Reducing Poverty by Closing South Asia's Infrastructure Gap

Luis Andrés,
Dan Biller, and
Matías Herrera Dappe

December 2013





THE WORLD BANK

Australian Aid

Acknowldgements

The authors are grateful to those who contributed to the South Asia Infrastructure Needs Regional Study in various capacities. This paper is a synthesis of the findings of this study. Thus, there are many to be thanked: Sudeshna Banerjee, Ashma Basnyat, Cecilia Belita, Edgar C. Bouharb, Diana Cubas, Juan A. Echenique, Jorge J. Escurra, Céline Ferré, Kirsten Hommann, Atsushi Iimi, Ada Karina Izaguirre, Johannes G. P. Jansen, Rahul Kanakia, Pravin Karki, Bill Kingdom, Neetu Mihal, Pradeep Mitra, Diana Moreira, Mohua Mukherjee, Elisa Muzzini, John Newman, Shaheena Nisar, Sheoli Pargal, Mario Picon, Saurabh Naithani, Fernanda Ruiz Núñez, Stefanie Sieber, Rabin Shrestha, Govinda Timilsina, Gonzalo Vázquez Baré, and Tomoyuki Yamashita. The authors also thank Laura Wallace for her editorial support. The authors are grateful to the South Asia Regional Chief Economist, Martin Rama, and the former regional Chief Economist, Kalpana Kochhar, for their support and technical input. The authors also greatly appreciate the guidance of Jack Stein, Gajan Pathmanathan, Jyoti Shukla, the South Asia Sustainable Development Department management team, and Country Management Units in the South Asia region. In addition, Marianne Fay (SDN, Chief Economist), Vivien Foster (SEGEN, Sector Manager), and José L. Guasch (Consultant) provided insightful and constructive comments through their capacities as peer reviewers. Financial support from SAR Chief Economist Office and the Australian Government is also gratefully acknowledged.

Senior authorship is not assigned. The findings, interpretations, and conclusions expressed in the reports and outputs under this initiative are those of the authors, and do not necessarily reflect the views of the Executive Directors of The World Bank, the governments they represent, or the counterparts that were consulted or engaged with during the informal study process. Any factual errors are the responsibility of the team.

Photo credits:

Power: Solar energy is used to light village shop. Sri Lanka. Photo: Dominic Sansoni / World Bank

Telecom: Supervisors team of the SDO NGO in front of a 'Basic Healt Clinic' under construction in the village of Said Ahmad Qazi. Photo: © Nicolas Bertrand / TAIMANI FILMS / WORLD BANK

Irrigation: An apricot nursery, supported by the HLP program. Afghanistan. 2008. Photo: © Sofie Tesson / TAIMANI FILMS / WORLD BANK

Water: Girl getting water from community water pipe. Sri Lanka. Photo © Dominic Sansoni / World Bank

Roads: 13 May 2012, Enjil District, Herat, Afghanistan :The 13 kilometer stretch of road leading to Nawin Enjil village outside of Herat that was developed under the auspices of the National Rural Access Program (NRAP). The villages of the area have benefitted from NRAP that has funded the completion of this road. The NRAP project aims to provide year -round access to basic services and facilities in the rural areas of Afghanistan to enhance the well being of the population and promote economic growth in the country. Under the project secondary roads are being rehabilitated by the Ministry of Public Works and tertiary roads by the Ministry of Rural Rehabilitation and Development.. Picture by Graham Crouch/World Bank

INTRODUCTION

Despite recent rapid growth and poverty reduction, the South Asia Region (SAR) continues to suffer from a combination of insufficient economic growth, slow urbanization, and huge infrastructure gaps that together could jeopardize future progress. It is also home to the largest pool of individuals living under the poverty line of any region, coupled with some of the fastest demographic growth rates of any region. Between 1990 and 2010, the number of people living on less than US$1.25 a day in South Asia decreased by only 18 percent, while the population grew by 42 percent.[1]

If South Asia hopes to meet its development goals and not risk slowing down—or even halting—growth and poverty alleviation, it is essential to make closing its huge infrastructure gap a priority. But the challenges on this front are monumental. Many people living in SAR remain unconnected to a reliable electrical grid, a safe water supply, sanitary sewerage disposal, and sound roads and transportation networks. This region requires significant infrastructure investment (roads, rails, power, water supply, sanitation, and telecommunications) not only to ensure basic service delivery and enhance the quality of life of its growing population, but also to avoid a possible binding constraint on economic growth owing to the substantial infrastructure gap.

For the past two decades, SAR and East Asia and Pacific (EAP) have enjoyed similar growth rates, yet SAR lags significantly behind EAP, Latin America, and the Caribbean (LAC) when it comes to access to infrastructure services—with certain areas featuring access rates comparable only to Sub-Saharan Africa (SSA). At the same time, there are tremendous variations among countries in terms of access to infrastructure services. Afghanistan, Nepal, and Bangladesh have access rates that resemble the average Sub-Saharan country, while Sri Lanka and the Maldives are more similar to Latin American countries in terms of average rates of infrastructure services. There are also enormous variations within SAR countries. Districts with very low access to infrastructure can be found in rich Indian states while districts with high access can be found in poor states. Moreover, within the same district, high access rates to one service (for example electricity) can coexist with low access rates to other services, such as sanitation.

It is commonly asserted that the poor have less access to infrastructure than the rich, similar to the case of private assets. In effect, a non-regressive access to infrastructure services would mean no correlation between actual access and different poverty related measures (such as households below poverty lines, and certain income and consumption levels). Whereas this may be desirable theoretically—especially for infrastructures with high public good characteristics—it is virtually impossible to achieve anywhere in the world. For example, location matters, and the choice between infrastructure access to all, regardless of where individual households are located and quality access to where most households are located, is a real policy challenge illustrated in its extreme case. While studies on the topic are scarce, it is clear that not all countries fare the same in their infrastructure service provision, and SAR countries are no different. Yet, do some SAR countries fare better with respect to providing infrastructure access to their poor? Are there infrastructure sectors that tend to be more regressive than others? What is happening with access to infrastructure services at the household and individual levels?

In an effort to shed light on all of these questions, this report takes a critical look at the status of infrastructure in SAR compared with other regions, as well as among and within

[1] The proportion of people living on less than $1.25 a day decreased from 54 percent to 31 percent (a 42 percent decrease), between 1990 and 2010, mainly due to the increase in population.

SAR countries. It then explores inequality of access to infrastructure services across South Asia's space (namely physical space, poverty space, and income space) and across time (how access of the young will influence future opportunities). Next, the report gives an estimate of the total cost of regional infrastructure needs, along with the infrastructure investment trends in SAR countries, and proposes a framework on how to rank infrastructure needs. Finally, the report examines ways to better use existing resources by rethinking infrastructure service provision—including the role of the private sector—and policy options to help the poorest gain better access to infrastructure.

