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Infrastructure, Transport and Economic Development- A Survey of Literature

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Abstract

The relationship between Infrastructure and Economic Development has been in academic and political discussion world over. Historical evidences suggest positive link between the two but academic and research pursuits followed much later in context of widening disparities among nation's developments. This literature review focuses on available literature and their findings on relationship between investment on infrastructure, within it transport infrastructure and economic growth. The review is not an exhaustive summary of all available literature but attempt has been made to include studies conducted in different economic and social settings and also with varied objectives. It is observed in the review that Infrastructure building is critical for economic development. Role of infrastructure is a determining factor due to its inherent multiplier effects. Transport Infrastructure has high multiplier effect due to positive externalities. However there are many studies who have concluded that impact of Infrastructure also depends on many other variables affecting economic growth including the volume of Infrastructure itself. Many studies find Law of diminishing returns in operation after a certain level of investment in infrastructure. This review also finds contrasting evidences of weaker link between them and micro level studies do not establish positive relationship with certainty.

Keywords*: Infrastructure, Economic Development, Investment, Transport*

1. INTRODUCTION

Infrastructure plays critical and defining role in development of any society. Transport infrastructure, as a significant constituent of total infrastructure base, is a facilitator and a component of input cost in the production process affecting cost of producing any goods or services and in turn price structure in the economy. Infrastructure investment has been researched world over. The degree of infrastructure's contribution has been deliberated, debated and disputed due to peculiar nature of its contribution to development. There are direct measurable impacts of infrastructure on several parameters of economic development like GDP, prices level but various externalities attached with infrastructure are difficult to capture and quantify. A universally accepted definition of infrastructure has alluded most of us. The concept of infrastructure is also time, context and geography specific.

Transport with its sub components like Roads, Railways, Airlines, Shipping constitutes a critical enabling infrastructure for an economy. It leads to optimization of human and physical resources in society. Infrastructure deficit is known to contribute to shortfall in GDP growth by at least 1-2% points. The difficulties in quantifying such relationship is because of the complicated nature of relationship with respect to positive externalities, forward, backward linkages and large number of variables influencing GDP growth. Anthony J Veneables and others[i] (2014) while analyzing Transport investment and economic performance for UK department of Transport stated "Transport is an essential input to income generation, and to consumption and wider domestic life. Estimates suggest that if all other drivers of growth were to increase by 10% and transport infrastructure to stay constant, then realized growth in income would be just 9% i.e. 1% less than it otherwise would have been."

This paper analyses findings of some literature on infrastructure and its role in development. The analysis focuses on definitions, relationship between infrastructure and economic development with specific reference to Transport infrastructure. All the dimensions of the subject and all literature are difficult to cover in one review and hence selective review has been taken up for identifying broad indicators. The review is not exhaustive but serves the objective of exploring intended relationship.

2.Infrastructure- Definitions

The term Infrastructure originated in the 19th century primarily to refer to Military installations. During 20th century the scope widened to include roads, Railways, and other public utilities. It further got expanded during the time of

American drive for development after great depression (1929) and Second World War. The American heritage dictionary of English languageiistates "the term infrastructure has been used since 1927 to refer collectively to Roads, bridges, rail lines and similar public works." H W Singeriii (1951), Ragnar Nurkseiv (1955), Gunnar Myrdalv (1956) were early scholars to attempt at defining Infrastructure as 'Social Overhead Capital' comprising of public utilities, power plants, water works, transport facilities. A.O.Hirschmanvi (1958), in 'The Strategy of Economic Development' differentiated between Direct Productive Activities (DPA) and Social Overhead Capital (SOC). In his opinion the SOC is the infrastructure without which the primary, secondary or tertiary productive activities cannot function. Hirschman further extends his definition by placing conditions, like services which are basic to economic activities, provided by public bodies, lumpiness in character and cannot be imported, are required to be satisfied for an activity to be defined as SOC.

Experts differ on definition of infrastructure owing to its scope, functionality and measurement. World Development reportvii (1994) defines infrastructure into two broad categories of economic or physical infrastructure and social infrastructure. It classifies Power, transport, water systems, communication and irrigation as economic or physical infrastructure and social infrastructure to include education and health. OECDviii defined infrastructure as "The system of public works in a country, state or region, including roads, utility lines and public buildings".
Rangarajan Commissionix (2001) of Government of India defined infrastructure on six characteristics namely Natural Monopoly, High Sunk Cost, Non-tradability of output, Non-rivalness in consumption, Possibility of price exclusion and Bestowing externalities in society. Rajshri Majumdarx (2002) starts with basic definition of infrastructure as "something which lies below or comes before the structure and is base or the initial foundation on which superstructure is built."

