

The Impact of Infrastructure Provisioning on Inequality

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1. Introduction

Infrastructure development is accorded great importance in developed and developing countries and forms major thrust in public policy framework. This is because infrastructure is considered as a major facilitator of economic growth, however, when considering the impact of infrastructure countries where weak governance, distorted public investment choices, and corruption are a reality, the benefits of infrastructural expansion that result in higher growth are not necessarily equally shared and could result in interregional or interpersonal income inequality. While there is growing belief about the potential benefits of public infrastructure, which include highways, bridges, ports, transportation networks, telecommunications systems, education and health infrastructure, one is struck by the lack of empirical evidence which looks at the nature of relationship between growth, inequality and infrastructure. More specifically, little is known about the ability of infrastructure to ensure that the proceeds from enhanced growth, if any, are distributed in a fair way. To begin with, even though the association between infrastructure and growth has been well established with the general agreement being that these two are positively related, it is wrong to assume that economic growth attributable to infrastructure development will consequently lead to a reduction in inequality. In this paper we look at the existing literature on the nature of relationship between different types of infrastructure and inequalities and specifically provide evidence from Indian experience. Such a study can help policymakers dealing with ways to tackle inequalities a fair understanding of the heterogeneous relationship between inequalities and infrastructure provisioning which can be kept under consideration while making policy recommendations.

The paper is organized as follows. Section 2 summarizes the relationship between infrastructure and infrastructure development and provides evidence from existing literature concerning the effects of infrastructure development on inequality. Section 3 provides the quantitative assessment of the relation between infrastructure and inequality in India and finally, section 4 draws conclusions and gives policy recommendations.

2. Relationship between Infrastructure Development and Inequality

Infrastructure provision is seen as a particularly important instrument for promoting regional development in which government can play an important role due to the public goods nature of

infrastructure facilities. It is an important mechanism whereby wealth can be distributed across members of the society by utilizing the so called market forces. It may be that through increasing access to productive opportunities, through reducing production and transaction costs (and thereby leading to industrial or agro-industrial development) and by helping increase the value of assets of the poor, infrastructure can help reduce inequality. Additionally, by providing easier geographic access, through improved transport infrastructure, labour mobility is enhanced which can make the surplus labour to move to places where labour is in short supply. A well-developed communication infrastructure can help ease the information flow and help disadvantaged individuals gain access to productive opportunities by connecting them to core economic activities (Calderon and Serven, 2004; Fan and Zhang, 2004 etc). Literature has also highlighted favourable impact of enhanced availability and quality of not just physical but also social infrastructure development on human capital and hence on productivity level, earning capabilities and welfare of the poor.

If infrastructure is built in areas that are already abundant in physical and human capital and have the greatest potential because of an already proven dynamism, then infrastructure could adversely affect inequality. However, if infrastructure is developed in regions that lack facilities and face resource crunch, these regions may manage to exploit the new production possibilities and this will help reduce inequality (Ferreira, 1995). In an environment with capital market imperfections, expanding public infrastructure services reduces the inequality of opportunity among entrepreneurs, increases the return on investment, and raises entrepreneurial activity among the less-favored segments of society (Ferreira, 1995). Better transport infrastructure can help connect the lower income groups to markets and expands the sets of opportunities available to them. For instance, rehabilitating rural roads in Bangladesh raised non-agricultural wage employment in targeted households and fostered markets that have become increasingly diversified across sectors (Khandker and Koolwal, 2007).

Telecommunication infrastructure can help reduce inequality by helping connect to core economic activities and allowing easy access to additional productive opportunities. Electrification programs in rural areas show impact on employment, especially female employment (Dinkelman, 2011). Households with access to electricity freed up time spent on cooking and lighting and this extra time was spent at work through self-employment or micro-enterprises. In addition to the conventional channels through which infrastructure impacts the economy, literature has also identified new channels like the impact of infrastructure development in improving human capital which then helps in increased job opportunities and productivity (for details see Brenneman and Kerf, 2002; Agenor and Moreno-Dodson, 2006). By investing in roads, for instance, governments may not only reduce production costs for the private sector and stimulate investment, but also improve education and health outcomes, by making it easier for individuals to attend school and seek health care. With their health

improving, individuals become not only more productive, but they also tend to study more. In turn, a higher level of education makes individuals more aware of potential risks to their own health and that of their family members. Moreover, investment in infrastructure, by improving health and life expectancy, may reduce uncertainty about longevity and the risk of death, thereby increasing the propensity to save. As a result of these various effects, the impact of infrastructure on income and welfare is compounded.