Our conclusion is that infrastructure deficiencies in South Asia are enormous, and a mix of investment in infrastructure stock and implementing supportive reforms will enable the region to close its infrastructure gap. As for the size of the infrastructure gap, we estimate that SAR needs to invest between US$ 1.7 and US$ 2.5 trillion (at current prices) in infrastructure until 2020.[2] In GDP terms, if investments are spread evenly over the years until 2020, SAR needs to invest between 6.6 and 9.9 percent of 2010 gross domestic product (GDP) per year—which would be an increase of up to three percentage points from the 6.9 percent of GDP invested in infrastructure by SAR countries in 2009.

Faced with this enormous demand for infrastructure investment, and with only limited available financial resources, it is critical for SAR to prioritize infrastructure investment needs. The criteria used to accomplish this must be able to answer questions about short-term needs versus longer-term development needs, especially in developing countries. For example, should infrastructure investment in the electricity sector be given priority over the transport sector? Given substantial lock-ins associated with infrastructure investments, should a country continue attempting to fill current gaps or direct investments to infrastructures that are likely large bottlenecks in the medium term? Moreover, it is not feasible to expect South Asian governments alone to shoulder the entire financial burden, underscoring the need for a bigger role for the private sector (such as through public-private partnerships).

In addition, South Asian governments need to ensure that infrastructure access is extended to the people who need it the most: women, the poor, and marginalized social groups. There are no simple guidelines to follow however, given the tremendous variations among and within SAR countries as to who has access to infrastructure services (in terms of physical location, income, and age). For example, while leading regions generally have better levels of access, many poor areas enjoy levels of access that are similar to those of rich areas. Plus some infrastructure services (like water) are more equally distributed than others (like sanitation). That is why providing some level of access is a start—even if those services are not of the highest quality. At the same time, policy makers should take into account which types of services best fit each population's needs (such as septic tanks for a mountainous region but sewerage lines for a more accessible urban area).

HOW SOUTH ASIA COMPARES WITH OTHER REGIONS

The demand for infrastructure has been growing globally, especially in Asia, driven by a myriad of factors such as economic growth, technological progress, and urbanization—putting greater and greater pressure on infrastructure services that are already severely stretched. According to the United Nations, five South Asian cities (Mumbai, Delhi, Kolkata, Karachi, and Dhaka) are expected to surpass the 15 million-person mark by 2015. Furthermore, according to the livability index produced by the Economist Intelligence Unit, four South Asian cities (Dhaka, Karachi, Kathmandu, and Colombo) are in the bottom 10 cities out of the 140 countries evaluated.

Yet structural change in South Asian countries has been relatively slow compared to that of East Asian countries—especially since 1990, when they had similar urbanization rates (SAR, 25 percent; EAP 28 percent) and were close in terms of infrastructure service provision. While they both enjoyed high growth rates over the next two decades, EAP has seen rapid urbanization (50 percent in 2012) while SAR has remained the least urbanized region in the world (31 percent), well below the world urbanization rate (53 percent). In effect, departing from similar points, South Asian countries

[2] The US$1.7 to US$ 2.5 trillion are at current prices, and they are equivalent to US$1.4 to US$2.1 trillion at 2010 prices.

TABLE 1: SAR LAGGING BEHIND ALL BUT SSA IN ACCESS TO INFRASTRUCTURE SERVICES

	Avg GDP Growth (2000–2012)[a]	Urbanization Rate (2012)	Telecom Access (per 100 people) (2011)[b]	Electricity Access (% of pop.) (2010)[c]	Access to Improved Sanitation (% of pop.) (2011)[d]	Access to Improved Water (% of pop.) (2011)[e]
East Asia and Pacific (EAP)	8.9%	50	98	92	67	91
Europe and Central Asia (ECA)	4.4%	60	157	100	94	95
Latin America and the Caribbean (LAC)	3.1%	79	125	94	81	94
Middle East and North Africa (MNA)	4.2%	60	105	94	89	89
South Asia Region (SAR)	6.7%	31	72	71	39	90
Sub-Saharan Africa (SSA)	4.7%	37	54	35	30	63
World	2.5%	53	103	78	64	89

Source: World Development Indicators, except when noted otherwise.
Notes: [a] The average GDP growth for MNA is for the period 2000–2009; [b] Telecom access is defined as the number of fixed and mobile lines; [c] World Energy Outlook 2010 by International Energy Association; [d] Improved sanitation is defined as connection to a public sewer, a septic system, pour-flush latrine, simple pit latrine, and ventilated improved pit latrine; [e] Improved water is defined as household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection.

are remarkably "under-urbanized" when compared to East Asian countries over the past half century.

How large is SAR's infrastructure gap compared with other regions? At this point, its access to infrastructure services closely resembles SSA, even though its economic growth is second only to EAP (table 1).

- ***Electricity access.*** In SAR only 71 percent of the population enjoys the benefits of electricity access, ahead of SSA at 35 percent, but way behind the rest of the regions at above 90 percent. According to businesses in South Asia, infrastructure is a major or severe hindrance to their growth, and electricity is the largest problem.
- ***Improved sanitation access.*** In this category, SAR (39 percent) is at the bottom with SSA (30 percent)—rates that are close to half the world average of 64 percent population access. Open defecation seems to be one of the most salient issues facing SAR—which ranks as the region with the highest incidence of open defecation in the world—with 680 million people (41 percent of the population) relying on it in 2011.[3]
- ***Improved water access.*** This is the only indicator where South Asia is about even with the rest of the world and EAP, averaging 90 percent population access. Yet the quality and quantity of improved water may be in question. Most of the access to water is through public stands; only 25 percent of the population has access to piped water and 24/7 water supply is a rare exception in South Asian cities.[4]
- ***Telecom access.*** Communication among people who are not in close proximity is inefficient. In terms of telecom access (measured as fixed and mobile lines per 100 people), SAR and SSA rank at the bottom (72 and 54) with less than half the access found in ECA and LAC (157 and 125).This situation becomes even more dramatic given SAR's low level of urbanization.
- ***Transport access.*** This other form of connectivity is also poor—a problem that troubles much of the developing world. Using total length of road network per 1,000 people, SAR has 2.9 km—which is close to EAP (2.5 km), SSA (2.5 km), and MNA (2.8 km), but well below the world average (4.7 km), ECA (8 km), and North America (24 km). Furthermore, the transport infrastructure suffers from serious shortcomings (such as lack of intra-regional connectivity among the national road networks,

[3] WHO/UNICEF Joint Monitoring Program
[4] Ibid.

TABLE 2: BIG RANGE AMONG SAR COUNTRIES IN ACCESS TO INFRASTRUCTURE SERVICES

Access to Infrastructure Services in SAR countries

	Telecom Access (per 100 people) (2011)[a]	Electricity Access (% of pop.) (2010)[b]	Access to Improved Sanitation (% of pop.) (2011)[c]	Access to Improved Water (% of pop.) (2011)[d]	Total Road Network (km per 1000 people)[e]	% Paved Roads[f]
Afghanistan (AFG)	54	30	29	61	1.6	29
Bangladesh (BGD)	58	47	55	83	0.1	10
Bhutan (BTN)	69	65	45	97	9.7	40
India (IND)	75	75	35	92	3.5	50
Maldives (MDL)	173	95	98	99	0.3	100
Nepal (NPL)	47	76	35	88	0.8	54
Pakistan (PAK)	65	67	47	91	1.5	72
Sri Lanka (LKA)	104	77	91	93	5.5	81

Source: World Development Indicators, except when noted otherwise.