Remy Prud Hommexi (2004) has explored the characteristics of Infrastructure and its history. "The concept of infrastructure and not only the word, has largely, and surprisingly, been absent from the history of economic analysis. Infrastructure and particularly transport infrastructure play a critical role in Adam Smith's vision of economic development. No roads, no transport, no trade, no specialization, no economies of scale, no productivity progress and no development."

Reserve Bank of Indiaxii (2013) defined infrastructure with reference to credit facilities extended by financial institutions to sectors like Energy, Communication, Water and Sanitation, Mining, Exploration and refining, Transport, Social and commercial infrastructure. RBI in a departure from conventional definition of infrastructure included 'Maintenance, Repairs and Overhaul (MRO) as part of Airport Infrastructure in 2014. Planning Commission of Indiaxiii defined infrastructure on similar line as a crucial input for economic development. Margret Thatcher, former British Prime Minister, underlining the significance of infrastructure famously commented "you and I come by road or rail, but economists travel on infrastructure."

There may be other definitions of infrastructure but broadly they include sectors contributing towards facilitating economic activities in an economy. The World Bankxiv in reference to role of infrastructure have stressed that "infrastructure is an integral part of development providing and delivering basic services that people need for everyday life i.e. safe drinking water, electricity, roads, sanitation etc."

3.Infrastructure and Economic Development

Historically, infrastructure was not in great discussion in academic circles but investment in sectors relevant to assist economic development had been a salient feature of industrial revolution era. The American canal constructions, building up of Rail networks across America or roads across the land had happened before America became a developed country. Even Europe invested heavily in building its power transmission network, road network and rail connectivity when they were still developing economically. The massive rail construction in India in 19th and early 20th century happened despite British Government's intent to keep India under developed. The literature on such developments is widely available in country wise studies. However, the issue of infrastructure's contribution to economic development was largely sidelined due to its peculiar nature of contribution till a seminal work by Aschauerxv(1989). He calculated the contribution of infrastructure in economic development to prove a positive correlation between the two.

World Development Report 1994 on "Infrastructure for Development" stated that "Infrastructure represents, if not the engine, then the wheels of economic activity. Infrastructure can deliver major benefits in economic growth, poverty alleviation and environmental sustainability- but only when it provides services that respond to effective demand and does so efficiently." The Report also asserts that a strong association exists between the availability of

certain basic infrastructure and economic development measured in terms of GDP (Gross Domestic Product), with the caution that investment in infrastructure doesn't guarantee growth. The WDR 1994 estimates that infrastructure capacity grows step for step with economic output- a 1% increase in the stock of infrastructure is associated with 1% increase in gross domestic product across all countries.

Barry Eichengreenxvi (1995), while analyzing the role of private enterprises in infrastructure development and lessons for developing countries draws upon examples of infrastructure financing in early Railway age. He argued, "For low income countries investments in infrastructure have alluring benefits as well as daunting costs…. Because lack of infrastructure limits investment and lack of investment limits infrastructure, low income countries can find themselves in a low level equilibrium trap from which it is difficult to escape." Drawing upon examples of building Railway networks in Americas, Europe and India during 19th and early 20th century, Eichengreen argued that infrastructure building must take place with public as well as private participation as finding resources for such huge investment by public authorities alone may not be possible. The early railway lines were mostly laid with private enterprises investing in projects under various schemes like guaranteed return on investment, subsidization of investment by Government, Land Grants etc. The historical research supports the proposition that railways were a source of positive externalities with some estimate claiming social returns at 30% a year. He has argued for active Government intervention in such investments quoting from the editors of The Economists (1858) "When great schemes of public utility are brought before the country, it is natural that the Government should extend its aid to such enterprises"xvii (Macpherson, W.J 1955).

Sutherlandxviii (2009) and others have analyzed relationship between infrastructure and growth through study of time series results. Their study reveals a positive impact of infrastructure investment on growth. However it shows that this effect varies across countries and sectors and over time. They have found evidence of over investment in some cases. Analysis of sectoral data through Bayesian model averaging of cross section growth regressions further reveals that infrastructure investment in telecommunications and electricity sectors has a positive effect on long term growth but same is not true for Railways and Road networks.

