment



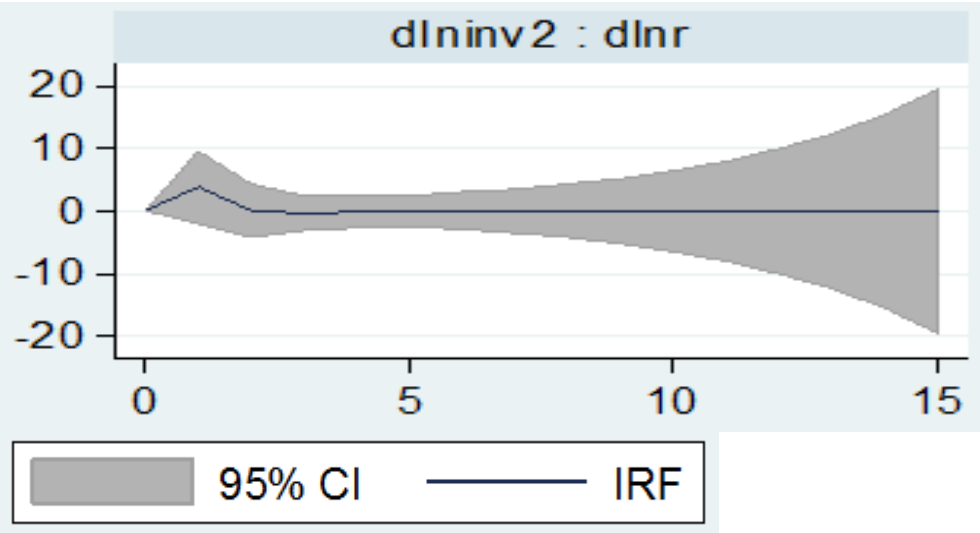
A one standard deviation shock to the public investment increases real GDP to 0.035 and after periods 2 the pattern of movement begins to decrease. After periods 3 – 14 it decreased up to -7.25e-07 and eventually closes to -2.17e-08.

The response of public investment due to shock in public investment



A one standard deviation shock to the public investment decreases its own to -0.259. After periods 3 – 9 with a slight variation the pattern of movement increased to 7.05e-06 and eventually closes to 2.24e-09.

The response of interest rate due to shock in public investment

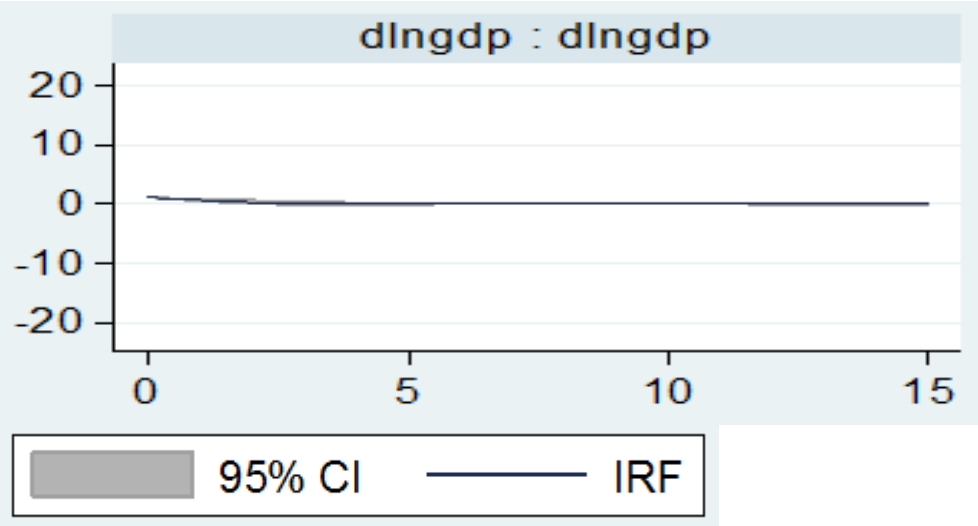


A one standard deviation shock to the public investment decreases interest rate to -0.038 and after periods 2 with a slight variation, the pattern of movement begins to increase and reached up to 8.60e-06. However, it decreased and eventually closes to 1.77e-09.

Appendix XXI: Impulse Response Function of PVAR – X Public Investment Shock to Real GDP

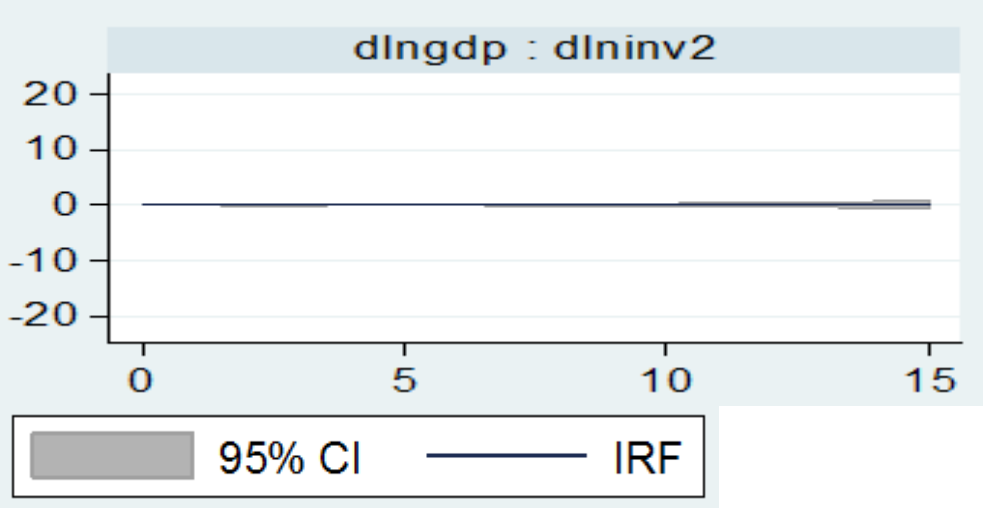
Graphs of impulse response function are presented below:-

The response of GDP due to Shock in real GDP



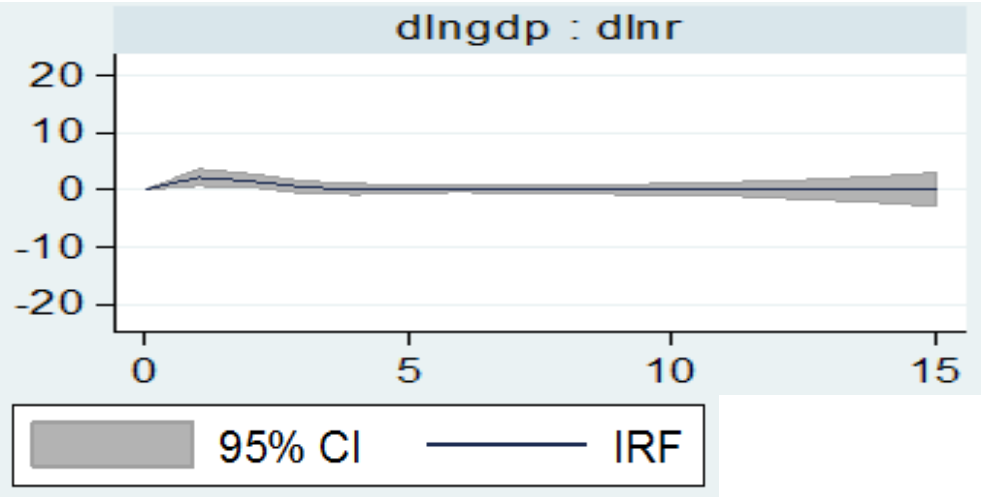
A one standard deviation shock to the real GDP increases its own to 0.518. After 2 – 10 the pattern of movement begins to decrease and reached up to 0. 001. However, after periods 10 the pattern of movement begins to increase and eventually increased up to 7.25e-08.

The response of public investment due to shock in real GDP



A one standard deviation shock to the real GDP increases public investment to 0.226 and after periods 3 the pattern of movement begins to decrease and dropped to -3.68e-08. However, once in periods 12 it increased to 5.10e and thereafter again begins to decrease and eventually closes to -1.28e-08.

The response of interest rate due to Shock in real GDP

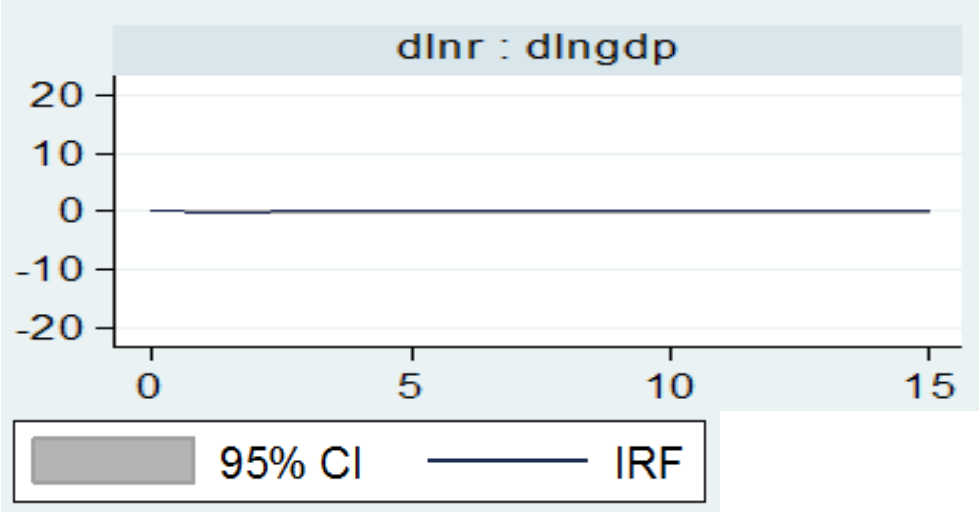


A one standard deviation shock to the real GDP decreases interest rate to -.023. Then after periods 2 – 15 the pattern of movement begins to decrease and eventually reached its highest point and closes to -6.33e-09.

Appendix XXII: Impulse Response Function of PVAR – X Public Investment Shock to Interest Rate

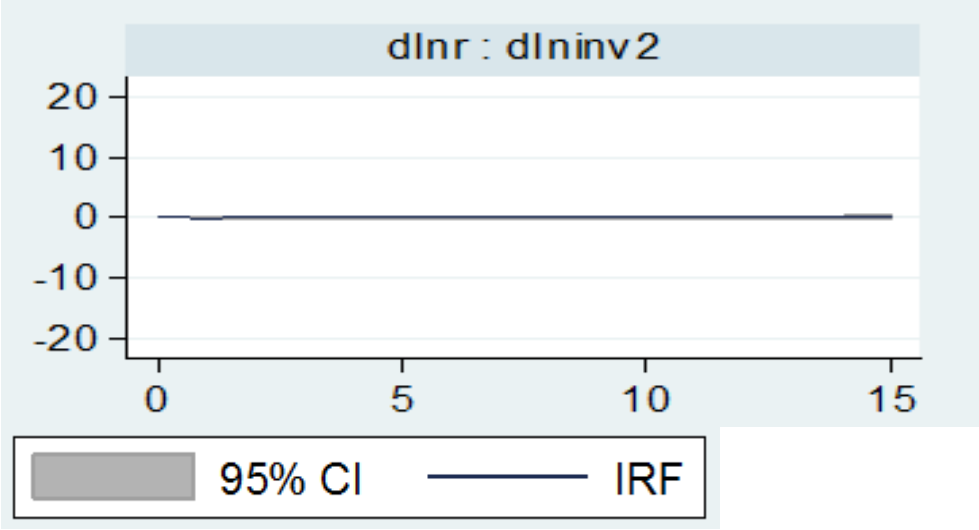
Graphs of impulse response function are presented below:-

The response of real GDP due to shock in interest rate



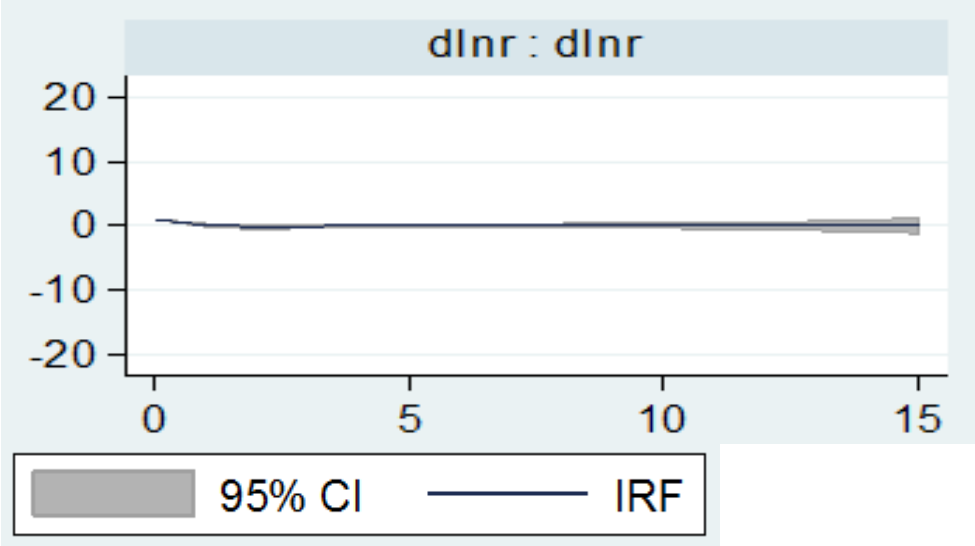
A one standard deviation shock to the interest rate increases real GDP to 2.168. Then after periods 2 – 12 the pattern of movement begins to decrease and dropped to 0.001. However, after periods 13 the pattern begins to increase and closes to 4.08e-07.

The response of public investment due to shock in interest rate



A one standard deviation shock to the interest rate increases public investment to 3.859. Then after periods 3 the pattern of movement begins to decrease and dropped to -8.74e-07. After slight variation, it closes to -6.24e-08.

The response of interest rate due to shock in interest rate



A one standard deviation shock to the interest rate decreases its own to .0145. Then after periods 2 the pattern of movement begins to decrease and reached to the highest point to -9.83e-08. However, it finally closes to -3.54e-08.

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