Notes: [a] Telecom access is defined as the number of fixed and mobile lines; [b] World Energy Outlook 2010 by International Energy Association, except BTN and MDV, which are based on authors' estimations; [c] Improved sanitation is defined as connection to a public sewer, a septic system, pour-flush latrine, simple pit latrine, and ventilated improved pit latrine; [d] Improved water is defined as household connection, public standpipe, borehole, protected dug well, protected spring, rainwater collection; [e] Varying data years: 2005 (MDV), 2006 (AFG), 2008 (IND, NPL), 2010 (BGD, BTN, PAK, LKA); [f] Varying data years: 2003 (LKA), 2005 (MDV), 2006 (AFG), 2008 (IND, NPL), 2010 (BGD, BTN, PAK).

unrealized potential for rail and inland water freight transport, and inadequate road and rail connectivity of ports with hinterlands). These limitations turn transport infrastructure into a hindrance for regional and international trade, as indicated by investment climate surveys.

HOW ACCESS TO INFRASTRUCTURE VARIES WITHIN SOUTH ASIA

So *who* has access to each type of infrastructure? We begin with a cross country comparison among South Asian countries and then we look at inequality of access across South Asia's region, weighing physical ("spatial"), poverty, and income spaces—an assessment that has never been done before for SAR.[5] Mapping access to infrastructure with characteristics of households provides a better understanding of the issues limiting access for some groups of the population, and allows for better design and targeting of policies to expand access to infrastructure services.

Benchmarking within South Asia

Sri Lanka and Maldives have the best access rates in the region. More than 90 percent of their population has access to improved sanitation, which is better than in LAC at 81 percent. In terms of electrification, only Maldives (95 percent) and Sri Lanka (77 percent) are above the average rate for developing countries (76 percent).[6,7] On telecom, Sri Lanka and Maldives top the lists with 104 and 173 telephone lines per 100 people. This places Sri Lanka almost at the world average of 103 lines per 100 people and above EAP (98 lines per 100 people).

Afghanistan, Nepal, and Bangladesh have the worst access rates in the region. Nepal, with the lowest number of telephone lines per 100 people in SAR (47), is behind Afghanistan (54) – which matches SSA (54). For electrification, Afghanistan, not surprisingly, is the worst; a meager 30 percent of the population can rely on electricity powered lighting at night. Moreover, Afghanistan and Bangladesh

[5] See Biller et al. (2013) for a detailed discussion about the methodology in this section.

[6] It should be noted that data sources are kept the same for consistency purposes when comparing countries. The Ceylon Electricity Board (CEB) estimates for example that over 90 percent of Sri Lankan households were electrified in 2011.

[7] World Energy Outlook/International Energy Association (IEA): http://www.worldenergyoutlook.org/resources/energydevelopment/globalstatusofmodernenergyaccess/.

(47 percent) are closer to the 35 percent found in SSA than to the 71 percent found in SAR. Total road network (km) per 1000 people is also low in Nepal, Afghanistan, and Bangladesh—in Maldives it is also low, but it is explained by geographical reasons. And only 29 percent of Afghanistan's roads, and 10 percent of Bangladesh's roads, are paved.

The exception is high average access to improved water in SAR, and not just in a few countries. Five out of the eight countries in SAR (i.e., Bhutan, India, Maldives, Pakistan and Sri Lanka) have access rates to improved water of at least 90 percent, similar to the 94 percent rate found in LAC.

Inequality across physical space

One way of judging inequality is to analyze whether some countries in South Asia do a better job of making access to infrastructure more equal within the country spatially than others. We do this by focusing on a lower administrative level (such as a district or province) and measuring inequality with Gini coefficients.[8] A Gini coefficient of zero represents perfect equality, while a coefficient of one represents maximal inequality. Our goal is to come up with a country-level measure of spatial inequality of infrastructure access adjusted by household spatial distribution, which is presented in table 3.

The results show quite a varied picture, with the Maldives having the lowest—and Afghanistan the highest—inequality of access to infrastructure services in the region. These results are not surprising, especially in the case of Afghanistan, given its level of development and years of conflict. What is surprising, however, is Pakistan's relatively low levels of spatial inequality. One possible explanation is the country's higher urbanization rate, with access to infrastructure services more skewed to its cities relative to other countries in the region.

We can also ask whether some infrastructure services fare better than others in terms of how they are distributed within countries to households. Again, the results show large variations. The most unequally distributed service throughout SAR is cooking gas (Liquefied Petroleum Gas (LPG))—likely reflecting its reliance on transport connectivity and its capital-intensive nature (it is mostly distributed in bottles). This heavy use of biomass for cooking, rather than the cleaner LPG, affects mostly children and women through indoor air pollution. In Sri Lanka, as Figure 1 shows, there are "mountains" of firewood and poverty.[9]

[8] The first step is to estimate a Gini coefficient over total households that have access to a given type of infrastructure service at the administrative level. But given that differences in the distribution of the access could be determined by where the households are allocated in the country, we actually estimate the Gini coefficient over the number of households of each administrative area. The next step is to subtract the Gini coefficient of population from the Gini of connections to see if there are areas in a country that are not receiving a rate of access proportional to their population. Access to a particular infrastructure service is spatially evenly distributed if its Gini coefficient is equal to the Gini coefficient of households—although this could also mean an equal absence of services.

[9] Improved water is a noticeable outlier in the Maldives which may be explained by small atolls having more access in relative terms because of the inclusion of rain water in improved water.

TABLE 3: TREMENDOUS INEQUALITY OF ACCESS ACROSS SAR'S PHYSICAL SPACE

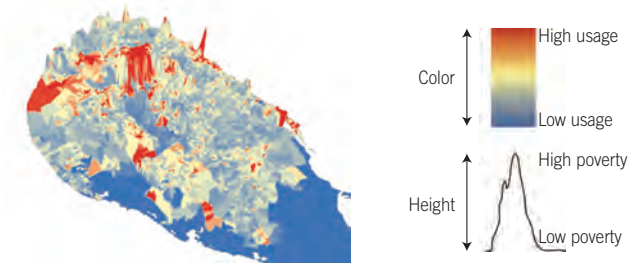
Gini Coefficients of Access to Infrastructure in South Asia

	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
	Access Gini Coefficients Adjusted by Household Distribution							
Improved Water	0.12	0.01	0.00	0.06	–0.10	0.04	0.02	0.01
Improved Sanitation	—	–0.01	0.18	0.29	0.01	0.06	0.02	0.01
Electricity	0.49	0.11	0.10	0.15	0.00	0.04	—	0.04
Cooking Gas	0.50	0.49	0.22	0.35	0.01	0.24	0.00	0.33
Phone	0.28	0.15	0.19	0.20	0.00	0.05	0.03	0.03

Source: Authors' calculations based on surveys presented in Andres et al. (2013).
Note: The Gini coefficients are estimated over a sample of administrative subdivisions selected on each country. An access Gini coefficient adjusted by household distribution of one expresses maximal inequality. An adjusted coefficient of zero expresses perfect equality.

