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Study of the Infrastructure Financing Development and Economic Growth in India

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Abstract: Infrastructure is one of crucial pillars of productivity in any economy and it is the backbone of development of any nation. A strong infrastructure is indispensable for the sustainable growth of a national economy. by tradition major infrastructure sectors are power, roads, railways, ports, civil aviation and telecommunication in physical infrastructure area, while social infrastructure covers areas like literacy and education, water and sanitation, health, housing, and culture. The objective of this research paper is to assess the extent of innovation in different areas of infrastructure and its contribution to the nation's development. The research paper analyzes the measures taken by concerned Infrastructure Financing Development Agencies to enhance the innovativeness of the infrastructure sectors. In this study has explained resource constraint is the critical factor for infrastructure deficit in India. This paper identifies stable exchange rate, mild inflation, clarity of taxation rules, fiscal discipline & sustainability of economic policy create investment climate in India. According to this paper, public private partnership model is the best model as infrastructure is concerned but effectiveness of this depends upon maturity of domestic bond market & infrastructure pricing policy. In addition, this paper discovers inadequate allocation of funds and facilities to the few infrastructure projects, delay in environment clearances, issues in the land acquisition, absence of credible dispute resolution mechanism are the technical barriers of investment in infrastructure. This paper suggests setting up an infrastructure development fund for those infrastructure sectors in which private participation is negligible. In addition, company act 2013 should be amended for more participation of corporate sector for infrastructure development.

Key Words: *Infrastructure, Sustainable, financing, Innovation and financing methods*

Introduction

Development of proper infrastructure is vital for economic growth of any country. Investors will like to put the capital only in those countries where there is developed infrastructure. Infrastructure consists of many things such as Road, Railway, Port, airport, electricity, telecommunication, water supply etc., Development of infrastructure is capital intensive and gestation period is high. At the same time return on capital in case of infrastructure projects is small as well as slow. Hence, investors are shy in investing

capital in infrastructure projects unless some special incentives and privileges are provided. Infrastructure is a profound determinant of nationhood, a measure of a country's success on the world stage. Physical infrastructure may be viewed as the manifestation of a country's economic power; social infrastructure's measures are the social capital and the standard of living of its citizens. A nation's physical infrastructure is generally taken to mean its public capital: its community buildings such as hospitals and schools; transport nodes of airports, seaports, rail and road networks; utility services such as water, power and waste services. Infrastructure in all its commercial manifestations is viewed by governments as the means to attract substantial private sector investment. This empirical research considers the manner by which a country's infrastructure program is funded, and the interrelationships between infrastructure development and economic growth experienced by developing countries, in particular, India.

Development of Indian economy is unachievable without sustainable inclusive economic growth. This depends upon the quality of infrastructure, which is one of the crucial drivers of productivity of an economy. Lack of quality Infrastructure is the most problematic factor in India for doing business (The Global Competitiveness, 2014). It also acts an imperative role for attracting foreign direct investment (Sharma, Nayagam & Chung, 2012). The Organization for Economic Co-operation and Development (OECD) estimated in 2009, that total new spending for infrastructure over the period of twenty year, (2010-2030) would be US $ 71 Trillion or about 3.5% of world GDP. The World Economic Forum's Positive Infrastructure Report found that the world faces a global infrastructure deficit of US$ 2 trillion per year over the next 20 years. There was improved investment in physical infrastructure from a level of five per cent of GDP during the Tenth Five-year Plan to seven percent of GDP during the Eleventh Five-year Plan in India. It is estimated that investment for the Twelfth Five-year Plan will be 5.71 per cent of GDP. In Prime Minister's inaugural speech on March 23, 2010 at "Conference on Building Infrastructure" held in New Delhi, he had anticipated that investment in infrastructure would need to US $ 1 trillion during the Twelfth Plan period (Second Report of, 2014). On the quality of infrastructure, India ranks 87 out of 144 countries (The Global Competitiveness, 2014).

Literature Review

Infrastructure financing has been a topic extensively studied by policy makers and practitioners. A number of papers have addressed how large-scale infrastructure projects can be organized and financed. The theoretical literature on infrastructure financing has explored the question of whether the project should be exclusively organized by the government or be structured in partnership with players from the private sector.

