Background

This note summarizes a larger literature review that looked at empirical evidence and literature regarding the direct and indirect relationship between infrastructure investment and poverty. The findings highlight the dominant impact that infrastructure investment has on economic growth and thereby on poverty. The links to growth are several including creating efficiency gains from private participation in infrastructure which positively impacts end users and taxpayers. The level and kind of investment required to reach growth rates needed to eradicate poverty differs depending on several parameters. These include level of development of the country, the maturity of its regulatory environment and the degree of competition. On average, the poorer a country, the larger the potential impact on growth from adding to infrastructure stock. The more direct impact of investing in infrastructure and facilitating infrastructure reform emerges from enabling affordable access to the poor which allows them access to markets, health and education facilities, and more time for income generating opportunities. Infrastructure also impacts the poor through creation of direct, indirect and induced jobs. The second order growth effects of investments in this sector, via provision of improved and reliable services, are the largest and affect the overall economy. The review also notes the gaps in evidence among specific sectors for their poverty impacts and point to potential areas of further research.

Objectives

This note summarizes a literature review conducted by IFC on identifying the transmission links of infrastructure investments and of infrastructure reform to poverty and economic growth. This exercise was undertaken as part of IFC’s Poverty Action Plan, to better understand how IFC operations in specific sectors across its investment and advisory operations result in eradicating poverty and boosting shared prosperity.

Analysis

Impact of infrastructure through economic growth

Strong links of infrastructure on economic growth: Economic literature provides strong support for positive links between infrastructure investment and economic growth, though there is debate on the amount and nature of...
infrastructure investment needed for growth that is sufficient to tackle poverty. Recent studies show that a 1% increase in stock of infrastructure (using public capital as proxy)\(^1\) lifts GDP by 0.08%, although this impact varies by country and region. Various studies provide the range of infrastructure investment that is needed as a percentage of GDP to achieve sufficient growth to reduce poverty- this ranges from 5-6% in Latin America & Caribbean (LAC) to 25% in the poorest countries of Sub Saharan Africa, and even more in fragile states.

**Adding infrastructure stock matters more in poor countries:** Evidence suggests that the impact of adding any infrastructure stock to growth is usually greater when the country is poorer. As a country develops, other dimensions focusing more on the quality of infrastructure and market failures such as addressing bottlenecks, technological lags become more important. Further, as the note discusses later, the more direct effects of infrastructure through job creation also differs among countries based on their level of development.

**Sectors with high network effects have greater impact:** In general however, at different stages of development, different types of infrastructure are important to maintain growth and productivity at levels sufficient to allow the country to catch up with the fastest growing countries. When analyzing types of infrastructure, the literature indicates that investments that have significant network effects will have more social benefits (by connecting markets). Specifically, investments in energy infrastructure or power provide most robust evidence in terms of social benefits. Telecom investments have shown to have some of the highest payoffs in terms of growth. In developing countries, transport investments such as roads and ports are shown to have a strong impact on growth while the same sector’s impact in developed countries comes in the form of improvement in quality rather than quantity. On the other extreme, impact of investments in water and sanitation have been least studied or evidence found due to the longer and more indirect link to growth. Finally, the quality of institutions, regulation and the degree of competition all affect the level of impact of investment.

**Linking infrastructure to economic growth through efficiency gains**

Private participation in infrastructure (PPI) helps in efficiency gains which should eventually translate to gains for the users through reduction in user costs, and taxpayers through replacing other tax structures by increased revenues from the concessions. This provides a trickle-down effect through overall growth to poverty. These gains are more pronounced in small and medium infrastructure projects with private participation or in countries where public procurement is poorly organized leading to distortion in competition and markets. For projects large enough to influence the sector as a whole, the efficiency gains are an important link to growth.

However, the benefits of these efficiency gains to the users depend on several factors. First and foremost, effective regulation and competition is critical for the private sector to deliver on these gains. Further, whether the gains trickle down to users depends also on the tax structure and how these gains are distributed- if the cost reductions are taxed, the benefits of lower prices will not emerge, which **negatively affects affordable access**- **one of the key ways in which infrastructure impacts the poor**. These gains are also sector and region specific. In electricity, PPI is associated with improvement in labor productivity and reduction in power losses which in turn has secondary and tertiary order effects. In the case of telecom, PPI has resulted in facilitating competition which in turn has resulted in reduction in user costs and increasing affordable access. Evidence of gains of PPI in the

\(^1\) Since data on specific defined sectors of infrastructure (electricity, gas, telecoms, transport and water supply, sanitation and sewerage) is not usually readily available, authors of studies usually often use public capital as a proxy.
water sector however is limited. This may be because it is harder to introduce competition in this sector and the regulatory environment and institutions needed for these benefits to emerge are usually not as well developed.

**Impact of infrastructure on poverty directly**

*Providing affordable and quality access:* While creating infrastructure stock is critical for growth, ensuring that this access is affordable is critical for poverty. In order to get the affordability right, both the price level and the price structure need to be right. For example, if families cannot afford safe water, then all its benefits by way of presence in school, education and potential income earning opportunities fall through.

Affordable access to infrastructure impacts the poor in various ways. Literature provides evidence on gains from saving time due to this access are largest for the poor, who use this time to increase their earnings through productive work. A study on the impact of household electrification in South Africa shows that female employment increased by releasing them from house work and encouraging the setting up of micro enterprises.

*Evidence of poverty impacts varies by sector:* When appropriate technological options are used that match local needs and ability to pay, it allows for faster and better delivery of infrastructure services to the poorest regions. For example, in the case of telecom, with the introduction of mobile telephony, not only has the sector benefited from a continuous technological revolution, but the affordability to telecom services has been increasing among the poor. Studies on impact of rural and feeder roads provide a lot of evidence on how these roads have helped provide access to market, basic education and health facilities and improved the overall productivity of poor households. Private sector participations in water utilities are those with the poorest poverty related performances among all infrastructure sectors. Cream skimming behavior is an important issue in water utilities because the cost of reaching rural areas is high creating barriers to entry.

*Project design can be influenced to address affordability challenges:* Evidence shows that this question of affordability can be addressed in project design by way of choice of technology and quality which will affect the costs and hence prices. Establishing an appropriate regulatory environment can set conditions for affordable access and addressing cream skimming through structures such as (a) universal service obligations that require operators to provide access to all or specific segments of the population (b) cross subsidies or discriminatory payment plans which reduce connection costs for the poor and (c) increasing the range of suppliers which provides poorer users a spectrum of operators.
Impact of infrastructure on job creation

As infrastructure is a capital intensive industry, the direct employees employed per unit of investment is typically not high. However, depending on the boundaries drawn, employment effects can be large considering the indirect and induced jobs. Second order growth effects of removing access to infrastructure constraints are also high.²

As the recent IFC Jobs Study highlights³, there are two main categories of created through infrastructure investments: (a) jobs associated with construction and maintenance activities and (b) jobs associated with improved services and lower costs for companies. In the case of the former, it has been estimated that $1 billion spent on road construction in the United States generates about 6000 direct jobs, 7790 indirect jobs and 14,000 induced jobs. While construction provides more short term jobs, maintenance and operations jobs tend to be longer term. In the case of the latter, providing access to infrastructure services can add significantly to job growth by allowing businesses and households to increase their output and productivity.

² Indirect jobs can be defined as jobs created in the company’s suppliers and distributors. Induced jobs are the jobs resulting from the direct and indirect employees of the company spending more money. Second order growth effects are the jobs resulting from the removal of an obstacle to growth. These definitions can be found in the IFC Jobs Study on ‘Assessing Private Sector Contributions to Job Creation and Poverty Reduction’, January 2013


LIGHTING AFRICA*

Lighting Africa, a World Bank and IFC program started in FY07, provides a good example of alternative ways of providing infrastructure at low cost. It replaces fuel-based, inefficient lighting technologies with new, affordable, clean, and sustainable lighting solutions—such as LEDs—in off-grid areas for base of the pyramid (BOP) consumers in Africa. The goal of Lighting Africa is to support the private sector by supplying quality, affordable and safe lighting to 2.5 million people by facilitating the sale of 500,000 off-grid lighting units by 2012. The project also hopes to supply 250 million people with modern off-grid lighting projects by 2030 through this sustainable commercial platform. Besides these targets, the program has also set out to transform the market by providing credible certification, raising awareness about clean energy sources, providing business support to its suppliers and other stakeholders, and working with the government on policy and regulatory issues.

The Lighting Africa project and its partners have helped facilitate access to clean lighting solutions for 3.8 million people in Kenya and Ghana. The program has sold over 700,000 units meeting quality standards. It has reached 22 million people with its consumer education campaigns, and conducted over 1000 village forums to educate people in the rural areas about the benefits of solar light over kerosene. The project has helped people save money by switching from fuel-based lighting to cheaper modern lighting alternatives. In addition to these savings, modern lighting products are becoming cheaper for the end user because the activities of the Lighting Africa project have lowered the costs that product developers and distributors incur when entering these markets.

Lighting Africa is an example of a program that addresses the issue of affordable access to energy, while establishing commercial viability for operators and significant poverty impact through various channels.

* From various IFC documents and the Lighting Africa website- www.lightingafrica.org
An infrastructure program can also be a relatively important source of job creation if labor intensive sub sectors and forms of construction are targeted. For instance, total number of jobs-years per GWh range from as high as 1.4 for solar PV (0.87 on average) to as little as 0.11 for gas or coal. Similarly, ILO studies argue that promoting labor intensive road construction will generate twice the number of jobs compared to capital intensive road construction and irrigation. Hence, if employment is the key development challenge for a country, infrastructure can target poverty more directly depending on the choice of technology made. Of course, this impact depends on several factors including labor market characteristics and skills available to match the needs. The latter is important since the need varies: construction in transport will require lower skilled jobs compared to energy or telecom investments.  

Intuition suggests that efficiency gains in infrastructure might also result in job destruction. Evidence from studies on PPI suggests that while this may be true in the short run, in the long run, there could be an overall and significant increase in employment coming from indirect and induced effects. In the case of ICT for instance, introduction of new technologies results in value added skill building and opportunities for new businesses. A study on port reform in Mexico showed that employment levels were higher post reform, while similar results did not hold with such reforms in Argentina. The link between job creation and infrastructure is an area not well documented and researched and poses an area of further study.

**POWERLINKS**

In 2003, IFC committed a loan of US $75 million to Powerlinks Transmission Limited (PTL) a joint venture company, to construct power transmission lines that helped transmit hydropower from Bhutan to a number of states in north and east India. The study focused not only on direct and indirect jobs, and at second order growth effects, including jobs created due to increased reliability in power supply and reduced power outages.

Firstly, the study found large indirect and induced job effects. Using input output tables, the study found that construction and O&M will create a total of about 243,000 persons-year employment (roughly 9,700 additional jobs) over the 25-year life of the project, combining direct, indirect, and induced jobs. Induced and indirect effects are much larger (199,000 person years) than direct jobs (44,000 person years) created. Secondly, there were large growth-related jobs created as power is a binding constraint for firms in India. The study estimated that the increase in power supply from Bhutan’s Tala hydropower plant transmitted through PTL’s transmission lines created about 75,000 new jobs in India over the period 2006-2012, of which about 4,600 are in West Bengal. Of these, 1,600 were due to reduction in power outages.

In terms of impact on poverty, the jobs created added Rs 47,000 lakh (about $94 million) to household income, which has special implications for poverty reduction, as the transmission lines were constructed through some of the poorest states in India. In addition, a large portion of induced jobs are created in the agricultural sector, creating employment and income for rural low-skilled population. Additionally, as this vital transmission link enables cross-border trade of power from Bhutan to India, it has a significant development impact in Bhutan through higher GDP growth and government revenues.


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4 It is importation to note that the temporary jobs can disappear once construction is over. Further, part of the challenge/choice that governments make is the tradeoff between higher immediate jobs that a labor intensive approach may lead to and the negative impacts that higher costs/ lower quality would bring if that choice were not the least cost option.
Challenges around measurement of impact of infrastructure services

In practice, measuring the ultimate impacts of individual investment projects especially the specific impacts on the poor can be hard yet critical given the impact they have on poverty reduction. Some of the challenges come from establishing an appropriate control group for the project (considering a lot of infrastructure projects are monopolistic by nature), long pay off periods which could go beyond duration of the project, and consequently the large costs associated with these more complex evaluations.

Some other general difficulties associated with measuring project specific impacts exist such as attribution problem, estimation and approximation and the collection and reliability of information. In the case of institutions like IFC that is interested to measure the impact on poverty of its infrastructure operations, it might be hard to define which impacts can be attributed to IFC alone, and the number of people benefiting from a new infrastructure program can only be roughly estimated based on certain assumptions. Also there is need to identify the types of people that actually benefit from the program and to compare the value of people getting new service and people getting better service.

The findings from the poverty literature review highlight that while there is lots of evaluation work being done on water & sanitation and the power sectors, there is a paucity of evidence in the railways and ports sectors- a gap worth considering from the perspective of M&E work in IFC.

Figure 1: Infrastructure and PPI: Direct and Indirect Transmission Links to Poverty
Conclusions and Recommendations

Infrastructure services and private sector participation in infrastructure plays a critical role in the economic growth of an economy, particularly the lower income countries. The impact on poverty comes through this economic growth for the most part. Direct impact on the poor comes from making this increased access affordable, which depends on several factors including the kind of infrastructure, the nature of enabling environment etc. Another channel of transmission is the significant indirect and second order job creation among infrastructure projects. Projects can be designed keeping the access to poor in mind by including aspects of universal service obligations, cross subsidies etc. While IFC works to better understand these links, it is important to note that there are challenges to measuring impact of infrastructure services and there exist gaps in evidence which are worth exploring for further M&E work.

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