FIGURE 1: SRI LANKA'S MOUNTAINS OF FIREWOOD AND POVERTY

Total Population that Uses Firewood for Cooking Relative to Poor Households



Note: This is an inverted view of Sri Lanka for visual purposes. The red peaks indicate both high usage and high poverty. The solid blue color area with no mountains indicates the absence of data for the north and part of the east.

The most equally distributed service throughout SAR is improved water, which is important in terms of welfare impacts given that no one can survive without it. The other sectors—improved sanitation, electricity, and phones—fall somewhere in between the two extremes. Households, appropriately or not, generally solve their own sanitation needs, so the incentives to invest in adequate technologies are more limited than in the case of water. Like water, electricity is a direct benefit to the household as opposed to sanitation. One would expect that households are willing to pay more for adequate electricity, however appropriate electricity services can be costly.

Inequality across poverty space

Another way of judging inequality is to analyze how pockets of poverty fit into the picture, in effect, introducing a socio-economic variable. We assume that a country with a higher poverty rate will have worse access to infrastructure services than a country with a lower one; but how strong is that link? To do this, we correlate the district poverty rate (percentage of people of each district that live under the poverty line) with the district rate of access to infrastructure (percentage of households that have infrastructure in each district) for India, Afghanistan, and Sri Lanka. This correlation helps us understand the income regressivity of access to these services by sector—that is, to what extent income (being above or below the poverty line) and access move together. In this analysis, high regressivity means that poor districts typically have less access compared to richer districts, whereas low regressivity means access is more equitably distributed among poor and rich districts alike.

Our results show that overall the link is regressive, but the strength of that link varies greatly among the countries and among sectors.

- ***India*** shows strong regressivity of infrastructure service access, except in water and phone services (Figure 2). The water exception is similar to that in the other countries.
- ***Sri Lanka*** shows a relatively weak regressivity of infrastructure service access (Figure 3). The exceptions to this trend are cooking gas and phone, which show a much stronger link.
- ***Afghanistan*** shows a relatively strong regressivity, except in water and in Kabul (its capital), an area with one of the country's lowest poverty rates (Figure 4). Cooking gas seems less regressive than in India and Sri Lanka.

Inequality across physical and poverty space

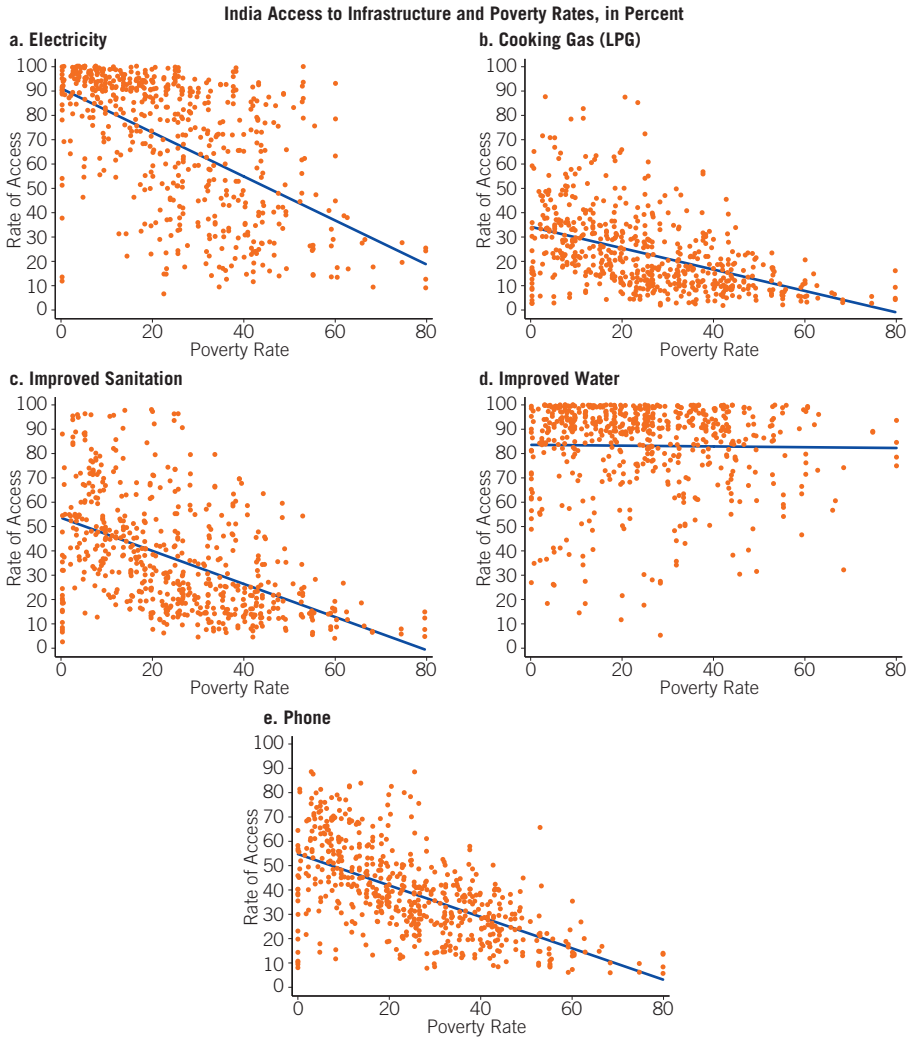
Yet another question that we can explore, this time by bringing together poverty data and physical access data for India and Sri Lanka, is whether poorer regions within a country have less access to key public services as a whole. We do this by constructing two infrastructure indexes[10]—which encompass only the basic infrastructure services that have the highest impact on welfare (such as water, sanitation, and electricity)[11]—and then use these to generate maps depicting how poverty and the location of infrastructure services intersect.

Our results show that leading regions generally mean better access but lagging regions do not necessarily mean worse

[10] The two methods are: (i) equal weights; and (ii) multicriteria decision-making approach assigning weights according to household level infrastructure service importance.

[11] Maps could be generated for each infrastructure service, but this analysis is easier done via other means as discussed later in the paper.