Theoretical Literature

From the studies that have attempted to model the impact of public capital or infrastructure on income distribution or inequality, it was observed there is no unanimity in the theoretical literature on the predicted relationship. The direction of relationship hinges upon the assumptions made regarding the nature of infrastructure/public capital investment and the manner in which it is financed (type of taxation); kind of infrastructure services considered; sectors in the economy and sets of agents or population groups in the economy and distinguishing between impact on income and impact on wealth distribution amongst other differences. Getachew and Turnovsky (2015) show that the effect of government investment on the equilibrium dynamics of both inequality and growth depends crucially upon the elasticity of substitution between public and private capital in production. The study by Ferreira (1995) introduces capital market imperfections and a production function that includes public capital as complementary to private capital. There are three different classes – subsistence workers, middle class entrepreneurs and upper class entrepreneurs and using general equilibrium model of wealth dynamics it has been shown that if public capital, which is provided free of cost, falls below a minimum level, the middle class disappears and a decrease in level of public investment results in higher levels of inequality. Lower income households will have no access to infrastructure, whereas, ‘private infrastructure owning’ upper class entrepreneurs will benefit more. This study also proves that an increase in productive public investment has a negative impact on inequality but results in greater output and advocates increasing government infrastructure provisioning. Getachew (2010) considers a two sector growth model and extends the imperfect credit market theory and concludes that inequality has adverse impact on growth and in an economy where initial skill sets of agents are log-normally distributed; there is differential impact of access to particular types of infrastructure on the distribution of income. By displaying how important public interventions can be for income distribution, they conclude that public capital could well lead to pro-poor growth.

While these models show that public capital does help reduce income inequality under certain assumptions, they fail to account for allocation of time between work and leisure. Chatterjee and Turnovsky (2012) in addition to incorporating the time dimension also distinguish between the impact of public capital on distribution of pre- and after-tax income and distribution of

wealth in a general equilibrium framework. The basic conclusion derived from their study was that regardless of the manner in which government finances its investment; it results in an increase in wealth inequality. Private capital is assumed to be more unequally distributed than labour. So when public capital increases, the productivity of both private capital and labour increases, however, because private capital is more unequally distributed than labor, it increases wealth inequality. Upon considering income inequality, the impact was found to be contingent upon the manner in which investment is financed as well as the time duration under consideration. The short run and long run effects were proved to differ and moved in opposite direction. In the short run, the impact of increased public stock resulted in a decrease in income inequality as the time allocation changes between work and leisure. However, in the long run, factor returns from capital stocks will matter more and result in increased inequalities between the factors. This paper fails to account for externalities generated by infrastructure stocks which could have an impact on wealth accumulation.

Empirical Evidence

There are two main themes followed in empirical literature looking at the relationship between infrastructure and inequality. One is associated mainly with directly examining the inequality impact of infrastructure by using Gini coefficients as the inequality measure and the impact of infrastructure variables (Lopez, 2004; Calderon and Chong, 2004; Calderon and Serven, 2010). And others are more microeconomic in nature which have looked at the impact of specific infrastructure interventions and its impact on the income and livelihood of those at the bottom.

Empirical literature testing whether there is any correlation between infrastructure investments and income inequality, and more specifically to evaluate the extent to which infrastructure investments may have a differential effect on those at top and bottom of income distribution appears to be ambiguous on a priori grounds. In the US itself, Hooper et al (2017) have tested the empirical link between infrastructure and inequality at state-level from 1950 – 2010 and found that highways and higher education spending growth in a given decade correlates negatively with Gini indices at the end of the decade. Such a finding suggests a causal effect from growth in infrastructure spending to a reduction in inequality, through better access to job and education opportunities. Further considering the impact on those at the bottom of the income distribution they have concluded that this relationship is stronger with inequality at the bottom 40 per cent of the income distribution. Fan, Zhang and Zhan (2002) identified by evaluating provincial data from 1970 to 1997 in a simultaneous equation model, that infrastructure development played a critical role for rising growth rates and for reducing poverty and regional inequality in China. A recent study by Zheng and Kuroda (2013) about the role of public transportation and knowledge infrastructure – on China's regional inequality, on growth, and on industrial geography across 286 cities found that an improvement in