Sutherland D *et al* for OECDxix (2009) studied impact of infrastructure on economic growth in countries with different levels of development. "Infrastructure investment can have effects on growth over and above those arising from adding to the capital stock. These effects can occur through a number of different channels, such as facilitating trade and division of labour, competition in market, efficient allocation of economic activity across regions and countries, diffusion of technology and adoption of new organizational practices or through providing access to new resources." OECD studies reveal that investment in physical infrastructure can boost long term economic output. However, OECD studies have also found that there is a possibility of threshold above which investment in infrastructure will have relatively muted effects. It also indicates that impact of investment in infrastructure is subject to law of diminishing returns and depends on level of provision already available. The study across countries point out towards inefficient use of investment in infrastructure causing sub optimal returns in raising output. The results of different sectors in different countries do not provide any linear outcome for investment in infrastructure.
A study by Vytautas Suieska and Ineta Simkunaitexx (2009) reflects on socio-economic impact of infrastructure investments. They highlighted varied impact investment in infrastructure have on different countries. "Characteristics of each country determine the set of infrastructure components and the aspect of impact on social and economic development: economic growth, income inequality, output, regional competitiveness, labour productivity and welfare".

Andrew Meaney and Pater Hopexxi (2012) have recognized significant economic benefits attached to investment in infrastructure both in short term as well as long term. However they visualize critical role of positive externalities determining investment decisions by private enterprises. They argue that "infrastructure has benefits (positive externalities) which may not necessarily be directly captured by the investor; rather they might be appropriated by users and wider society. Thus in the face of positive externalities, the investor, who is primarily interested in direct benefits, would price the infrastructure investment lower than the wider society. This would lead to socially sub optimal, low levels of investment."

\Amar Bhattacharya, Mattia Romani and Nicholas Sternxxii(2012) talk of positive externalities of infrastructure investment causing social returns to exceed market return leading to market failures and distortion in investment decisions. They agree that there is extensive evidence that infrastructure development can increase economic growth

and reduce level of inequality. They have added additional dimensions of environmental sustainability and maintenance costs for larger benefits of infrastructure in longer run.

Aswini K Mishra, K Narendra and B P karxxiii (2013) in a 10year analysis of data for infrastructure investment and its relationship with economic growth have concluded that "Infrastructure has a huge impact on national and local development. That it exhibits a very high rate of return, even compared to other investment, might be due to its spill-over or externality effects." From their regression analysis they have established that 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.

V. Oreshinxxiv (2014) studied the infrastructure needs of Russia in its quest for modernization. Underlining the role of infrastructure he says, "The development of economic infrastructure expands productive potential by deepening the division of social labour and raising the quantity and quality of services provided, helping to increase the productivity of resources and rates of socio-economic development. A rational and coordinated economic infrastructure has played an important role in the economic development of all leading countries, including the Unites States, Japan, Germany and France." Drawing the experience of post-World War II, he has highlighted the critical role played by investment in infrastructure in modernizing societies. Outlining the Russian strategy he says, "A well-developed infrastructure is a key element in the stable growth of international trade and in the expansion of its potential. Countries that concentrate efforts on the development of infrastructure are in a position to seize great opportunities and advantages."

Jeffrey Gutman and othersxxv(2015) while researching on role of international community in financing infrastructure in Sub- Saharan Africa discuss about severe infrastructure deficit hampering the developmental aspirations of millions of people in these countries. "While developed countries take for granted infrastructure availability till it fails to deliver, the sub-Saharan Africa faces the lack of infrastructure as one of the most significant obstacles to sustaining and distributing the trajectory of growth and poverty alleviation on the continent."

4.Transport Infrastructure and Economic Development

Transport sector is a critical component of overall infrastructure profile of an economy. Many studies have looked specifically at the relationship between output and transportation infrastructure capital. "The OECDxxvi (2006) study estimated the expected elasticity of output to transportation infrastructure. The study suggests that the effect of transportation infrastructure investment depends on the country's level of economic development. Particularly, the study reports an elasticity of 0.2 for developed countries, an elasticity of 0.64 for the five largest developing countries (China, India, Brazil, Indonesia and Russia) and an elasticity of 0.76 for all other developing countries.
The study emphasized on the impact of transportation infrastructure investment on economic growth based on an aggregation of the contribution of each individual infrastructure project. From their research they have argued that analysis of the effect of transportation infrastructure through use of an aggregate variable may produce inaccurate estimates, as the externality effects cannot be captured properly with such a variable. They have arrived at the conclusion that "investment in public transportation infrastructure, such as railways and airports, has a larger effect on output than investment in road infrastructure. Thus specific investment choices of each country may also have a significant impact upon the elasticity of output to infrastructure."

Prosenjit D. Chaudharyxxvii (2006) in his paper on intercity rail and road transport in India has studied the extent of externalities in transport services. He says that the benefits of transport sector in a developing country cannot be denied, it is nevertheless characterized by widespread negative externalities. Although his focus is on analyzing relative cost of externalities between rail and road sector, the critical role these sectors play in development is emphasized. He has also argued in favour of rail transport for freight movement for being environmentally sustainable and also having lesser external cost compared to road (Energy efficient, lesser accidents).

James Aduxxviii (2009) in his thesis on financing and evaluation of investment in road infrastructure development comments "the role of road transportation as a catalyst for accelerated socio-economic development is not in doubt. Road transportation facilitates the movement of people, goods and services within the country. It provides service to other sectors such tourism, mining, health, trade, education, agriculture, energy among others. Investment in road infrastructure development may not be evaluated using only traditional appraisal methods such as net present value, Internal rate of return, Accounting rate of return, Pay back method etc. This is due to the fact that road infrastructure comes with other social and economic benefits that are difficult to quantify in monetary terms."

Tsekeris & Tsekeris (2009)xxix, while studying the link between Transport investment and regional developments, have sounded caution on over provisioning of investment in Transport improvement. They emphasize on management on existing transport networks to optimize return on investment. In a meta-analysis of empirical evidence, Patricia C Melo et el (2013)xxx have examined the productivity of transport infrastructure investment. They find that "the hypothesis that investments in transport infrastructure produce strong economic benefits and foster growth is not universally applicable. Core infrastructure, of which transport infrastructure represent a larger part, is expected to have stronger impact than other components of public capital such as hospital buildings or education buildings." In a case study of Channel Tunnel in Europe R. Angueraxxxi(2006) commented that "The cost overrun and benefit shortfall on the channel tunnel were so large that the British economy would have been better off had the Tunnel never been completed."

There are studies, which have examined the impact of transport infrastructure on economic development through analysis of empirical data and statistical analysis. Anthony Venables et al.xxxii have studied relationship between transport infrastructure and economic development and its impact on project appraisal in British department of transport. In areportxxxiii(2009) for American public transportation association to study economic impact of public transportation investment focuses on how investment in public transportation affects the economy in terms of employment, wages and business income. It addresses the issue of how various aspects of the economy are affected by decisions made regarding investment in public transportation. Another reportxxxiv (2012) on assessing the economic benefit of transportation infrastructure, effort has been made to derive direct economic benefits of transport infrastructure investment for better cost–benefit analysis in project appraisal decisions.

In some of the contemporary studies, the hypothesis of strong positive relationship between investment in Transport infrastructure and economic growth has been challenged through micro studies of returns from individual projects. The theories propounded by David Ashauer (1989), Paul Krugman (1991), Alicia Munnel (1990) and others were questioned on the premise that the link between infrastructure investment and economic growth is more in the field of public investment and at times politically driven. In contrast, the micro level literature is based on evidence from project level case studies and larger datasets of actual outcomes of infrastructure mega projects in terms of cost, time and benefit performance. Pickrell (1992) Studied rail transit projects in US cities, Flyvbjerg (1998) did study for a Municipality in Denmark and others found wide gap between aspirations, projections and reality of infrastructure projects. Atif Ansar et el (2016)xxxv conducted extensive micro study on several individual mega projects in China to test the hypothesis that 'a high level of infrastructure investment is a precursor to economic growth'. They conclude that macro level theories and micro level case study outcomes do not match to establish a positive definite relationship between investment in transport infrastructure and economic growth. They suggest that there are large numbers of variables which operate in the economic environment and evidence show that "poor project outcomes translate into substantial macro-economic risks: accumulating debt and non-performing loans, lost alternative investment opportunities."

5.Conclusion

The above review of literature attempts to cover building of theoretical premises on correlation between infrastructure investment and economic growth based on empirical data and statistical analysis of time series data for many countries. There is general agreement on positive relationship between investment in infrastructure and economic growth. However, the level of impact of such investment on development is not found to be uniform across the countries. Some studies using the micro level data of individual projects have challenged the macro level hypothesis of positive link between the two. Large infrastructure projects suffer from over provisioning, under casting of cost and over estimation of intended benefits. It is found that investment in infrastructure suffers from economic syndrome of law of diminishing returns as well. Many times sum of returns from individual projects does not add up to positive outcomes at macro level.

The need for investment in infrastructure for economic development is universally recognized at policy level as they are more likely to influence economic indicators like GDP growth rate, poverty reduction, expansion of production potential in an economy, widening of capital stock through FDI inflows. However, the degree of correlation depends on many factors, which have been highlighted by most of the studies. Some studies have even argued that the decline in productivity during the 1970s and 1980s in the USA and Europe may have been the consequence of the decline in public capital investment that took place during that time.xxxvi Calderon et al.xxxvii examined data from several Latin American countries in the years 1980-84 and 1995-98 and found that where investments in

infrastructure decreased (as percent of GDP), a similar or larger decrease was also observed in GDP. However, contrary theories also exist on limitations of such infrastructure investments in driving growth in all conditions.

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