Martmort and SandZantman (2006) consider the classic infrastructure problem in which the government is seeking to procure a public good or service on behalf of its citizens. The government may either deliver the service under public ownership (railways, water, or power, for example) or fully or partially outsource the activity to the private sector and their model has the following trade-off: retaining good projects is a way for the government to signal to private parties that the quality of the infrastructure assets is good. But this comes at the expense of moral hazard entailed by imperfect information and non-verifiability of efforts. Their model delivers the following sharp predictions: first, the amount of risk kept by the government increases with the quality of the infrastructure.

Full privatization emerges in their model only for the worst-quality infrastructures.

Perotti (1995) provides a framework in which partial privatization is a way for a government to credibly signal that it will not behave opportunistically upon privatization (such as decreasing or even eliminating tolls, once the toll-highways are privatized). The profits are assumed to be exogenous in this model. In reality, profits may be endogenous depending on the efforts expended by both parties - the private sector player must keep the highways in good order, and the government must commit not to behave in a politically opportune manner, ex-post.

The Infrastructure finance market in India is characterized by the absence of an active long-term corporate debt market, asymmetric information on infrastructure projects, and inherent risks in financing infrastructure projects. Adding to the problem of inadequate long-term funds is the conversion of development finance institutions (DFIs), which had been the major source of long-term finance earlier, into commercial banks which face asset liability mismatch issues and are rapidly nearing their limits for sectoral and group exposure in infrastructure.

Table 1: The following table summarizes the available financing sources in infrastructure:

Financing Sources for Infrastructure Projects	
Domestic Sources	**External Sources**
Equity 1. Domestic investors (independently or in collaboration with international investors) 2. Public utilities 3. Dedicated Government Funds 4. Other institutional investors	**Equity** 1. Foreign investors (independently or in collaboration with domestic investors) 2. Equipment suppliers (in collaboration with domestic or international developers) 3. Dedicated infrastructure funds 4. Other international equity investors 5. Multilateral agencies
Debt 1. Domestic commercial banks (3–5 year) 2. Domestic term lending institutions (7–10 year) 3. Domestic bond markets (7–10 year) 4. Specialized infrastructure financing institutions such as Infrastructure Debt Funds	**Debt** 1. International commercial banks (7–10 year tenor) 2. Export credit agencies (7–10 year) 3. International bond markets (10–30 year) 4. Multilateral agencies (over 20 year)

Source: Asian Development Bank: Proposed Multitranche Financing Facility India: India Infrastructure Project Financing Facility,

Conceptual Framework

Infrastructure Financing in India

The financial sector in India is dominated by banks. (IMF 2013) Commercial banks are the largest group, comprising 58% of total financial assets, followed by life insurance with 17% of total assets. There are a large number of NBFCs with 12% of total assets operating in specialized segments (leasing, factoring, microfinance, infrastructure finance). Pension and provident fund assets account for about 5.5% of total assets. Pension provision covers 12 percent of the working population and consists of civil service arrangements, a compulsory scheme for formal private sector employees, and

private schemes offered through insurance companies. Finally mutual funds account for 8% of assets. Public ownership is a defining feature of the financial system. Majority publicly owned banks account for three quarters of banking system assets. About 69 percent of insurance premiums and 80 percent of insurance assets are accounted for by public insurers. Most of the pension system is in public hands. The public life insurance company and public provident fund are the two largest providers of funds to the Indian capital market. Projection of Infrastructure Investment and Financing during the 12th Five Year Plan period 2012-2017.

Table 2: Descriptive

Particulars	**Amount (Rs. Crores)**	**% of total**
Total Infrastructure Investment	5,574,663	100%
Govt (Central/State) Budget and Internal generation	1,973,732	35%
Private -Internal Accruals / Equity	825,291	15%
Borrowing		
Govt PSU	917,092	16%
Private	1,858,549	33%
Total	**2,775,641**	**50%**
Availability of Borrowing		
Domestic Bank Credit	1,164,646	21%
NBFCs	618,462	11%
Pension/Insurance funds	150,248	3%
External Commercial Borrowings (ECBs)	331,834	6%
Likely Total Debt Resources	2,265,171	41%
Gap between Estimates and Likely Requirement	510,470	9%