FIGURE 2: INDIA'S INFRASTRUCTURE SERVICES ACCESS IS STRONGLY REGRESSIVE

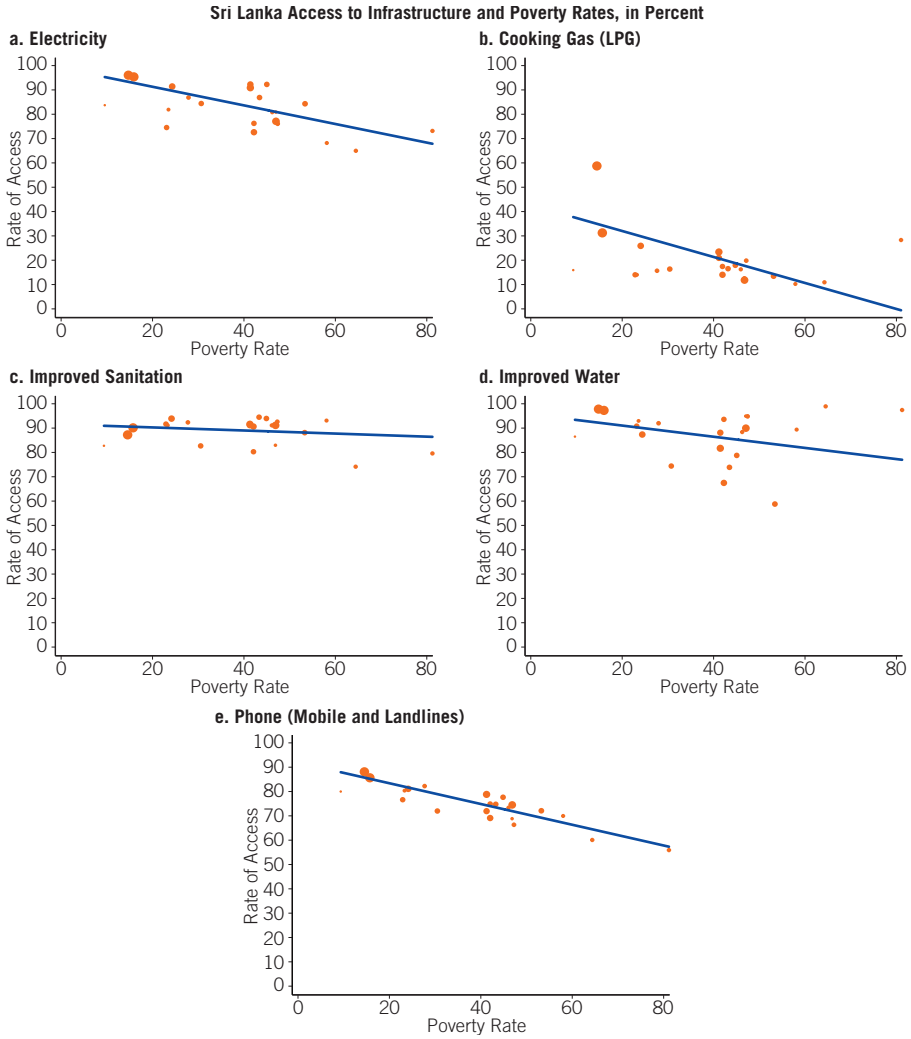


Source: Authors' calculations based in infrastructure access from India DHLS-3 and poverty rates from Debroy and Bhandari (2003).
Note: The size of each point is based on the population size. The coefficients associated with the scatter plots are –0.89 (significant at 99% of confidence) for electricity, –0.44 (significant at 99% of confidence) for cooking gas, –0.67 (significant at 99% of confidence) for improved sanitation, –0.02 for improved water, and –0.64 (significant at 99% of confidence) for phone.

access. As expected, in India the lagging states (those with a higher poverty level) have higher access to basic infrastructure, in contrast with the leading states (those with a lower poverty level). This is intuitively expected. The curious exception is the northeast area bordering Bangladesh, Bhutan, China, and Myanmar. The exception found in India is more prevalent in Sri Lanka, where basic infrastructure seems to be more inclusive. Access is widely spread, and the quality of these services in the country is known to be generally good. It is clear that the leading region—the Western Province—enjoys better access and a lower poverty rate. Yet, for the lagging provinces, the story is more mixed, except for those where the country's 30-year conflict was more present.[12]

[12] See Biller et al. (2013) for further discussion on this issue.

FIGURE 3: SRI LANKA'S INFRASTRUCTURE SERVICES ACCESS IS ONLY WEAKLY REGRESSIVE



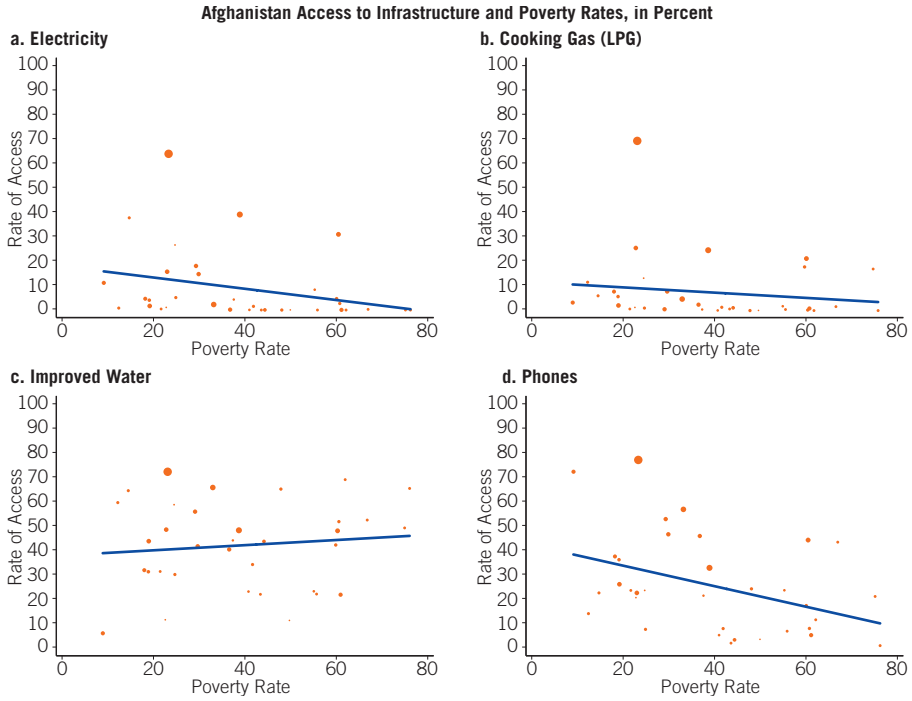
Source: Authors' calculations based in Sri Lanka HIES 2010.
Note: The size of each point is based on the population size. The coefficients associated with the scatter plots are: –1.51 (significant at 99% of confidence) for electricity, –2.34 (significant at 99% of confidence) for cooking gas, –0.25 for improved sanitation, –0.9 for improved water, and for phone –1.69 (significant at 99% of confidence.

Inequality across income space

One question that still remains is how equitably access is distributed across different income levels—that is, for those with access, is it the richer individuals who have the bulk of the access or do richer and poorer individuals tend to have more similar access? This matters because it allows policy makers to better target policies to expand access. To answer this question, we compared income quintiles and access rates for Afghanistan and Sri Lanka.

Our results show that in Sri Lanka and Afghanistan, the rich enjoy better access than the poor, but the countries differ greatly in how equal that access is across incomes. In Sri Lanka, the difference in access across quintiles is small—all quintiles are close to the mean—meaning that there is an almost equal share of access to infrastructure regardless of income quintile. The opposite story is true in Afghanistan.

FIGURE 4: AFGHANISTAN'S INFRASTRUCTURE SERVICES ACCESS IS REGRESSIVE



Source: Authors' calculations based in Afghanistan NVRA 2008.
Note: The size of each point is based on the population size. The coefficients associated with the scatter plots are –0.03 for improved water, –0.39 (significant at 90% of confidence) for electricity, –0.36 for cooking gas and –0.66 (significant at 95% of confidence) for phone.