transportation infrastructure reduced trade cost, increased growth, and decreased the income gap but at the expense of increasing industrial agglomeration between cities. Taking into account the impact of both the quantity and quality of infrastructure on distribution of income Calderon and Chong (2004) took the impact of both quantity and quality of infrastructure on income inequality into account and provided evidence of a negative relation between those from 1960 to 1997. They used cross-country and panel regressions (using GMM dynamic methods to minimize endogeneity problems) and various types of infrastructure indices. Similarly, Calderón and Servén (2005) considered the growth and inequality aspect of infrastructure investment by evaluating impact of infrastructure development on growth and income inequality using a large panel data set covering more than 100 countries over a time period of 40 years (1960-2000). They concluded that a greater availability and quality of infrastructure services had a significantly positive impact on health and/or education and, hence, on income and welfare for especially the poor in developing countries. Seneviratne and Sun (2013) studied the links between income distribution and infrastructure for ASEAN-5 countries. They ran a set of pooled ordinary least squares (OLS) regressions covering 76 advanced and emerging market economies for the time period between 1980 and 2010 and found that better infrastructure improved income distribution but the same could not be said for investment in infrastructure. Evidence from Latin America shows that privatization of infrastructure sectors often benefited the poorest groups by granting them access to services (Chisari et al (1999) and Navajas (2000)). For instance, improved access to electricity, water, and telephones for poorer groups lifted their incomes in Guatemala. The expansion of infrastructure services to rural areas in El Salvador reduced the time required to reach markets, which created significant gains for poorer groups. Lastly, improving road quality had an important impact on income and, especially, on wage employment in Peru.

Reduction in production and transaction costs through access to roads has been a key determinant of income convergence for the poorest regions in Argentina and Brazil (Estache and Fay, 1995). At microeconomic level, studies that have evaluated the impact on income of a particular intervention affecting a given group of households suggest that physical infrastructure in roads and communications facilitates spatial access and information flows, raising labor mobility, boosting rural non-farm economies, and reducing the incidence of poverty in some geographic areas (Jalan and Ravallion 2003, Zhu and Luo 2006, Reardon et al. 2007). This type of intervention has also proved successful in Vietnam by increasing workers' wages and developing local markets in poor communities (Mu and van de Walle 2007). Channel through which electrification programs in rural areas had an impact on employment, especially female employment, was studied by Dinkelman (2011). Households with access to electricity were able to free up time otherwise spent on cooking and lighting, this extra time was then spent at work through self-employment or micro-enterprises.

In addition to the conventional channels through which infrastructure impacts the economy, literature has identified new channels like the impact of infrastructure development in improving human capital which then helps in increased job opportunities and productivity (for details see Brenneman and Kerf, 2002; Agenor and Moreno-Dodson, 2006). By investing in roads, for instance, governments may not only reduce production costs for the private sector and stimulate investment, but also improve education and health outcomes, by making it easier for individuals to attend school and seek health care. With their health improving, individuals become not only more productive, but they also tend to study more. In turn, a higher level of education makes individuals more aware of potential risks to their own health and that of their family members. Moreover, investment in infrastructure, by improving health and life expectancy, may reduce uncertainty about longevity and the risk of death, thereby increasing the propensity to save. As a result of these various effects, the impact of infrastructure on income and welfare is compounded. The impact on both poverty and inequality by infrastructure expansion gets boosted when it is also accompanied with improvements in education and health outcomes (Fan and Zhang 2004, Zhang and Fan 2004).

But just like the theoretical studies, empirical literature on this topic does not provide unanimous conclusion in terms of infrastructure development leading to a reduction or increase in inequality. The study by Brakman et al (2002) found that government spending on infrastructure increased regional disparities within Europe. In a similar vein, for India, Banerjee (2004) and Banerjee and Somanathan (2007) analysed the impact of accessibility to infrastructure services on the distribution of income and showed that these two are positively related, i.e. the benefits of infrastructure services were mostly accrued in higher income groups as opposed to benefitting the poor. The study by Khandker and Koolwal (2007) found that expanding paved roads had a limited distributional impact on income in rural Bangladesh. The paper by Raychaudhari and De (2010) attempted to understand the inter-linkages among infrastructure, trade openness, and income inequality using panel data of 14 Asia-pacific countries from 1975 to 2006 and concluded trade openness and infrastructure influence income inequality but the reverse is not necessarily true. Also, the effect of infrastructure development on trade was not significant.

Another interesting aspect in this debate has been highlighted by Crescenzi et al (2017) which looks at the Government quality and the economic returns of transport infrastructure investment in European Regions. The local institutional environment in which investments are made will affect the scale and type of new infrastructure investments and, consequently, their economic returns. Poor institutions enhance the opportunities for private gain at the expense of a sound provision of public goods (Acemoglu and Dell, 2010). Their results show the influence of regional quality of government on the economic returns of transport infrastructure. In weak institutional contexts investment in motorways—the preferred option

by governments—yields significantly lower returns than the secondary road. Government institutions also affect the returns of transport maintenance investment.

Recent scholarly literature has also shown that the impact of infrastructure on inequality varies for the type of infrastructure being considered. The returns of transport infrastructure investment have been more limited than those of expenditures in other development axes, such as human capital and innovation (Rodríguez-Pose and Fratesi, 2004; Crescenzi, 2005; Crescenzi and Rodríguez-Pose, 2012).

3. Indian Experience

Looking at the relationship between infrastructure and inequality observed in the 17 major Indian states (Bajar and Rajeev, 2016) have found that this relationship depends on the type of infrastructure being considered and the level of development that the state/region falls under. The impact of infrastructure variables on a consumption inequality measure indicates that some components of infrastructure, mainly power and roads, tend to increase interpersonal inequality at the regional level. This is especially true for lower income states. With increased access to roads and electricity, the consumption of goods such as higher end cars, access to material for building more expensive houses, expenses on social functions, and durable goods such as television sets, refrigerators and the like, increases for those people who had higher income (and by implication the demand for these goods) to begin with but did not have access to markets. With a better roads network, productive opportunities may have been made available to those who did not have access earlier, but the benefits from these may have accrued more to the already rich in terms of better investment opportunities which led to ever higher returns that translated into more consumption inequality. However, for higher income states the impact of infrastructure was largely insignificant. It can therefore be inferred from the study, that expansion of regional infrastructural facilities may enhance the average consumption level among segments of the population but these impacts are not uniform across the populace, and is accompanied by increased inequality within the states.

Interestingly, improvement in expenditure on social services helps bring convergence through reduced interpersonal inequality. A study by Datt and Ravallion (2002), used 20 household surveys for India's 15 major states and concluded that a lack of basic education, along with other factors, acts as an impediment on the ability of the poor to participate in productive opportunities for economic growth. In Bajar and Rajeev (2016) per capita expenditure on social services by state government is shown to have a negative impact on inequality. This is especially significant in the low income states which highlights the importance of government role as well as targeted social programs which can have significant impact in reducing inequality by providing access to education, health and other social services to all and not just a "lucky" few in a society.

4. Policy Recommendations

There is large diversity in the results found in studies that look at the relationship between infrastructure and inequality. There is unanimity in that the relationship between infrastructure and inequality is more nuanced than what it appears to be. This relationship varies according to: Type of infrastructure being looked at – investments in social infrastructure is sure to reduce inequalities by helping those at the bottom of the income distribution to improve their education and health outcomes, but the results for other physical infrastructure like roads and electricity in reducing inequality are not as well defined; and by Differences in measurement of infrastructure – some studies have looked at one infrastructure indicator as a proxy for all infrastructure indicators, others take public investment as an indicator, while still others consider all infrastructure indicators simultaneously.

Based on the research on distributional impact of infrastructure development, the evidence suggests equity-enhancing effects but such is not the case for all types of infrastructure and it depends also on the provisioning of infrastructure and its quality. Some policy recommendations that can thus be made are:

- **Investments in social infrastructure development** – education, health, sanitation and water - help reduce inequalities as those at the bottom of income distribution benefit directly from these services. But at the same time, just building a school or hospital or health centres will not have an impact unless there teachers and medical staff gets hired and attends to people regularly. It is often the case in many developing countries that school and hospital buildings are constructed but the staff doesn't get hired or doesn't show up.
- **Smarter physical infrastructure development** – Recent scholarly literature has underlined that the returns of transport infrastructure investment have been more limited than those of expenditures in other development axes, such as human capital and innovation. One possible explanation posits that changes in accessibility deriving from new roads may benefit the economic core at the expenses of the periphery or that the returns of infrastructure investment are mediated by the quality of regional government institutions co-responsible for ensuring the selection and realization of specific projects. Poor institutions enhance the opportunities for private gain, undermining sound provision of public goods (Acemoglu and Dell, [2010](#)). In weak government quality conditions, new investment in transport infrastructure may respond more to political and individual interests than to economic and collective ones. Institutional failure is at the heart of a greater propensity to finance “flagship” and large-scale transport projects (i.e., motorways, high-speed rail), more appealing to

incumbent politicians seeking re-election, at the expense of less flashy “ordinary” transport investments (i.e., secondary roads, freight railways).

- **Differences in the needs of Rural and Urban** - Urban inequalities are much larger than rural inequalities and in developing countries at least, infrastructure development is concentrated in urban areas and rural is largely ignored. In order to reduce inequalities, governments have to be sensitive to the demands for infrastructure from the rural areas which often lag behind the urban even in basic infrastructure facilities like surfaced roads, electricity connection, sanitation and access to safe drinking water. By providing access to infrastructure services in rural areas, these regions can see an improvement in growth and incomes and this helps reduce the rural-urban inequalities.
- **Equality of opportunities and incomes across households to good quality infrastructure**– By definition, infrastructure is a public good but its access is not uniform. The reason is that more unequal societies devote fewer resources to the provision of public goods, including infrastructure. While infrastructure may help reduce inequality, at the same time inequality may hamper the provision of infrastructure services to the poor. (There is little systematic information on access to, and affordability of, infrastructure services for different percentiles of the income distribution, whether over time or across countries).
- **Maintenance of Existing Infrastructure** - When considering how to allocate scarce resources for the development of public infrastructure, many countries have a tendency to neglect maintenance in favor of new infrastructure investment projects. Maintenance affects the quality of existing infrastructure and thus the flow of services derived from it. Furthermore, maintenance expenditures also affect the depreciation rates of both public infrastructure and private capital. It has been shown that focusing all additional resources on maintenance is shown to generate the largest reduction in inequality, while a more balanced policy that increases both investment and maintenance maximizes output growth (Gibson and Rioja, 2016).

References

- Agenor, P.R and B. Moreno-Dodson, "Public Infrastructure and Growth: New Channels And Policy Implications," Policy Research Working Paper Series 4064, The World Bank, 2006
- Ajitava Raychaudhuri & Prabir De, "Trade, Infrastructure and Income inequality in Selected Asian Countries: An Empirical Analysis," Working Papers 8210, Asia-Pacific Research and Training Network on Trade (ARTNeT), an initiative of UNESCAP and IDRC, Canada, 2010.
- Bajar, S. and Rajeev, M., 2016. The Impact of Infrastructure Provisioning on Inequality in India: Does the Level of Development Matter?. *Journal of Comparative Asian Development*, 15(1), pp.122-155.
- Bandyopadhyay, S. "Convergence Clubs in Incomes across Indian States: Is There Evidence of a Neighbours' Effect?," *Economics Letters*, 116, 565—570. September 2012
- Banerjee, A. "Who is getting the public goods in India? some evidence and some speculation," in Basu, K. (ed.), *India's Emerging Economy: Performance and Prospects in the 1990's and Beyond*. Cambridge, MIT Press. 2004
- Banerjee, A., and R. Somanathan, "The political economy of public goods: Some evidence from India." *Journal of Development Economics* 82, 287-314. 2007
- Brakman, S., Garretsen, H. and C. van Marrewijk (2002), "Locational competition and agglomeration: The role of government spending," *CESifo Working Paper* 775.
- Brenneman, A., and M. Kerf, "Infrastructure and Poverty Linkages: A Literature Review". The World Bank, Mimeo, 2002.
- Calderón , C and Luis Servén,, "The Effects of Infrastructure Development on Growth and Income Distribution." 270, Central Bank of Chile, 2004.
- Calderón, C. and Chong, A, "Volume and Quality of Infrastructure and the Distribution of Income: An Empirical Investigation." *Review of Income and Wealth*. 50, 87-105, 2004.
- Calderón, C. and Servén, L, "The Output Cost of Latin America's Infrastructure Gap." In: Easterly, W., Servén, L., eds., *The Limits of Stabilization: Infrastructure, Public Deficits, and Growth in Latin America*. Stanford University Press and the World Bank, pp. 95-118, 2008.
- Chatterjee, Santanu and Turnovsky, Stephen J., Infrastructure and Inequality Available at SSRN:<http://ssrn.com/abstract=1100163> or <http://dx.doi.org/10.2139/ssrn.1100163>, 2012
- Crescenzi, Riccardo. 2005. "Innovation and regional growth in the enlarged Europe: the role of local innovative capabilities, peripherality and education," *Growth and Change*, 36, 471–507.

- Crescenzi, Riccardo and Andrés Rodríguez-Pose. 2012. "Infrastructure and regional growth in the European Union," *Papers in Regional Science*, 91, 487–513.
- Dinkelman, Taryn. "The Effects of Rural Electrification on Employment: New Evidence from South Africa." *American Economic Review* 101, 3078-3108. 2011
- Estache, A. "On Latin America's Infrastructure Privatization and its Distributional Effects." Washington, DC: The World Bank, Mimeo, 2003.
- Estache, A., Fay, M., "Regional Growth in Argentina and Brazil: Determinants and Policy Options." Washington, DC: The World Bank, Mimeo, 1995.
- Fan, S. L. Zhang and X. Zhan. "Growth, Inequality and Poverty in China: The Role of Public Investments". Washington DC, Research Report 123, International Food Policy Research Institute, 2002.
- Ferreira, F. "Roads to equality: Wealth Distribution Dynamics with Public-Private Capital Complementarity", LSE Discussion Paper TE/95/286, 1995
- Gannon, C. and Liu, Z., "Poverty and Transport." Washington, DC: The World Bank, Mimeo, 1997.
- Getachew, Yoseph & Turnovsky, Stephen. Productive Government Spending and its Consequences for the Growth-Inequality Tradeoff. *Research in Economics*. 69. 10.1016/j.rie.2015.09.001. 2015.
- Gibson, J. & Rioja, Felix. Public Infrastructure Maintenance and the Distribution of Wealth. *Economic Inquiry*. Volume 55, Issue 1. 2016
- Hooper, E., Peters, S. and Pintus, P., 2017. To What Extent Can Long-Term Investment in Infrastructure Reduce Inequality?.
- Khandker, S., and G. Koolwal, "Are pro-growth policies pro-poor? Evidence from Bangladesh." Mimeo, The World Bank. 2007
- Lopez, H., "Macroeconomics and Inequality." *Macroeconomic Challenges in Low Income Countries*. The World Bank Research Workshop, October, 2003
- Pi, J. and Y. Zhou. "Public infrastructure provision and skilled–unskilled wage inequality in developing countries." *Labour Economics* 19(6), 881-887. 2012.
- Raychaudhuri, A & Prabir De, "Trade, Infrastructure and Income inequality in Selected Asian Countries: An Empirical Analysis," Working Papers 8210, Asia-Pacific Research and Training Network on Trade (ARTNeT), an initiative of UNESCAP and IDRC, Canada, 2010.

Seneviratne, Dulani and Sun, Yan, “Infrastructure and Income Distribution in ASEAN-5: What are the Links? IMF Working Paper No. 13/41, 2013.

Zheng, D. and Kuroda, T. “The Role of Public Infrastructure in China's Regional Inequality and Growth: A Simultaneous Equations Approach”. *The Developing Economies*, 51: 79–109, 2013