Source: Planning Commission 2013

Given the pattern of household savings in India there is a scarcity of long term savings. More than 50% of household savings is accounted for by 'physical savings' (investments in physical assets such as homes and more recently in gold) and not subject to financial intermediation. About 55% of household financial savings is accounted for by bank deposits, which are relatively short term in nature. Life insurance and provident and pension funds account for the balance savings. Investments in equity, has been small, except during the period just prior to the financial crisis. Consistent with the pattern of household savings the main sources of infrastructure financing are commercial banks, insurance and pension funds and NBFCs. Table 1 below shows the projected sources of financing for the 12th five year plan. Of the total planned investment the share of the private sector is about 48%. Almost 50% of the total investment is expected to be

financed by borrowings. The distribution of the 50% borrowings is 21% is from banks, 11% from NBFCs, 3% from pension and insurance funds and 6% from external commercial borrowings with a 9% gap.

Table 3: Financing by banking sector to Infrastructure Financing Projects

Rs. Crores						
As on	**Mar-07**	**Mar-08**	**Mar-09**	**Mar-10**	**Mar-11**	**Mar-12**
Commercial banks	144,531	205,336	269,972	379,888	540,390	619,100
Life Insurers (Life Fund)	69,837	63,262	66,673	85,674	89180	97,319
Non Life Insurers	6,102	7,660	8,980	10,373	12,215	15,198

Source: Planning Commission 2013

Banks also face an asset-liability mismatch if they provide long term loans financed by relatively short term deposits. According to the, while banks have been meeting the needs of financing infrastructure currently, there may be some further constraints on such long term financing once the Basel III bank liquidity norms such as the Liquidity Coverage Ratio and Net Stable Funding Ratio are implemented. According to the Trends and Progress in Banking, "maturity mismatch has often been highlighted as a concern for the Indian banking sector given the sector's increased exposure to long-term infrastructural loans financed primarily from deposits of shorter maturities." Similar concerns have also been expressed by rating agencies.

Statement of the problem

- For the development of infrastructure finance in India the Public sector Commercial banks are currently leading source of debt capital to the infrastructure sector in India. Banks are not willing to invest in long term infrastructure projects in India due to maturity variance created by short-term liabilities.
- The Infrastructure financing projects are generally executed through special purpose vehicles (SPV). The financing project has neither credit history nor strong balance sheet.
- The issues and challenges of debt instruments by SPVs needs a well-developed debt market. Raising funds from the Indian financial market through the issuance of bond has become a challenging task due to underdeveloped bond market (Lam, Chiang & Chan, 2011).
- The majority of research on infrastructure finance projects, as noted above, supports a significant and positive relationship between public infrastructure and economic growth.
- The infrastructure financing project there is an element of risk involved for government policymakers who depend on such research to predicate economic outcomes from various Project financing methods. This kind of risk is especially

relevant in Indian public funding, where there is no empirical study on the relationship between the two variables. The majority of Research Studies refer to the positive and significant relationship found to the development of the infrastructure projects.

- Moreover, financing public infrastructure is a crucial issue, especially in emerging economies where budgetary surpluses are difficult to achieve and income flows are vulnerable to global forces (Merna & Njiru 2002). Because incomes are lower in developing countries, savings are low and thus investment is low. Older and stronger economies have the financial resources to recover quickly from an economic downturn.

Significance of the study

- This study examines the public infrastructure investment on economic growth issues and challenges in India, by means of empirical research and quantitative analysis. It should be noted that, as the social consequences of infrastructure investment are difficult to measure and data are available, the financial aspects of public infrastructure investment are analyzed.
- The scope and design of the research is as follows. First, a literature review is undertaken to identify the nature of extant research on infrastructure inputs and effects, and to analyses the themes that emerge from the findings. Further, international research is examined over the relevant period to find points of comparison with Indian's experiences. And the study is timely, as public infrastructure investment has recently achieved a policy focus in India. As India is a developing country, this study extends research from its existing focus on the financial environments of mature economies to the dynamics of an emerging economy.
- There is no identified research that investigates public infrastructure expenditure's impact on Thai economic growth, presumably due to a lack of data. Public infrastructure-related studies for India.
- The Indian literature does not individual between public consumption and public investment. This research places importance on public investment, specifically, infrastructure investment. The proposed issues and challenges t of this emphasis is to provide specific knowledge and a deeper understanding of the impact of public investment, especially infrastructure, on the Indian economy.
- The literature strongly supports the notion that public infrastructure investments significantly and positively affect economic growth. However, few studies address the financing of infrastructure and those that mention in Indian experience do so superficially. This study takes the approach that finance is a function of investment; investment is an indicator of economic growth.

Research Methodology

"Scientific Research is a systematic, controlled, empirical and critical investigation of hypothetical propositions about the presumed relations among natural phenomena" (Kerlinger, 2004). "Research is the systematic and objective identification, collection, analysis, dissemination and use of information for the purpose of assisting management in decision making related to identification and solution of problems and opportunities" (Malhotra, 2005). The data were obtained from the World Bank, Asian Development Bank, the National Economic and Social Development Board, the Ministry of Finance, the Revenue Department, the Excise Department, and the Customs Department. A recursive supply-side model based on the Standard Neoclassical Model framework is used. All variables used in the study are aggregate national data, as a first step, a list of Infrastructure service companies have been selected. The study has selected list includes 15 major publicly from Bombay stock exchange listed companies. Daily stock prices of the listed companies for a period of five years from April 1, 2008 to March 31, 2015 were collected from Capitaline, a corporate database. Values of BSE100 index for the same period too were obtained from Capitaline. BSE100 index is a broad based index of 100 large and most active stocks from across various industrial sectors listed on the Bombay Stock Exchange (BSE). The present study based on the secondary data, collected from the different sources like World Development Reports of various years, Human Development Report of India (2011), majority of data and literature collected from the existing growth theories, empirical studies. Particularly this study is not related to any region, state but its concern India's socio economic perspective. Why infrastructure is more important other than the growth determinants and how infrastructure influences the different sectors of the economy, than it studied the global and Indian experience of infrastructure and growth through empirical evidences and establish the relationship between infrastructure and growth.

Scope and Coverage of the study

The study mainly concentrates on various components of infrastructure in India. The study has been selected major infrastructure finance project development among 2000 project the study has selected only 9 project throughout county. The study stresses on various economic and social infrastructure facilities like roads, railways, banks, schools, hospitals etc. available in the district. The study is an effort to assess the development of infrastructure facilities in the 9 infrastructure projects.

Objective of the study

- To find out the major components of existing infrastructure facilities in the country across major states so as to understand the position of the infrastructure financing project.
- To analyse the need for development of infrastructure in economic development of India
- To analyses the level of development of various infrastructural indicators across

different states in the India so as to understand the disparity in infrastructure development.

Research Hypothesis

The study aims at testing the following hypotheses:

H1. Infrastructure is an Indicator of Economic Development.

H2. Infrastructure Financing Development contributed to the economic development of India.

H3. There is a disparity in infrastructure development among different Project Financing.

Data Analysis of the infrastructure financing projects

Infrastructure Investment - to economic Growth Model

In this study examine the effects of infrastructure on overall growth and thereby sustained in the economy. There are many infrastructure variables that can be considered to determine the effect of infrastructure on growth. Since adding unimportant variables will add overhead to the analysis without any significant effect on the dependent variables, we need to identify which are the important variables. In order to address the first research question, we use here an aggregate production function, which can be written in the form:

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$$Q = A^{*} F(K, L, I)$$

where A* is the factor productivity represented by the state of technology, K is the stock of capital, L is the labour force, and I is the amount of infrastructure investment.

Using the Cobb-Douglas form

$$Q = A^{*} K^{\alpha} L^{\beta} I^{\delta} e^{u_t}$$

Now, writing (2) in logs gives:

$$\ln Q_t = \ln A^{*} + \alpha \ln K_t + \beta \ln L_t + \delta \ln I_t + u_t$$

Here the interpretation of production elasticities α, β & δ is tricky. If one assumes that labour and private capital are paid as per their productivities and finds δ>0, α+β=1 and α+β+δ>1, so that returns to scale are increasing. It is also possible to use (2) to determine the rate of return on infrastructure investment. Differentiating Cobb-Douglas of (2) yields:

$$\delta = F_I I / Q$$

where FI is the marginal product of infrastructure capital. As far as second research

question is concerned, Principal Component Analysis (PCA) technique has been used to discover the important sector-specific infrastructure investment.

Data Sources

Due to the fragility of the Indian database it is not possible to find, in particular, infrastructure investment data for a fair number of years. However, for a comparative analysis, data for all the variables or indicators have been taken since 2004-2014.

Table4: Availability of source

Variable	Source	Period
Labour force ('000)	Labour force participation rate (ILO estimates; by sex and age group)	2004 to 2014
GFCF in Infrastructure	Data for use of Deputy Chairman, Planning Commission, 18 May 2014	2004 to 2014
GDP at current prices	Central Statistical Office (CSO)	2004 to 2014
Gross Domestic Capital Formation	Central Statistical Office (CSO)	2004 to 2014

Note: **** GFCF in infrastructure includes GFCF in irrigation, electricity, gas, water supply and wind energy, ports etc., construction and Roads & Bridges, railways

Table 5: The values of these parameters for the above-mentioned period is given below.

Values of Selected Indicators

Year	Labour force (crore)	GFCF in INFRA (Rs.in Crore)	GDPMP (Rs.in Crore)	Gross Domestic Capital Formation (Rs. in Crore)	Gross Domestic Capital Formation other than Infrastructure (Rs.in Crore)
2005	40.14	88,521	1,802,801	429,430	340,909
2006	40.92	109,303	2,009,556	532,692	423,389
2007	42.06	116,950	2,164,262	538,525	421,575
2008	43.21	115,931	2,346,105	547,857	431,926
2009	44.38	123,940	2,526,888	650,323	526,383
2010	45.57	140,820	2,835,789	798,995	658,175
2011	46.77	182,603	3,242,209	1,064,041	881,438
2012	46.90	235,806	3,692,485	1,279,891	1,044,085
2013	47.00	275,111	4,293,672	1,531,568	1,256,457
2014	47.10	330,968	4,986,426	1,901,928	1,570,960

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Empirical Results

$$LNGDP = \underset{(1.48)}{3.26} + \underset{(0.23)}{0.13}\ LNCAPITAL + \underset{(0.23)}{0.46}\ LNINFRA + \underset{(0.57)}{1.15}\ LNLF$$

Linear Regression Results

Dependent Variable: LNGDP

Table6: Sample: 2005 to 2014

Variable	Coefficient	Std.Error	t-statistic	prob
C	3.262145	1.477943	2.207219	0.0694
LNCAPITAL	0.129654	0.226132	0.573356	0.5872
LNINFRA	0.460044	0.230836	1.992949	0.0933
LNLF	1.148501	0.565001	2.032744	0.0883
R-squared	0.992028	F-statistic	248.8712	
Durbin-Watson stat	1.384301	Prob (F-statistic)	0.000001	

Note: LNLF represents the natural logarithmic value of labour force, LNINFRA represents the natural logarithmic value of infrastructure investment, LNCAPITAL represents the natural logarithmic value of capital formation in sectors other than infrastructure, and LNGDP represents the natural logarithmic value of GDP at current market prices.

Results show that the coefficient of infrastructure is positive (0.46) and also is statistically significant (at a 10% level), implying that a very high rate of return, even compared to other investment, might be due to its spill-over or externality effects. Similarly, to assess which set of infrastructure parameters seems to be quite significant, PCA analysis has been used on the following variables:

1. Road Construction (Road)
2. Railways (Rail)
3. Electricity, Gas, Water supply (EGW)
4. Communications (Com)
5. Irrigation (irr)
6. Storage (strg)
7. Ports

Considering the above variables, an attempt is made to identify significant variables taking ten years and five years of data. The pattern that the variables follow in both the samples should be the same, indicating that all the variables follow the same pattern across time. The results from both analyses are discussed in detail below. PCA requires that there should be some correlations greater than 0.30 between the variables of concern, which is satisfied as observed from the correlation matrix of variables in

Table 7: Correlation Matrix of the infrastructure financing projects

	Irr	Road	Rail	EGW	Com	Strg	Ports	Gdp
Irr	1.000	-0.262	0.500	0.532	0.677	0.081	0.753	0.744
Road	-0.262	1.000	0.084	0.194	0.017	0.640	-0.079	0.010
Rail	0500	0.084	1.000	0.281	0.736	0.370	0.734	0.742
EGW	0.532	0.194	0.281	1.000	0.144	0.241	0.694	0.783
Com	0.677	0.017	0.736	0.144	1.000	0.360	0.424	0.576
Strg	0.081	0.640	0.370	0.241	0.360	1.000	0.238	0.225
Ports	0.753	-0.079	0.734	0.694	0.424	0.238	1.000	0.890
Gdp	0.744	0.010	0.742	0.783	0.576	0.225	0.890	1.000

It is already seen in the above regression analysis that infrastructure has a major impact on growth. The correlation matrix cannot quantify the impact of each of these parameters on growth, each of the infrastructure parameters has a positive correlation with growth, and an increase in investment in each of these parameters will result in an increase in growth. Observing the positive correlations in the table it is evident that each of these sectors is interrelated, and an increase in growth because of an increase in investment in any particular sector might not be solely because of that sector.

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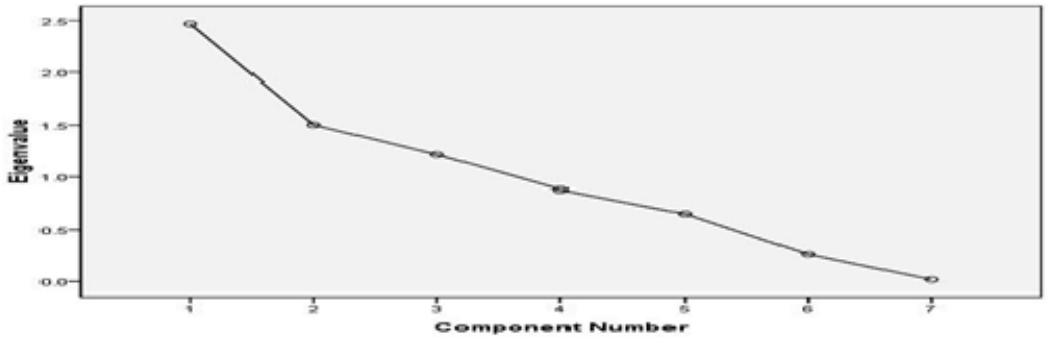
A further analysis compares the change in GDP with the change in each of the parameters by calculating eigenvalues and corresponding eigenvectors. All the components whose eigenvalues are greater than 1.0 are significant. In both the samples there are three components having eigenvalues greater than 1.0, which explains more than 70% of the total variance of the data, when the criteria is only 60%. The higher the eigenvalue of a component the higher its importance, as it explains most of the variance in the data. The component loadings of each of the components are analyzed to see the individual importance of sectors, and the absolute value of the component loading of a sector explains its own importance to growth.

Table 8: Components of the analysis

Component	Eigenvalue	Cumulative variance
1	2.466	35.233
2	1.502	56.694
3	1.215	74.046

Above table shows that the first component with higher eigenvalue and steep slope has more information about the significant parameters of growth, followed by the second and third components; all of which have eigenvalues of more than 1.0.

Figure 2: Screen Plot of Eigenvalues



Finally we consider each of the components individually to identify the significance of each parameter. Its shows all the components with the component loading values that explain the parameters' significance. Pattern matrix of infrastructure financing projects

Table 8: Component

	Component		
	1	2	3
Irr	-.956	-.113	-.151
EGW	.931	-.027	-.017
Rail	.619	-.066	-.578
Ports	.310	.766	.172
Strg	-.305	.717	-.023
Com	.072	.647	-.151
Road	.113	-.083	.915

Looking at the first component, Irrigation (Irr), Electricity Gas and Water (EGW), and Railways (Rail) seem to be more significant. They all are moving together with higher values and so have a major impact on growth both individually and together. India is an agrarian economy and so it is evident that investment in the irrigation sector is very important, as supported by the results with the component loading value of 0.956, as are Electricity, Gas, and Water supply and Railways, which enable economic growth to drive forward and better communications in the industrial economy. However, Road Transportation and Water Transportation are also important as they facilitate well-established communications in the economy. This fact is evident by looking at the second and third components, where Road and Ports have component loadings of 0.915 and 0.766 in the third and second components, respectively. Considering all the components together, no infrastructure sector component appears to have less importance and an increase in investment in all components together can have a major impact on the growth of the economy.

Econometric model for the evaluating the infrastructure financing projects

The null hypothesis is that the two samples are drawn from a single population, and therefore their distributions are equal. It requires the two samples to be independent and the observation to be ordinal or continuous measurements. In a less general formulation, the Wilcoxon-Mann-Whitney two-sample test may be thought of as testing the null hypothesis that the probability of an observation from one population exceeding an observation from the second population is 0.5. This formulation $f_1(x) = f_2(x+\delta)$, requires the additional

Assumption that the distributions of the two populations are identical, except if there is possibly a shift. An alternative interpretation is that the test assesses whether the Hodges-Lehman estimate of the difference in central tendency between populations is zero. The Hodges-Lehman estimate for a two-sample problem is the median of all possible differences between an observation in the first sample and an observation in the second sample. It is commonly thought that the MWW tests for differences in median, but this is not strictly true. The test involves the calculation of a statistic (U), whose distribution under the null hypothesis is known. In the case of small samples, the distribution is

tabulated, but for small sample size above 20, there is a good approximation using the normal distribution. For large samples, a formula can be used.

All the observations are arranged into a single ranked series, without regard to the sample they are in. The ranks for observations which came from sample 1 are added. The sum of the ranks in sample 2 is also determined through calculation. Since the sum of all the ranks equals;

$$R_1 + R_2 = \frac{N(N+1)}{2}, \quad (1)$$

Where N is the total number of observations

Mann-Whitney statistics, U, is given by:

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 \quad (2)$$

Or

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2 \quad (3)$$

Where n1 and n2 are the sample sizes for sample 1 and sample 2 respectively. R1 and R2 are the sum of the ranks in sample 1 and 2 respectively

$$U_1 + U_2 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1 + n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2 \quad (4)$$

The sample distribution of U is symmetrical and has a mean (μu) and variance (δ2u).

However, if the elements of the samples to be considered are greater than 20, the U statistics could be converted to the Z statistics to make the computation reliable.

The approximated value of Z is given by:

$$Z = \frac{2R_1 - n_1(N+1)}{\sqrt{n_1 n_2 (N+1)/3}} \quad (5)$$

Or

$$Z = \frac{2R_2 - n_2(N+1)}{\sqrt{n_1 n_2 (N+1)/3}} \quad (6)$$

Where Z is the Z statistics value and N is the summation of the number of elements in the two samples

Conclusion

1. Development of the infrastructure sector is crucial to the growth of the Indian economy. Sustainable development can only be attained through a careful analysis of the factors that have mitigated growth in the past, and thereafter, taking the appropriate corrective measures.

2. Over the last decade, the Indian government has made significant efforts to eliminate bottlenecks in these areas. It has initiated policies and schemes such as ECs/EIs and Model Concession Agreements to increase the inflow of private sector investments and make the bidding process for projects more transparent.

3. It is now generally accepted that infrastructure projects require long term financing and life insurance and pension funds are the major sources of long term finance. Banks can at best be expected to provide short term financing during the construction period. To the extent pension and insurance funds do not have their own due diligence capabilities for infrastructure projects, Infrastructure Finance Companies (IFC) and Infrastructure Debt Funds (IDF) can provide such services.

4. In addition, if the infrastructure projects do not meet the minimum ratings requirements, then the Infrastructure Investment and Financing Company Limited (IIFCL) can provide credit enhancement to the bonds issued by such projects. The success of these initiatives will now depend upon the ability of the government to generate a supply of PPP projects in an environment of policy certainty.

5. In conclusion it could be said that there are wide range of disparities between different States the indicating the need for inclusive growth. Besides, the lack of development in the social infrastructure in comparison to economic infrastructure calls for addition development both in quantity and quality in schools and hospitals throughout the state.

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