However, some services (like water) are more equitably distributed than others (like cooking gas) among those with access. In Afghanistan, the equality of access across income quintiles is particularly striking for improved water. Whether poor or rich, the shares of quintile over the total connection in the country hardly deviate from the mean. This is particularly remarkable given that access to improved water is very low in the country—significantly lower than all other countries in South Asia and the region's average. Regardless of years of conflict and scarcity of service, it seems that the Afghani society has emphasized sharing household access to water. Whether in Sri Lanka or Afghanistan, the use of cooking gas is particularly prevalent for the highest quintile, making it the rich's form of cooking. The reason, as discussed, is the capital intensive nature of LPG, its reliance on network connectivity, and the easy available of cheaper, albeit inferior, alternatives.[13]

[13] This has been underscored in the literature as well; see Kojima et al. (2011) and Kojima (2011).

HOW ACCESS TO INFRASTRUCTURE AFFECTS OPPORTUNITIES FOR YOUTH

So how unequal is access to infrastructure among children? After all, infrastructure investment choices to fill the infrastructure gap made today affect current and future generations. Moreover, not addressing the infrastructure gap threatens both welfare and economic growth in the medium and long term.

The Human Opportunity Index: Access to Infrastructure as Opportunity

Our main instrument for measuring the inequality of access to infrastructure across time is the Human Opportunity Index (HOI), which was first published in 2008, and was used to evaluate access in Latin America. It essentially measures how personal circumstances impact a child's probability of accessing the services that are necessary to succeed in life. This is critical because the opportunities a child gets throughout life are determined directly by the circumstances related to access to infrastructural services during

their formative years—not necessarily to their personal decisions or level of effort.

This study calculates an HOI that is focused on basic infrastructure as opportunities, and the importance of both improving overall access to it and ensuring its equitable allocation to achieve key socio-economic outcomes—such as early childhood development, education completion, good health, and access to information. It can be interpreted as a composite indicator of two elements: (i) the level of coverage of basic opportunities necessary for human development (such as access to primary education, water and sanitation, or electricity); and (ii) the degree to which the distribution of those opportunities is conditional on circumstances children are born into (such as gender, income, or household characteristics). For this study we have selected four circumstances: (i) household size, (ii) location (urban versus rural), (iii) education of household head, and (iv) gender of household head.[14]

Inequality of Opportunity in the Access to Infrastructure Services

Our results show that typically, South Asian countries with better infrastructure coverage also provide more equitable access for households with children under 15, thereby offering higher HOIs. Take the case of *improved sanitation* (table 4). As expected, countries with the highest coverage (the Maldives and Sri Lanka) feature the lowest dissimilarity index, and therefore, the HOI is very close to the coverage. In contrast, countries with low levels of coverage (such as Bangladesh) are associated with higher discount rates, and thus lower HOIs. However, if we take two similar access rates, such as in the case of India (36 percent) and Nepal (37 percent), we see a significant difference in how that access to sanitation is distributed, with Nepal (0.14) being more even than in India (0.24)—which results in India having a lower HOI (0.27) than Nepal (0.32). Also, a country with higher coverage, like Pakistan (44 percent), but featuring the same dissimilarity index as India (and thus higher than for Nepal), still ends up with a higher HOI than India but with a similar one to that of Nepal. In the case of access to *improved water*, rates are high enough to guarantee a low dissimilarity index. *Electricity* also follows the pattern of decreasing dissimilarity index as coverage is higher.

Can we ascertain how much individual circumstances drive the HOIs for each type of infrastructure? We explore this by looking at all 9 types of infrastructure, and then calculating both the dissimilarity/inequality index and HOI for each indicator, and then the contribution of each circumstance to the HOI. A few patterns stand out:

- Indicators linked to a higher quality of access register significantly higher inequality of opportunity than more standard, general indicators of access (improved water source versus piped water, improved sanitation versus sewerage). Hence, general indicators of access hide differences in types of access among different circumstance groups.
- At the country level, two factors—the location of the household (urban versus rural) and the education of the household head—explain over 70 percent of the HOIs across countries and across indicators (most of the times, over 80 percent).
- In the case of India, at the state level location is still a key factor, but the role of education of the household head, and in a few cases, household size, gain in importance in explaining HOIs. And while the contribution of gender of the household head seems negligible at the country level, there are a number of states where access is unevenly distributed among female and male headed households.

PINNING DOWN THE "INFRASTRUCTURE GAP"

Over time, societies inherit man-made infrastructure stock from previous generations. Yet different factors influence demand and supply, and as countries grow these needs—both the type of infrastructure and the quality of service provision—are likely to evolve. In this report, we assess the infrastructure gap using a four-step process, as illustrated in Figure 5. It shows (1) where a country is today; (2) where a country would like to be at a given point in time; (3) the difference between the two points (i.e. the infrastructure gap-how far business-as-usual scenarios, shown by the dotted

[14] These circumstances reflect previous inequality of opportunities studies and are in line with similar analyses that are part of the SAR Regional Flagship Report on Inequality of Opportunities (forthcoming in 2014).

TABLE 4: BETTER COVERAGE TYPICALLY GOES WITH MORE EQUITABLE ACCESS AND THUS HIGHER HOIs

Access to Infrastructure Services and Human Opportunity Index for household with children under 15 years old

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Pakistan	Sri Lanka
Year	2008	2006	2007	2007	2009	2011	2006	2010
Improved Sanitation								
Coverage	—	45%	38%	36%	94%	37%	44%	90%
Dissimilarity Index	—	0.15	0.24	0.24	0.01	0.14	0.23	0.03
HOI	—	0.38	0.29	0.27	0.93	0.32	0.34	0.87
Improved Water								
Coverage	46%	98%	96%	83%	86%	88%	92%	88%
Dissimilarity Index	0.11	0.00	0.01	0.03	0.09	0.02	0.01	0.02
HOI	0.41	0.97	0.95	0.80	0.78	0.86	0.91	0.86
Electricity								
Coverage	17%	50%	72%	68%	100%	75%	—	85%
Dissimilarity Index	0.58	0.20	0.12	0.12	0.00	0.08	—	0.05
HOI	0.07	0.40	0.63	0.60	1.00	0.69	—	0.81

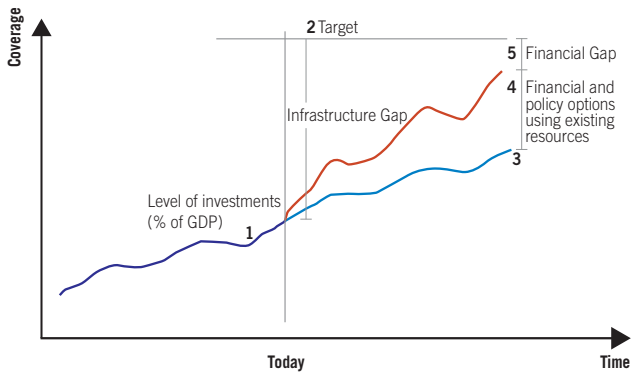
Source: Authors' calculations based on NVRA 2008 for Afghanistan, MICS 2006 for Bangladesh, BLSS 2007 for Bhutan, DLHS-3 for India, DHS 2009 for Maldives, DHS 2011 for Nepal, DHS 2006 for Pakistan and HIES 2010 for Sri Lanka. All estimations represent the proportion of access in the sample with children below 15 years of age.

Note: The column coverage is estimated over the predicted values of access to infrastructure for each household. Piped water is restricted – "Piped water in the premises." For the Bangladesh improved water rate of access we did not use the assumption made by JMP where they discard 20 percent of protected wells due to arsenic contamination. For Bangladesh improved sanitation data, to make rates comparable, we include as JMP pit latrines without slabs in the category of improved sanitation (when is categorized as unimproved). For further information about these changes in the JMP methodology check JMP data by country (http://www.wssinfo.org/documents-links/documents/?tx_displaycontroller[type]=country_files). Due to the lack of information about landlines in Bhutan the definition of phone (mobile and landlines) is the same as mobile phones. Sri Lanka sewerage connection is not presented because it is not identifiable in the data. For Pakistan, there is no information about the tenancy of mobile phones in the household. The lack of information about access to electricity in Pakistan is caused by significant differences with the official data (World Energy Outlook) which motivates us to think the estimates in these countries are not comparable definitions of access to electricity.

blue line, will take the country toward reaching its goal);[15] (4) how far financial and policy options using existing resources (shown by the dotted red line) could take the country toward reaching its goal; and (5) the remaining financial gap that will need to be bridged. Keep in mind that the importance of the financial gap will vary among countries, depending on how well better use of existing resources can close the infrastructure gap.

At this point, most governments in SAR have some estimates of the investments required to reach certain targets, such as 24/7 electricity supply and the MDGs in water and sanitation, but those estimates are not consistent across the

FIGURE 5: A FRAMEWORK FOR ASSESSING INFRASTRUCTURE NEEDS



Source: Authors' elaboration.

[15] Given that (3) is the sum of (4) and (5), the four steps are (1), (2), (4), and (5).

TABLE 5: SAR'S TOTAL INVESTMENT TAB COULD REACH AROUND $2 TRILLION
(Investment Requirements 2011–2020 (total, in billions of dollars 2010)

	Bangladesh		India		Nepal		Pakistan		Sri Lanka		SAR (5)[a]		SAR (8)[b]	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Transport	36.0	45.0	340.0	595.0	3.7	5.5	17.2	21.5	10.8	18.0	408	685	411	691
Electricity	11.0	16.5	375.0	468.8	5.3	7.0	64.0	96.0	4.8	9.0	460	597	464	603
WSS[c]	12.0	18.0	95.0	162.0	1.7	2.6	9.3	14.0	0.6	1.8	119	198	120	200
Solid Waste	2.1	4.2	32.5	65.0	0.4	0.5	3.3	6.7	0.2	1.3	39	78	39	78
Telecom	5.0	5.0	150.0	225.0	0.4	0.6	12.4	12.4	2.0	2.5	170	246	171	248
Irrigation	7.7	11.6	140.0	210.0	1.6	2.3	9.7	14.6	2.5	3.1	161	242	163	244
Total	74	100	1,133	1,726	13	18	116	165	21	36	1,356	2,045	1,369	2,064

Source: Andres et al. (2013).
Note: Estimations based on the technical models as well as the extrapolations for the other sectors where the models were not run.
[a] SAR (5): Bangladesh, India, Nepal, Pakistan, and Sri Lanka. [b] SAR (8): Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. Based on an extrapolation from SAR (5) estimates. [c] WSS: Water Supply and Sanitation.

region. That is why we developed different methodologies for different sectors. These models also allow us to calculate and compare the costs of different sets of targets. Each model was applied to one country, which gives five sector-country combinations: (i) power – Nepal; (ii) transport – Sri Lanka; (iii) water and sanitation – India; (iv) solid waste management – Sri Lanka; and (v) irrigation – Afghanistan.

So how much money will be needed to close the infrastructure gap? We estimate that SAR needs to invest US$ 1.7 to US$ 2.5 trillion in infrastructure until 2020—equivalent to US$ 1.4 to US$ 2.1 trillion at 2010 prices (table 5).[16] Going forward, a mix of investing in infrastructure stock and implementing supportive reforms will enable the region to close its infrastructure gap. In GDP terms, if investments are spread evenly over the years until 2020, SAR needs to invest between 6.6 and 9.9 percent of 2010 GDP per year—an increase of up to 3 percentage points from the 6.9 percent of GDP invested 2009 (table 6).

What are the odds that SAR can put together enough funds to meet these investment targets? An inspection of past infrastructure investment trends suggests this will be difficult to do.[17] Certainly, the 2009 level of 6.9 percent is much higher than the 1973 level of 4.7 percent, although there were many fluctuations around this trend from 1973 to 2011. The main driver of these fluctuations, especially in the 1980s, was electricity generation—which accounts for more than a third (37 percent) of the total portfolio during this period. In contrast, investment in transport (31 percent), irrigation (15 percent), and water supply and sanitation (7 percent) were much more stable, although telecom (11 percent) has been on a steady rise.

As expected, these overall patterns have been largely driven by India, which contributes the biggest share of total infrastructure investment in South Asia during the 1973–2009 period. In fact, infrastructure investment in India makes up on average 79 percent of total investment in the region. The second largest contributor—Pakistan—has an average share of only 12 percent, and is followed by Bangladesh with 7.9 percent, Nepal with 1.0 percent, and Bhutan with 0.2 percent.

[16] See Andres et al. (2013) for the description on the methodology for computing these estimates.
[17] While the main source of the data for these investments are multi-year development plans prepared by the National Planning Commissions, annual reports from ministries, state banks, and other related government agencies have also been used in order to form as much as a complete picture as possible. The data used is a mixture of estimated and actual expenditure, as not all plans state actual expenditure from the previous plan or fiscal year. Furthermore, these plans do not distinguish between Capital and Operational Expenditures (CAPEX and OPEX). For public sector investment, South Asia is defined as: Bangladesh, Bhutan, India, Nepal, and Pakistan. Afghanistan, the Maldives, and Sri Lanka are not included in this definition due to data limitations.

TABLE 6: CLOSING SAR'S INFRASTRUCTURE GAP WILL REQUIRE INVESTING A HIGHER SHARE OF GDP

Investment Requirements 2011–2020 (% of GDP, per year)

	Bangladesh		India		Nepal		Pakistan		Sri Lanka		SAR (5)[a]	
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Transport	3.60	4.50	1.97	3.44	2.32	3.49	0.98	1.23	2.17	3.64	1.97	3.31
Electricity	1.10	1.65	2.17	2.71	3.34	4.46	3.66	5.49	0.97	1.82	2.22	2.89
WSS[b]	1.20	1.80	0.55	0.94	1.08	1.62	0.53	0.80	0.12	0.37	0.57	0.96
Solid Waste	0.21	0.42	0.19	0.38	0.24	0.30	0.19	0.38	0.04	0.27	0.19	0.38
Telecom	0.50	0.50	0.87	1.30	0.27	0.40	0.71	0.71	0.40	0.50	0.82	1.19
Irrigation	0.77	1.15	0.81	1.21	0.99	1.48	0.55	0.83	0.50	0.63	0.78	1.17
Total	7.38	10.02	6.55	9.98	8.24	11.75	6.63	9.44	4.21	7.23	6.55	9.89

Source: Andres et al. (2013).

Note: These percentages are based on the investment requirements at 2010 prices. They are based on the technical models as well as extrapolations for the other sectors where the models were not run.

[a] SAR (5): Bangladesh, India, Nepal, Pakistan, and Sri Lanka. [b] WSS: Water Supply and Sanitation.

These differences in the shares of total infrastructure investments in the region are roughly in line with the relative size of each economy. The average infrastructure investment as a percentage of GDP for the period 1973–2009 hovers around 6 percent for India, Pakistan, and Bangladesh, and 5 percent for Nepal. Bhutan, with infrastructure investments representing 14.6 percent of its GDP, has given significantly higher importance to infrastructure development.

Given that a significant share of the infrastructure investment in the years ahead will have to come from the private sector, it is interesting to note that some sectors—such as energy and telecom—have drawn a lot more private investor interest than others (table 7).[18, 19] On a country level, while India has the largest presence by far, with 85 percent of regional private investment commitments, it follows Bhutan and Maldives, in terms of proportion of investment commitments with respect to GDP.

Of these investments, as Figure 6 shows, some sectors attract full privatization more than others. In transport, the private sector tends to partner with the public sector through Public-Private Partnerships (PPPs); while in telecoms, it tends to invest by itself (regulated privatization). When it comes to energy, the private sector chooses to invest mainly by itself, but also through partnerships with the public sector. Many of the PPPs in the power sector in South Asia happen in generation (60),[20] mainly through build-operate-transfer arrangements. This is despite the fact that PPPs are the optimal organizational structure in transmission, not in generation or distribution.

Even so, public provision is still the norm in South Asia. According to the World Bank Private Participation in Infrastructure Database,[21] there are fewer than 1,000 active projects in the energy, telecom, transport, and water and sanitation sectors under PPPs or fully owned by the private sector.[22] This number is low when compared with the

[18] The core source for private sector investment is the World Bank Private Participation in Infrastructure Database (for a detailed explanation on the PPI methodology, refer to: http://ppi.worldbank.org/resources/ppi_methodology.aspx). In this section, Private Participation in Infrastructure (PPI) investment consists of all eight countries in the region—Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka.

[19] Irrigation is not included in the definition of infrastructure for this section. This is primarily because there is not enough data available but also because irrigation is primarily a public sector domain.

[20] As of August 2013, there are 69 active projects in the power sector under lease contract, concession, or Build, Operate, Transfer (BOT), according to the World Bank Private Participation in Infrastructure Database

[21] http://ppi.worldbank.org

[22] The database considers 7 possible statuses for a project (i.e., cancelled, concluded, construction, distressed, merged, operational, under development). We consider a project is active, if it is not cancelled or concluded.

TABLE 7: PRIVATE INVESTORS FAVOR ENERGY AND TELECOM
(Total Private Sector Investment Commitments in Current US$ Mil (1990–2012)

	Water Supply and Sanitation	Transport	Energy[a]	Telecom	Total	% of total PPI[b]	% of GDP (2007–2012)
Afghanistan	0	0	2	1,683	1,685	0.47	0.01
Bangladesh	0	0	3,285	6,855	10,140	2.83	1.14
Bhutan	0	0	201	18	219	0.06	2.65
India	470	81,098	135,703	89,054	306,325	85.49	2.57
Maldives	0	478	0	84	562	0.16	4.09
Nepal	0	0	997	135	1,132	0.32	0.66
Pakistan	0	2,555	13,416	17,090	33,061	9.23	1.59
Sri Lanka	0	740	1,438	3,003	5,181	1.45	1.04
SAR	470	84,871	155,042	117,922	358,305	100	2.34

Source: World Bank Private Participation in Infrastructure Database.
Note: % of GDP was computed as a simple average across the specified period. For Afghanistan, % of GDP is from 2001-2011 due to a lack of data.
[a] Energy entails a combination of electricity and natural gas. [b] PPI: Private Participation in Infrastructure.

more than 400 power plants in the region; the extension of the electricity transmission network; the large number of cities where electricity distribution, water, and sanitation networks exist or are needed; the more than 400 seaports and airports; and the extension of the road network.

PRIORITIZING INFRASTRUCTURE INVESTMENT

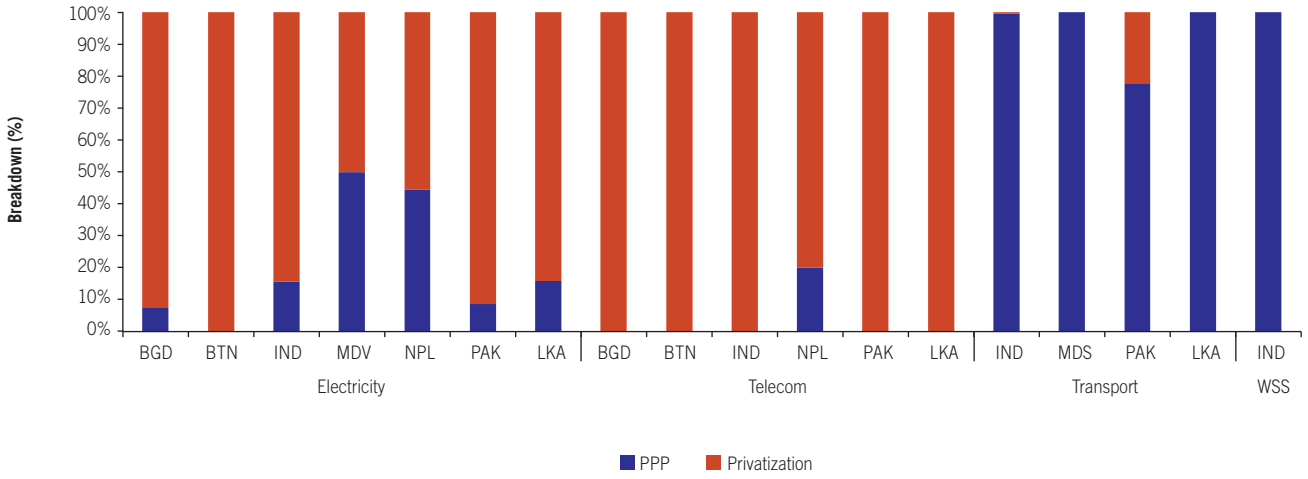
Which investment projects should SAR countries tackle first, or even second, third, and fourth? Not surprisingly, how to prioritize investment projects or portfolios is a common question a government at any jurisdictional level asks. This question is especially critical in developing countries, particularly in South Asia and Sub-Saharan Africa, where demand for investment is huge and financial resources are limited. A few existing studies attempted to address this question,[23] but the methodological framework they developed is narrow and can be applied only to rank infrastructure investment projects.

For that reason, we developed a methodology to help prioritize infrastructure needs in developing countries, particularly in South Asia. It consists of three main steps: (i) Identifying factors that affect infrastructure investment decisions, (ii) Quantifying identified factors, and (iii) