Theoretical and Applied Economics
Volume XXIII (2016), No. 3(608), Autumn, pp. 141-162

Integrating the issue of infrastructural investment with economic growth: The case of India

Mukul GUPTA
Birla Institute of Technology and Science, Pilani, Rajasthan, India
guptamukul65@gmail.com
Rahul BUDHADEV
Birla Institute of Technology and Science, Pilani, Rajasthan, India
rahul.budhadev10@gmail.com
Varun CHOTIA
Birla Institute of Technology and Science, Pilani, Rajasthan, India
varun.chotia7@gmail.com
N V Muralidhar RAO
Birla Institute of Technology and Science, Pilani, Rajasthan, India
nvmrao@pilani.bits-pilani.ac.in

Abstract. *The development of a country's infrastructure is instrumental in accelerating its economic growth. The inadequacy in the infrastructure provisions hinders population to promote self reliance in economic sectors, thereby proving to be a hindering factor to economic growth. Through this paper, we have aimed to investigate the relationship between investment in key infrastructure sectors and economic growth, in order to see how these sectors impact India's economic growth and how significant this impact is. Further, a detailed qualitative analysis of all the infrastructure sectors involved in our study has been done with a focus on explaining the reasons behind significance/ insignificance of a particular sector. In the final part of analysis, a budget allocation model has been formulated with the help of linear programming technique. This model gives us a fresh viewpoint of the prospective inclination of government budget, and its extent of allocation to the diversity of infrastructure sectors.*

Keywords: Infrastructure, Infrastructure investment, CEPPI, economic growth, sectorial performance, budget allocation and Linear Programming.

JEL Classification: C5, H5, O1.

1. Introduction

Over the past 25 years, there has been significant growth in the Indian economy and it is now amongst the top 10% nations worldwide in terms of economic growth. This economic growth has been instrumental and has led to the expansion of a plethora of services, which by themselves have grown exponentially. But this might have made the economists, overlook the fact that one of the major factors behind this rapid economic structure transformation is the rapid growth in infrastructure over the past few years. Infrastructure, in general, is a setup which facilitates the provision of goods and services to the public. Inherently, it is incapable of producing goods and services directly on its own. Rather, it provides a platform for this to happen. All in all, it is a term to collectively address the stock of basic facilities and capital equipment like buildings, machinery, roads, bridges and rail lines among others, necessary for the functioning of an industrial economy. Our study primarily includes the following sub segments of the Infrastructure sector: road, rail, air transport, energy (electricity, power), telecommunications, water, agriculture, manufacturing, and mining. All these are instrumental towards economic growth and their absence will only deteriorate it. An efficient networking in transport, including quality roads, railroads, ports, and air transport, means that entrepreneurs can now get their goods and services into the market in a secure and timely manner and facilitate the movement of workers to the most suitable jobs. An uninterrupted power supply means that businesses and factories can work smoothly. An extensive communications network allows for a rapid and free flow of information, thereby increasing economic efficiency by helping businesses to communicate faster and make better and well informed decisions. Needless to mention, but water is one of the most important natural resources and is of indispensable use to all living organisms on earth. India, primarily being an agrarian country, has 60 per cent of its population being dependent directly or indirectly on agriculture. Finally, the manufacturing and mining sector forms the backbone of any economy in the world and is the major source of export income for our country.

A well-known fact is that an adequate supply of infrastructure services is an essential ingredient for productivity and growth. Insufficient infrastructure facilities can only impede economic growth and in order to stimulate growth and reduce poverty, it is essential to improve the supply, quality and affordability of infrastructure services. Thus, strong infrastructure facilities are extremely important as they form the backbone of a nation's economy. Growth in overall infrastructure assets create higher economic value by encouraging urbanization and industrial growth and providing better inter country connectivity and stronger trade links which finally provides the required momentum for per capita GDP growth. Thus, investment in infrastructure is crucial as it is instrumental in the creation of the core assets required for development.

This made our government to shift their focus towards infrastructure development, as was evident from the 10th and 11th Five Year plans. The current finance minister Arun Jaitley has underlined the government's commitment to reviving the investment cycle to spur growth by increasing public expenditure in the infrastructure sector. He has announced a significant increase of Rs.70,000 crores in investment in infrastructure in 2015-16 over

the current year, with a focus on railways and roads. The money will come from an additional public investment outlay of Rs. 1.25 trillion over that of 2014-2015. Also, the opening up of the government towards Foreign Direct Investments (FDI) and public private partnerships (PPPs) has been a big move to draw private sector investments into this sector. This benefited the infrastructure companies as inflow of new capital as well as technology enhanced their capability and enabled them to undertake large scale projects within the country. Infrastructure investments are expected to double from Rs 9, 19,225 crores (US$ 169.9 billion) during the 10th Five Year Plan (2002-2007) to Rs 20, 54,205 crores (US$ 379.6 billion) during the 11th Five Year Plan (2007-2012).

Given the expected growth in infrastructure over the next twenty years, it becomes extremely necessary to predict and analyze the potential parameters that might curtail the growth in this sector, thereby forming strategies and policies to mitigate them. Thus, this paper focuses on the Infrastructure front and takes into account certain chosen infrastructure sectors that influence the economic growth of India and analyse the impact of these sectors on the same. This study examines and explains how these infrastructure sectors have influenced the overall economic growth of India by constructing an empirical model and conducting a sectorial analysis, thereby trying to elucidate how each sector is contributing to the growth of the country (both qualitatively and quantitatively) and how different economic policies can be channelized to promote economic growth.

2. Literature review

The word infrastructure is defined in dictionary as “the underlying foundation or basic framework”. Infrastructure encompasses activities that share technical features (such as economies of scale) and economic features (such as spillovers) from users to non-users (Patra and Acharya, 2011). As stated by Patra and Acharya (2011), Infrastructure is the underpinning stone of any country, to sustain an atmosphere of ample economic and social development; it is a pre requisite condition. The linkage between infrastructure and economic prosperity is very multifaceted and two dimensional, the former not only fosters production and consumption but also caters to many direct and indirect externalities involving a sizeable flow of expenditure thereby, creation of additional proceeds and employment. In the literature, there are various indicative studies examining the affiliation between different physical infrastructure services and per capita income/output. These studies are further on suggestive of a fact that it advocates towards the growth of output, income and employment of the economy and ultimately the quality of life of the masses in the given economy (Looney and Frederiksen, 1981; Hardy and Hudson, 1981; Aschauer, 1989; Ebert et al., 1991; Queiroz and Gautam, 1992; Gramlich 1994; Cutanda and Paricio, 1994; Esfahani and Ramirez, 2003).

The World Development Report (1994) published by the World Bank under the title ‘Infrastructure for Development’ rightly mentions that “the adequacy of infrastructure helps ascertain one country’s success and another’s failure in diversifying production, expanding trade, managing persistent population explosion, reducing poverty, or improvising on environmental conditions.” The affect of capital infrastructure on the

impoverished can be at times disproportionate, and hence on the job opportunities and income prospects. The empirical tests of infrastructure have also spelled out its influential role in bringing economic growth and development. For example during the 1970s, the high correlation between declining productivity in the USA and fall in investment on public infrastructure showed that infrastructure investment would likely foster economic development (Aschauer, 1989; Gramlich, 1994).

Talking about investment in infrastructure, Demurger (2001) in his research provided empirical evidence on the links between infrastructure investment and economic growth in China. Using panel data from a sample of 24 Chinese provinces throughout the 1985 to 1998 period, he estimated a growth model to illustrate that, besides dissimilarities in terms of changes and openness, demographics and infrastructure investment did account significantly for observed differences in productive progress across provinces. Eakin and Schwartz (1995) in their work developed a neoclassical growth model that explicitly included infrastructure investment in it and was constructed to devise a tractable framework through which we can analyze the empirical significance of public capital accumulation to boost up economic growth. However, they found little support for claims of a drastic productivity growth from increased infrastructure investment.

Macroeconomists have long felt that the accumulation of public capital is instrumental in determining the productivity. They felt that the drastic slowdown in US productivity of 1973 was owing to the lowering of investment in public capital. Gramlich (1994) in his review essay talked about the drastic slowdown in US productivity growth. Aschauer changed the entire viewpoint about this with his series of papers (1989a, 1989b, 1989c). He formulated an econometric model which highlights the togetherness of movements of infrastructure investment and productivity growth. His work brought about a revolution in this field. Those who were not able to comprehend this mysterious problem of low productivity of US were given a new aspect to look upon. Button (1998), in his paper examined the empirical and theoretical work reflecting on some of the underpinnings of the endogenous growth debate and the usefulness of public capital in stimulating economic development. Munnell (1992) in his work suggested that public policies should not be made without economic reasoning and established a healthy relationship between infrastructure investment and economic growth. Eisner(1991) took the substantial dataset put together by Munnell and Cook for 48 states over the years 1970 to 1986 and used the data in pooled time series regressions, in pooled cross sections, and finally in distributed-lag investment functions. Eisner's results supported Munnell's finding that states should have more capital and ultimately more infrastructure investment, which can lead to a greater output.

There have also been research works comprehending this relationship between infrastructure investment and economic growth for India. Kohli (2006) in his pronounced work talked about politics of economic growth in India post liberalization. He stated that post-1991, industrial growth had not accelerated, and the uneven growth across Indian regions defies any simple market logic. He further mentioned that India's economy had grown briskly because the Indian state had prioritized growth since 1980, and slowly but surely embraced Indian capital as its main ruling ally.

Infrastructure advancement will aid in the creation of an enhanced investment climate in India. The presence of adequate infrastructure facilities will entail for the modernization and commercialization of agriculture and the accomplishment of income surpluses for capital accumulation. It can endow with a basis for the enhancement of local manufacturing industries, along with the amplification of markets for the outputs of these industries (Srinivasu and Rao, 2013). To foster infrastructure growth in the country, the government anticipated to reassess the issues of budgetary provision, tariff policy, fiscal stimulus, private sector participation, and public private partnerships (PPPs) with prior insistence.

Significant amount of studies have also been done on the budget allocation aspect and the investment in different infrastructure sectors by the government. Persson and Tabellini (1999) tried to demonstrate how economists might reach depths on comparative politics, establishing a link between the government spending and the system as a whole. They have worked with these predictions and collected cross-country data from 1990, using social and economic determinants for government spending. Fan and Hazell (2000) have used state-level data for 1970-1993, and developed a simultaneous equation model to estimate the direct and indirect effects of different types of government expenditure on rural poverty and productivity growth in India.

This paper would be bringing about modifications to the studies previously conducted on these topics. Here, we have used CEPPI as an overall macroeconomic indicator over GDP per capita (as used in other research papers), when linking economic growth and investment in infrastructure, in order to study the importance of different infrastructure sectors in our nation's growth. Khramov and Lee (2013) in their paper have analyzed the validity of CEPPI by taking historical data of US from 1790 to 2012. They have shown that the CEPPI reflects the major events in US history, including wars, periods of economic prosperity and booms, along with economic depressions, recessions, and even panics. This paper also conducts an empirical analysis to score various infrastructure sectors. For further extrapolate the extensive research conducted under this study, a budget allocation model has been formulated, in order to experiment the practical application of such a study and its utility in manipulating the budget and formulating government policies. Investment patterns in various infrastructure sectors and their link-up with the Economic growth of India in terms of CEPPI, and its conversion to a budget allocation prototype can be a major breakthrough in terms of union budget analysis and allotment.

3. Data and research objectives

This paper aims to investigate the issue under study in the following sections by setting the following research objectives:

- Analysis of various infrastructure sectors on economic growth of India in order to study their impact and how significant this impact is.
- A detailed analysis of all the infrastructure sectors involved in our model with a focus on explaining the reasons behind significance/insignificance of a particular sector.

- Based upon the results of Step 1 and Step 2, devising a model which can be of use to Indian government and policymakers in terms of allocation of sector wise budgets.
- The data used for the empirical analysis comprises of the CEPPI value each year and the respective expenditure in the various sectors of Indian Economy. The data will be collected from the year 2000 onwards.
- CEPPI

In this study, an indicator named as CEPPI (Country Economic Performance and Prudence Indicator) has been employed to illustrate the economic performance of India at a global perspective. The Country Economic Performance and Prudence Indicator (CEPPI) is a macro-indicator to measure state, national, and global economic performance. The CEPPI examines the primary segments of an economy – households, firms and government – by incorporating four variables into a single indicator. The four variables are Inflation, Unemployment, Budget deficits, and GDP growth. In contrast to other indicators, CEPPI does not use complicated predictability maximization procedures but was designed for simplicity, making it easy to calculate and simple to apply to the economy.

A. Reason for choosing CEPPI over GDP

The reason for choosing CEPPI over GDP is to get an overall macroeconomic indicator, representing the condition of an economy from an all-round perspective. Real GDP growth is not the only representation of a country's growth. It should be normalized with other negatives to give us an idea of the "real" growth of an economy. For CEPPI, our main basis of choice of variables lies in the fact that there are three sectors – firms, households and government. From household's point of view, inflation rate would be something that would affect them adversely and would be a clear indicator from their perspective. From firm's point of view, unemployment rate would be something that would affect them significantly and would be representing this sector. For Government, Budget deficit to GDP is the major indicator. These indicators represent the negative side too because an increase in them causes downfall in the economy and therefore, this negative impact has been normalized with a positive real GDP growth to give an all-round macroeconomic indicator.

B. CEPPI Calculation for India

India is one of the fastest emerging economies in terms of GDP growth. But for any country, a growing GDP is not enough to indicate healthy economic performance. Here, we have calculated the performance of India accounting for negatives like Inflation Rate, Unemployment Rate and deficit. This gives us a clear overall idea of how effective is Indian economy's performance.

The formula for CEPPI is:

CEPPI = 100% – Inflation Rate (%) – Budget Deficit to GDP ratio (%) – Unemployment Rate (%) + GDP growth rate (%).

The following table shows the CEPPI values for the different years (from 1992-93 to 2013-14).

Table 1. *CEPPI values – 1992-1993 to 2013-2014*

Year	CEPPI
1992-93	85.08
1993-94	89.89
1994-95	85.81
1995-96	88.68
1996-97	89.58
1997-98	88.42
1998-99	83.85
1999-00	95.38
2000-01	90.79
2001-02	91.92
2002-03	89.87
2003-04	95.55
2004-05	96.96
2005-06	96.56
2006-07	95.42
2007-08	96.94
2008-09	89.60
2009-10	89.07
2010-11	88.44
2011-12	90.25
2012-13	88.54
2013-14	85.80

Source: Computed values by authors using Unemployment, GDP, Inflation and Budget Deficit time series figures from the World Bank Database.

C. Sectorial indices

For the following study we have chosen the following sectors which contribute the maximum to the overall economic growth of the country:

1. Agriculture and Allied Activities.
2. Water.
3. Energy.
4. Industry and Minerals.
5. Transport.
6. Telecommunication.

We all are aware that Expenditure is the input/investment in any particular sector, while Revenue is the output. Moreover, CEPPI can be thought of as a modified form of output from investment across all sectors, in the complete economy. Therefore, Expenditure in each infrastructure sector was chosen in order to analyze the impact of these sectors on economic growth of India. The expenditure figures obtained are the total expenditure figures for each sector, which comprises of both the operating expense, as well as the investment in new projects.

Table 2. *Sector wise expenditure – 2000-2001 to 2013-2014*

Year	Agriculture	Water	Energy	Industry and Minerals	Transport	Telecommunication
2000-01	2911.934	209.013	3728.986	2930.935	10061.135	1676.856
2001-02	3011.361	420.749	4874.678	4429.886	14365.573	1322.354
2002-03	3148.209	187.953	4275.926	2886.418	14875.122	1611.024
2003-04	3804.465	202.905	4891.455	2949.366	16225.137	630.454
2004-05	4815.455	297.946	5805.925	2947.252	17667.404	587.840
2005-06	6502.826	422.948	4620.707	4472.675	24065.741	729.585
2006-07	7622.165	447.631	7186.968	5868.942	27939.647	746.052
2007-08	8866.322	487.791	6197.818	6613.875	28794.028	789.074
2008-09	10125.976	455.768	8243.456	8619.960	30219.400	990.800
2009-10	10966.940	415.912	9281.402	9631.644	44633.914	853.714
2010-11	15641.465	486.115	10379.985	12381.635	61679.415	629.090
2011-12	16096.340	493.374	8572.380	12149.345	64909.570	2189.349
2012-13	16943.488	426.635	5881.463	11671.504	56559.558	2498.860
2013-14	17396.858	463.441	7664.600	11550.373	63455.754	3671.878

Note: all figures in crores of Rupees.
Source: Expenditure Budget Volume I, 2014-15: Annex- 3.3(1.47).

4. Empirical analysis and discussion

A. Regression model

The CEPPI figures are directly obtained from the table 1 above, whereas the independent variables are scaled down within a range of 1-100 to counter the issue of values in different scales/ranges. We have done this normalization by finding out their Grading Coefficients.

Table 3. *Regression data set*

Year	CEPPI	Agriculture	Water	Energy	Industry and Minerals	Transport	Telecommunication
2000-01	90.786	16.738	42.364	35.925	23.672	15.500	45.668
2001-02	91.915	17.310	85.280	46.962	35.778	22.132	36.013
2002-03	89.872	18.096	38.095	41.194	23.312	22.917	43.875
2003-04	95.547	21.869	41.126	47.124	23.820	24.997	17.170
2004-05	96.959	27.680	60.389	55.934	23.803	27.218	16.009
2005-06	96.561	37.379	85.726	44.516	36.123	37.076	19.870
2006-07	95.422	43.813	90.729	69.239	47.400	43.044	20.318
2007-08	96.943	50.965	98.868	59.709	53.417	44.360	21.490
2008-09	89.602	58.206	92.378	79.417	69.619	46.556	26.983
2009-10	89.069	63.040	84.299	89.416	77.790	68.763	23.250
2010-11	88.436	89.910	98.529	100.000	100.000	95.024	17.133
2011-12	90.252	92.524	100.000	82.586	98.124	100.000	59.625
2012-13	88.544	97.394	86.473	56.662	94.265	87.136	68.054
2013-14	85.797	100.000	93.933	73.840	93.286	97.760	100.000

Source: Computed values by authors using Tables 1 and 2.

Simple Regression Analysis using OLS method was performed using Stata and the following results were obtained:

$$CEPPI = 96.68 - 0.102*X_1 + 0.0901*X_2 - 0.300*X_3 - 0.0637*X_4 + 0.0965*X_5 + 0.148*X_6$$

Where:
X_1=Telecom, X_2=Transport, X_3=Industry and Minerals;
X_4=Energy, X_5=Water, X_6=Agricultural and allied;
R-squared value= 0.9232; Adjusted R-squared value= 0.8575.

Based on the p values, the Telecommunication sector, Industry and Minerals sector and Water sector come out to be significant. Out of these, only water sector has a positive coefficient.

The Transport sector, Energy sector and the Agricultural and Allied activities sector turn out to be insignificant. Both Transport and Agricultural and Allied activities have a positive coefficient while energy sector has a negative coefficient.

B. Sector wise evaluation

This section includes a detailed overall analysis of all the infrastructure sectors involved in our model. It tries to explain the reasons behind significance/ insignificance of a particular sector.

1. Telecommunication sector

India's telecommunication network is the second largest in the world based on the total number of telephone users (both fixed and mobile phone). It has the world's third-largest Internet user-base. According to the Internet and Mobile Association of India (IAMAI), the Internet user base in the country stood at 190 million at the end of June 2013. India is the world's second-largest telecommunications market, with 933 million subscribers. Now, the telecom sector has been highly dependent on indirect investments via the private route rather than government investment. FDI inflows in the sector during the period April 2000-July 2014 stood at Rs 80,608.47 crores (US$ 13.1 billion), while the investment during April 2014 – July 2014 itself has been Rs 13,889 crores, as per Department of Industrial Policy and Promotion (DIPP). Moreover, the sector has witnessed huge scams including the 2G scam in 2008, thereby decreasing the productive government expenditure in this sector. This might be the reason behind the negative coefficient, during the regression analysis. All these stats signify the increasing horizon and importance of telecommunications sector and hence, it plays an important role in terms of impacting economic growth of India.

2. Transport

Transport in the Republic of India is an important part of India's economy. It accounts for a share of 6.4 % in India’s Gross Domestic Product (GDP). It comprises distinct modes such as rail, road, coastal shipping, civil aviation, inland water transport and pipelines to name a few. Urbanization and fast industrialization have led to increase in demand of freight and passenger transport, which also consumes a large portion of energy, especially petroleum products. This leads to decrease in the productive expenditure. Also, most of the development projects take up a lot of time for completion. But the budget for the complete project is dumped within a single five year plan. Thus, there is rarely sync between the recording of revenues and expenditure of any particular project, which might be a reason for the insignificance of the transport sector in our analysis.

3. Industry and Minerals

As per McKinsey and Company, India’s manufacturing sector could touch US$ 1 trillion by 2025. India’s growing economy and the investment policies offered by the

government, provide domestic and international players many opportunities to invest in manufacturing sector. Mining Industry's GDP contribution varies from 2.2-2.5% only but going by the GDP of only industrial sector it contributes 10-11%. Reasons like the New Industrial Policy of 1991 which opened the floodgates of FDI in India, Special Economic Zones where taxes are reduced, financial and environmental regulations are relaxed, reaffirm the significance of this sector from the government's point of view.

The major reason behind the coefficient of this sector being negative can be the export of various minerals across the world, making the productive expenditure in this sector very less. There is a high premium which the companies earn by the export of such minerals. Thus, due to the high premium earned, we realize that the revenues earned by this sector are much more than the expenditure amount. Thus, the productive expenditure is very low, thereby the negative coefficient.

4. Energy sector

Energy in India is depicted by energy and electricity production, consumption and import in India. The root causes like scanty resources to the mass, outgrowing Demand-Supply Disparity, volatile Energy Pricing, uprising Energy Intensity could be suggestive raison d'être for the statistical insignificance of energy sector. Also, Energy Elasticity is the percent increase in per capita energy consumption for one percent rise in per capita GDP. As per the data from the World Bank Databank, its value estimated from the time series data of India over 1990-91 to 2003-04 comes to 0.82 which is significantly lower than 1.08 estimated for the period since 1980-81.

According to reports at the IBEF, Investment is this sector is reported to be $9.2 Billion for April 2000 to August 2014 and revenue turnout in FY2012 to be $6.5 billion. Contrary to that, the telecom industry has Investment is this sector is reported to be $13.4 Billion for April 2000 to August 2014 and revenue turnout in FY2012 to be $39.5 Billion. This illustrates that telecom industry is burgeoning the country's overall growth compared to energy sector.

5. Water sector

Water is one of the most essential imperative natural resources and is of indispensable use to all living organisms on earth. Abundant Water Resources, Potential of Irrigation Facilities, Increasing Demand of Desalination Plant Market in India, Growth in Water and Wastewater Treatment Equipment Market, and Booming Home Water Purifier Industry and Potential of Hydroelectric Power production in India make this sector acquire a pivotal position while analyzing the impact on economic growth of India.

Some Salient features:

- India has an ultimate irrigation potential of 139.89 million hectares out of which a minimal 108.2 million hectares (77.35%) of the total land that can be irrigated has been utilized.
- India is endowed with economically exploitable and viable hydro potential assessed to be about 84,000 MW at 60% load factor. In addition, 6,780 MW in terms of installed capacity from Small, Mini, and Micro Hydel schemes have been assessed.

- Micro irrigation system market in India (primarily via drip and sprinklers) has grown at the stupendous CAGR of 27.3% during the period from FY'2008-FY'2013
- Also, the India Desalination Plant Market is expected to register a CAGR of 19% by 2019, while the Water and Wastewater Treatment Equipment Market might grow up to 7.4% CAGR by 2018, whereas the Water purifier Industry might grow up to 22% CAGR by 2019.

The regression coefficient for this indicator is significant and shows a change with the CEPPI in the positive direction. The reason for this observation could be all the above mentioned factors. Thus, a significant part of the budget could be allocated to this sector as it would contribute to overall economic growth of the country.

6. Agriculture sector

India is predominantly an agrarian based nation with 60 per cent of its population subsists contingently or independently on agriculture. Factors like Leap-Frogging, Agricultural Subsidies and a derisory irrigation system substantiate the fact that agriculture sector is not the key contributor in the preceding past. Lastly, incompetence and amateurish tendencies among farmers, small size of land holdings in India, and execution of non-agricultural practices on agricultural land, primarily contribute to the stagnating growth of this sector.

C. Sector wise evaluation

In this final section of empirical analysis, we have evaluated all the significant infrastructure sectors (Empirical Analysis: Section 1) based on the following parameters to ultimately arrive at a composite score for each of them.

- Foreign Direct Investments (FDI)/Public Private Partnerships (PPP)
- Past Government Expenditure
- Scams
- Compounded annual growth rate (CAGR)
- Revenue
- Import/Export
- Future scope of the industry

The composite score is calculated on an average score of 0-10, based on the sectors performance in each of these seven parameters. The scoring is done based on the analysis mentioned below.

- FDI/PPP: Scoring on this parameter is done on the basis of the extent of FDI/PPP in the respective sectors over the past few years. Higher the FDI or PPP, lower is the government budget allocation in this sector. Thus, Water gets the highest score, while Telecom the lowest.
- Past Government Expenditure: Very evidently visible from the Expenditure data given above is the fact that there is has been massive expenditure/investment in the Industry and Minerals sector, while that in the Water sector is the least. Thus, Water gets the least score here.

- Scams: The Industry and Minerals and the Telecom sectors have witnessed huge scams by big ministers and industrialists. Examples are the 2G Scam, Coal Gate etc. Whereas the Water sector has relatively provided a very less scope for such corruption to take place. Thus, highest is the score for Water.
- CAGR: The CAGR for the Industry and Minerals and the Telecom Sector over the past few years has been recorded to be 11.5% and 10.4% respectively. On the other hand for Water sector, the average CAGR value of its subdivisions is estimated to be around 18.9% (Desalination: 19%; Waste water Treatment: 7.4%; Home water purification: 22%; Micro Irrigation: 27.3%). Hence, water gets the highest score.
- Revenues: The revenues for the Industry and Minerals sector touched $142 billion in 2011. Also, the Telecom sector revenues were recorded to be around $39 billion in 2013. Whereas the Water sector revenues are estimated to be lower compared to the two. Hence, water gets the lowest score, while Industry and Minerals gets the highest.
- Import/Export: Telecom industry is very exhaustive in nature with no exports. Moreover, the required resources are mostly intangible and hence the lowest score. Whereas, Industry and Minerals would get the highest score due to massive exports and the huge premium earned on it. Aluminium exports to South Korea, Japan and China fetch a premium of $223-$230 per tone. Hence, Industry and Minerals get the highest score. Also, Water sector though doesn't enjoy much premium on exports. However, it is a natural resource available abundantly (thus no need of imports) and has a massive domestic market pertaining to the high demand.
- Future Scope of Industry: The phenomenon of Leapfrogging has restricted the growth of the Industry and Minerals sector. Moreover, the future scope of the Water Sector is bright due to the increasing demand of the ever increasing demand of water leading to the growth of the Desalination and Purification Industry. Hence Water gets the highest score here while Industry and Minerals the lowest.

Table 4. *Sector wise evaluation*

Parameters	Water	Industry and Minerals	Telecom
FDI/PPP	7	3	1
Past Govt. Expenditure	3	7	5
Scams	8	2	2
CAGR	8	4	3
Revenue	3	5	4
Import/Export	5	7	1
Future scope	7	2	4
Total	41	30	20

Source: Values allotted by authors.

Thus, the above sector wise evaluation gives us the following composite score for each of the significant sectors:

Water: 41

Industry and Minerals: 30

Telecom: 20

D. Budget allocation

1. Introduction

The previous two sections of the empirical analysis pertaining to research objectives 1 and 2 analyze the different infrastructure sectors of the Indian Economy and their level of significance from the point of view of impacting India's economic growth. Based upon the results of the above three sections, we have aimed to do a Budget Allocation exercise within the three significant sectors with a view of maximizing the CEPPI and in turn the GDP. The significant sectors (as per the regression results from Section 1) within which the budget allocation would take place are:

- Telecommunication
- Industry and minerals
- Water

To achieve the above said objective, we have used the Linear Programming technique using MATLAB. We all are aware that Linear programming is the mathematical problem of finding a vector x that minimizes the function:

$\mathbf{min_x \{f^T x\}}$

Subject to the constraints:

Table 5. *List of constraints*

$A_x <= b$	Inequality constraint
$A_{eq}x = b$	Equality Constraint
lb <= x <= ub	Bound Constraints

Where f, x, b, beq, lb and ub are vectors whereas A and A_{eq} are matrices.

2. Optimization

The following section contains the objective function and constraints for our analysis:

1) Objective function

From the regression results, it is observed that only the Telecom, Industry and Minerals, Water come out to be significant. The aim here is to maximize the CEPPI value.

Therefore, the objective function is:

CEPPI = 96.68263 - 0.1024221*X1 - 0.3004156*X3 + 0.0965767*X5

Where, X1 = Telecommunication sector, X3 = Industry and mineral sector and X5 = Water sector

2) Inequality constraints

Assuming that the government has 100 crores of money to be allocated for these three significant sectors, the first constraint becomes:

x1 + x3 + x5 <= 100

The composite sectorial indices for each of the significant sectors from the above sector wise evaluation are:

Telecom: 20

Industry and Minerals: 30

Water: 41

The above scores follow these constraints. This can be verified by putting in the respective composite sector scores for x1, x3 and x5.

0.8x1+ 1.9 x3 >= 73

1.9x3 + 0.4x5 <= 74

x1 + 0.4x5 >=36

The above inequality constraints can be derived from the composite sectorial indices by forming their linear combinations in the following manner. For instance, if three variables a, b, c are 10, 20, 30 respectively, then we can have n number of linear combinations out of them, like:

2b >= a + c (2*20 >= 10 + 30)

0.8a + 0.5b <= 18 (0.8*10 + 0.5*20 <= 18)

2.1b + 0.7c >=63 (2.1*20 + 0.7*30 >= 63)

3) Equality constraints

There are no equality constraints in our Optimization problem.

4) Bounds

The upper bounds of X1, X3, X5 each is 100 and lower bounds of each is 0.

$0 \leq X1, X2, X5 \leq 100$

5) Linear programming: MATLAB

Now, using the Linear Programming tool in MATLAB, on the objective function, subject to the above mentioned bounds and constraints, we get the following result for the Budget Allocation problem.

F value (Function value) is the optimized CEPPI value obtained from the Linear Programming function in MATLAB. Thus, the value obtained from the optimization solution can be used to obtain the CEPPI value.

F value = CEPPI = 90.35793

And the budget allocation comes out to be:

Telecom sector (x1) 22.91%

Industry and mineral sector(x3) 28.78%

Water sector(x5) 48.32%

3. Analysis: budget allocation

The above Sectorial Budget Allocation model was formed using the regression equation as the Objective function, the composite sector wise indices for the Inequality constraints, and logically derived bounds. But the derived sector wise indices can form a series of inequality constraints and satisfy each of them. Thus, our study would be incomplete if those are not incorporated in it.

So keeping everything else constant, and changing the inequality constraints, we tried to evaluate and analyze the result. The inequality constraints were changed one or two at a time, by changing the range covered by the two constants in the inequalities, keeping in mind that they satisfy the composite sector wise indices as closely as possible, so that we get robust results. Following are sets of multiple inequality constraints and their corresponding CEPPI values.

Firstly, without changing the coefficients in the third constraint, we try increasing/decreasing the range covered by both the constants in the first two constraints, and the changing the inequality sign in the third one.

0.6x1+ 1.5x3 >= 57		x1: 20.13%
2x3 + 0.7x5 <= 89	CEPPI = 89.63963	x3: 29.95%
0.8x1 + 1.2x5 <=66		x5: 41.58%
0.6x1+ 1.5x3 >= 57		x1: 24.92%
2x3 + 0.7x5 <= 89	CEPPI = 90.25283	x3: 28.03%
0.8x1 + 1.2x5 >=66		x5: 47.05%

Now, on increasing the range from 32 (57-89) to 51 (47-98),

0.4x1+ 1.3x3 >= 47		x1: 20.14%
2.3x3 + 0.7x5 <= 98	CEPPI = 89.63523	x3: 29.95%
0.8x1 + 1.2x5 <=66		x5: 41.57%
0.4x1+ 1.3x3 >= 47		x1: 25.03%
2.3x3 + 0.7x5 <= 98	CEPPI = 90.06263	x3: 28.45%
0.8x1 + 1.2x5 >=66		x5: 46.51%

On further increasing the range to 102 (19-121),

0.2x1+ 0.5x3 >= 19		x1: 20.29%
2.8x3 + 0.9x5 <= 121	CEPPI = 89.63223	x3: 29.89%
0.8x1 + 1.2x5 <=66		x5: 41.47%
0.2x1+ 0.5x3 >= 19		x1: 24.82%
2.8x3 + 0.9x5 <= 121	CEPPI = 90.23063	x3: 28.07%

0.8x1 + 1.2x5 >=66 x5: 47.11%

But what if we decrease the bound covered by both the constants to 1 (73-74)?

0.8x1+ 1.9x3 >= 73 x1: 19.69%

1.9x3 + 0.4x5 <= 74 CEPPI = 89.65833 x3: 30.13%

0.8x1 + 1.2x5 <=66 x5: 41.88%

0.8x1+ 1.9x3 >= 73 x1: 22.91%

1.9x3 + 0.4x5 <= 74 CEPPI = 90.36263 x3: 28.77%

0.8x1 + 1.2x5 >=66 x5: 48.31%

Up until now, we obtained more or less similar results from all the set of constraints that we chose. But once the constants from the first two constraints overlap each other and the difference between the second and the first constant becomes highly negative, we can observe that the CEPPI value becomes very high but the budget allocation becomes highly skewed, which is not desirable. This can be illustrated from the forthcoming set of constraints.

2x1+ 3x3 >= 100 x1: 50.00%

1.2x3 + 0.4x5 <= 53 CEPPI = 93.65403 x3: 00.00%

0.8x1 + 1.2x5 <=66 x5: 21.66%

2x1+ 3x3 >= 100 x1: 50.00%

1.2x3 + 0.4x5 <= 53 CEPPI = 96.39263 x3: 00.00%

0.8x1 + 1.2x5 >=66 x5: 50.00%

In the above set of ten constraints, we altered the coefficients of only the first two constraints. Now, we will try and analyze the results by changing the third constraint only, keeping the first two constant.

0.8x1+ 1.9x3 >= 73 x1: 19.44%

1.9x3 + 0.4x5 <= 74 CEPPI = 89.60553 x3: 30.23%

x1 + 0.4x5 <=36 x5: 41.39%

0.8x1+ 1.9x3 >= 73 x1: 22.91%

1.9x3 + 0.4x5 <= 74 CEPPI = 90.36263 x3: 28.77%

x1 + 0.4x5 >=36 x5: 48.31%

On increasing the constant in the third constraint to 86,

0.6x1+ 1.5x3 >= 57 x1: 20.09%

2x3 + 0.7x5 <= 89 CEPPI = 89.63433 x3: 29.96%

1.8x1 + 1.2x5 <=86 x5: 41.53%

0.8x1+ 1.9x3 >= 73		x1: 22.91%
1.9x3 + 0.4x5 <= 74	CEPPI = 90.36263	x3: 28.77%
1.8x1 + 1.2x5 >=86		x5: 48.31%

If the constant in the third constraint is 113,

0.8x1+ 1.9x3 >= 73		x1: 19.81%
1.9x3 + 0.4x5 <= 74	CEPPI = 89.68263	x3: 30.08%
2.3x1 + 1.6x5 <=113		x5: 42.19%
0.8x1+ 1.9x3 >= 73		x1: 22.91%
1.9x3 + 0.4x5 <= 74	CEPPI = 90.36263	x3: 28.77%
2.3x1 + 1.6x5 >=113		x5: 48.31%

4. Inferences: budget allocation

During the course of the above simulation, we realized that there can be any number of possible sets of the inequality constraints, all of which would give us similar results within a fixed range, if the following conditions are satisfied:

The constants of the first two constraints should form a positive bound, i.e. the difference between the second and the first constant should not be negative. If that happens, the results would turn out to be highly skewed. From the above illustrations, we can observe that the inequality sign in the third constraint should be facing away from the constant, so that we have a higher CEPPI value.

Thus, for practical purposes, we have removed those cases where the results were highly skewed, i.e., weightage to any one particular sector was extraordinarily high or very close to zero. We have shown a few such illustrations in the above section. This was done because while allocating budget amongst the three sectors, the government cannot overlook the others and spend a majority chunk on any one particular sector and no money in the other.

Finally, from all the above cases, we can infer that to maximize the CEPPI value, and bring it above the 85.8 mark from 2013-14, the government should spend majorly on the Water sector. This should bring the CEPPI value around 89-90, which can lead up to a major improvement of around 3.5% to 5%, within one year. Also, from the above illustrations, one can observe that the CEPPI values are higher in even numbered illustrations as the greater than sign is facing away from the constant. Thus, these illustrations must be chosen, as they can give a better CEPPI value. A 5% range for budget allocation for each of these significant sectors can be proposed as:

Telecom sector (x1)	20% - 25%
Industry and mineral sector(x3)	25% - 30%
Water sector(x5)	45% - 50%

5. Conclusions

Through this paper we have constructed a composite macroeconomic growth index i.e. the Country Economic Performance and Prudence Indicator (CEPPI) for India by combining individual indicators like the GDP growth, Budget Deficit, Inflation and Unemployment. Analyzing the sector wise impact of each of the six infrastructure sectors on the CEPPI, we conclude that Telecom, Industry Minerals and Water are the most significant sectors and therefore, the government's focus should be more on these sectors while allocating the budget.

India has primarily been an Agrarian country but this sector is not the major contributor to the economy in the recent past as suggested by our empirical analysis. However, there is potential and immense scope if India's resources are properly tapped and people are encouraged to take up jobs in the agricultural sector. Technology and improvement in facilities is also an essential in terms of maximizing output. The water sector turns out to be significant showing the potential for allocating a greater portion of the budget to it. This is owing to the availability of water resources in abundance in India, huge scope of irrigation facilities, and rise of the desalination plant market. Also, Hydroelectric power generation is showing immense potential if efficiently trapped and channelized. The gaining popularity of hydroelectric power and a wide variety of irrigation facilities is sustaining many rural as well as urban areas. Waste water treatment and home water purifier industry is also on the rise. These factors further authenticate that investment in water sector could be a turnaround in terms of achieving higher economic growth, with luring opportunities and promising productivity.

The Telecom and Industry and Minerals sectors also come out to be significant in our analysis owing to the share of FDI and PPP in its investments. Since 1991, when our Government opened the floodgates to the world, there has been a massive inflow of capital and technology in India. FDI's and Public-private partnerships have emerged as a far more viable option in delivering the goods. One of the major advantages of this is that it can reduce the role of Government bureaucracies in performing entrepreneurial activities for which they may be poorly suited. Where market forces are still weak and important public interest are at stake, the strengthening of relevant government institution may be a pre-requisite of successful privatization. The Telecom and the Transport sector in India have been the most widely open sectors to such form of privatization, thereby decreasing the Government's interest to allocate a significant separate budget for them, and relying on the private sector investments. Moreover, the significance of industry and Minerals sector is also due to the inflated fat premium they get on their exports. The FDI and private sector investments have been consistently increasing in the Telecom-munications, Transport and Industry and Minerals sector. Water Sector shows a promising untapped potential, which makes it a viable option for investment. So, in order to maximize the CEPPI value, the government should consider allocating a larger portion of its budget towards the Water sector as indicated by the above model.

6. Policy implications

Budget allocation by any government is a sensitive issue and instrumental is elucidating our country's growth. Generally, the announcement of budget by our government is subjected to excruciating scrutiny by several sections of the society for a diversity of issues. The government's budget allocation varies from one government to the other and is purely based on their ideology and primary objective. If a government has industrial development as their primary objective, then their budget allocation would be pro industrialism, and if some government is pro-inclusive growth, it would reflect in the distribution of their budget. All these different schools of thoughts are criticized by groups of people subject to certain shortcomings. No budget allocation can be perfect for all sections of the society. All this paper does, is merely construct a suggestive budget allocation model in order to maximize the macroeconomic indicator of the country i.e. CEPPI. Budget allocation would obviously vary depending on the government's ideology and the economic need during their tenure, but the requirement of an ideal budget, irrespective of their ideology, would be one that maximizes the country's growth. The government's budget allocation would ideally depend upon several factors but this approach is purely from the point of view of maximizing government expenditure to the fullest, ultimately contributing to the economic growth of the country. The government needs to allow the inflow of FDI's for promoting certain sectors and could invest in those which show a greater future potential. A majority of productive growth persuading areas are those coming from the significant sectors of Telecom, Industry Minerals and Water. Efficient investment in all these sectors will provide the much needed boost required for economic upliftment which in turn will contribute to sustainable and satisfactory development. Our analysis implies the fact that our government needs to spend more in these sectors keeping in view the fixed amount of budget. We require a synchronized plan of action between the policymakers and the government to achieve this.

7. Scope for further study

In this study, we have taken into account six major infrastructure sectors. However, the study can be expanded to include more number of sectors like Banking, Insurance etc. depending on their feasibility and importance in terms of objective of the study. We have performed the analysis using 2000-01 to 2013-14 as the time span based on data availability. Data could be taken for a greater span, which help in strengthening the study.

References

Aditya, K.P. and Arabinda, A., 2011. Regional Disparity, Infrastructure Development and Economic Growth: An Inter-State Analysis. *Research and Practice in Social Sciences.* Vol. 6, No. 2 (February 2011) pp. 17-30.

Agarwalla, A., 2011. Estimating the Contribution of Infrastructure in Regional Productivity Growth in India. *Working Paper,* No. 2011-05-01. Ahmedabad: Indian Institute of Management.

Aschauer, D.A., 1989. Back of the G-7 pack: public investment and productivity growth in the Group of Seven. *Working Paper Series*, Macroeconomic Issues 89-13. Federal Reserve Bank of Chicago.

Button, K., 1998. Infrastructure investment, endogenous growth and economic convergence, Annals of Regional Science, 32(1), February, pp. 145-62.

Calderón, C. and Servén, L., 2004. The Effects of Infrastructure Development on Growth and Income Distribution. *Policy Research Working Paper*, 3400, Washington DC: World Bank.

Canning, D. and Bennathan, E., 2000. The social rate of return on infrastructure investments. *World Bank Working Paper*, No. 2390.

Cashin, P. and Sahay, R., 1996. Internal Migration, Centre-State Grants and Economic Growth in the States of India. *IMF Staff Papers*, Vol. 43, No. 1, pp. 123-171.

Chakravarti, R., 2009. An Empirical Analysis of Investment Determinants in Indian States: 1998-2006. *The Michigan Journal of Business*, pp. 9-53.

Cutanda, A. and Paricio, J., 1994. Infrastructure and Regional Economic Growth: The Spanish Case, Source: Regional Studies. *The Journal of the Regional Studies Association*, Vol. 28, No. 1, February 1994, pp. 69-77(9).

Démurger, S., 2001. Infrastructure Development and Economic Growth: An Explanation for Regional Disparities in China?. *Journal of Comparative Economies,* 29, pp. 95-117.

Easterly, W. and Wetzel, D., 1989. Policy determinants of growth: survey of theory and evidence. *World Bank Policy Research Working Paper,* 343.

Eguvanti S., India's home water purifier industry to grow at a CAGR of 22% till 2019, available at: <http://www.indianotes.com/Analysis/Indias-home-water-purifier-industry-to-grow-at-a-CAGR-of-22-till-2019/189734/22/I>

Eisner, E.W., 1991. The enlightened eye: Qualitative inquiry and the enhancement of educational practice. New York: Macmillan, p. 264.

Esfahani, H., and Ramíres, M.T., 2003. Institutions, infrastructure and economic growth. *Journal of Development Economics*, (70), pp. 443-477.

Fay, M., Toman, M. Benitez, D. and Csordas, S., 2010. Infrastructure and Sustainable Development. In: Chapter 8, Post Crisis Growth and Development: A Development Agenda for the G-20, Washington, D.C.: The World Bank.

Fu, W. and Zhang, J., 2011. The Empirical Analysis on Relationship between Infrastructure Investment and Regional Economic Growth in China, *Proceedings of the 8th International Conference on Innovation and Management*, pp. 349-353.

Gramlich, E.M. 1994. Infrastructure Investment: A Review Essay, *Journal of Economic Literature, American Economic Association*, Vol. 32(3), pp. 1176-96.

Hardy, A. and Hudson, H., 1981. The role of the telephone in economic development: an empirical analysis. Washington: Keewatin communications.

Holtz-Eakin, D. and Schwartz, A.E., 1995. Spatial Productivity Spillovers from Public Infrastructure: Evidence from State Highways. *NBER Working Paper,* No. 5004.

Hulten, C. and Schwab, R., 1993. Infrastructure spending: where do we go from here?. *National Tax,* J 46, pp. 261-273.

Justman, M. 1995. Infrastructure, Growth and the two Dimensions of Industrial Policy. *The Review of Economic Studies*, (62), pp. 131-157.

Lall, V.S., 1999. Role of Public Infrastructure Investments in Regional Development: Experience of Indian States. *Economic and Political Weekly*, Vol. 34, No. 12, pp. 717-725.

Looney, R. and Frederiksen, P., 1991. The regional impact of infrastructure investment in Mexico. *Regional Studies*, No. 15, pp. 285-296.

Martin, P. and Rogers, C.A., 1995. Industrial Location and Public Infrastructure. *Journal of International Economics*, (39), pp. 335-351.

Munnell, A.H., 1992. Policy Watch: Infrastructure Investment and Economic Growth. *Journal of Economic Perspectives*, 6(4), pp. 189-198.

Persson, T. and Tabellini, G., 1999. The size and scope of government: Comparative politics with rational politicians. *Institute for International Economic Studies, European Economic Review*, Vol. 43, Issues 4-6, April, pp. 699-735.

Queiroz, C. and Gautam, S., 1992. Road Infrastructure and Economic Development, Western Africa Department and Infrastructure and Urban Development Department. *The World Bank*, June, WPS 92.

Rao, P.S. and Srinivasu, B., 2013. Infrastructure Development and Economic growth: Prospects and Perspective. *Journal of Business Management and Social Sciences Research* (JBM and SSR), pp. 81-91.

Ravi, K.S. Kohli, 2006. The comfort of strangers: social work practice with unaccompanied asylum-seeking children and young people in the UK. *Child and Family Social Work*, Vol. 11, Issue 1, pp. 1-10, February 2006.

Ridings J.L. Jr. and Khramov, V., 2013. Country Economic Performance and Prudence Indicator, An Indicator and Methodology for Assessing a Country's Economic Performance. *Working Paper*.

Sengupta, R., Mukherjee, S. and Gupta, M., 2015, Financing for Infrastructure Investment in G-20 Countries, *National Institute of Public Finance and Policy, New Delhi*, Working Paper No. 2015-144.

Shenngen, F., Hazell, P., Haque, T., 2000. Targeting public investments by agro-ecological zone to achieve growth and poverty alleviation goals in rural India. *Food Policy,* 25(4), pp. 411-28.

Somik, V.L., 2006. Infrastructure and regional growth, growth dynamics and policy relevance for India. *Springer-Verlag 2006*, 41, pp. 581-599.

Spiros, B., Panicos, O. and Mamuneas D., 2000. Infrastructure, Specialization, and Economic Growth. *The Canadian Journal of Economics*, (33), pp. 506-522.

Straub, S. and Terada-Hagiwara, A., 2010. Infrastructure and Growth in Developing Asia. *Economics Working Paper Series*, No. 231, Tokyo: Asian Development Bank Institute.

Sturm, J.E., Kuper, G.H. and de Haan, J., 1998. Modelling government investment and economic growth on a macro level: A review. In: S. Brakman, van H. Ees and S.K. Kuipers. Eds. *Market Behaviour and Macroeconomic Modelling*, London: MacMillan Press Ltd. UK.

Government of India, 2014. Economic Survey 2013-14, New Delhi: Department of Economic Affairs, Ministry of Finance.

India Desalination Plant Market to Exhibit CAGR of About 19% in terms of Installed Capacity by 2019, available at: <http://www.techsciresearch.com/3033>

India needs $2.3 trillion investment in energy sector by 2035: Asian Development Bank, available at: <http://timesofindia.indiatimes.com/business/india-business/India-needs-2-3-trillion-investment-in-energy-sector-by-2035-Asian-Development-Bank/articleshow/24154555.cms>

Indian energy sector: an overview, available at: <http://www.indiaenergyportal.org/overview_detail.php>

Interim Report of the High Level Committee on Financing Infrastructure. *Planning Commission, Government of India*, August 2012.

International Seminar on Groundwater, Issues and challenges of the 21st century organized by Sripat Singh College, Jiaganj, Murshidabad, West Bengal, available at: <http://isgic.ss-college.org/htm/BOOK_OF_ABSTRACTS.pdf>

Mini Hydro, available at: http://bginfra.com/mini_hydro.php

OECD, 2007. Infrastructure to 2030: Main Findings and Policy Recommendations. Paris, OECD.

Overview of the demand in the Indian Transport and Logistics Industry – Market Study Report – European Business and Technology Centre.

Report on the Indian Telecom Sector by the Indian Brand Equity Foundation available at <http://www.ibef.org/industry/telecommunications.aspx>

The role of public investment in social and economic development, Public Investment: Vital for Growth and Renewal, but should it be a Countercyclical Instrument?. *United Nations*, New York and Geneva, 2009.

Water and Wastewater Treatment Equipment Market expected to Grow with CAGR of 7.4% Till 2018, available at: <http://www.marketsandmarkets.com/ResearchInsight/water-treatment-equipment-market.asp>

What is the 2G spectrum scam? – India Today online, available at: <http://indiatoday.intoday.in/story/what-is-the-2g-scam-all-about/1/188832.html>

Working Sub-Group on Infrastructure- Infrastructure Funding Requirements and its Sources over the implementation period of the Twelfth Five Year Plan (2012-2017). Planning Commission, Government of India.

World Bank. 1994. World Development Report 1994: Infrastructure for Development, New York: Oxford University.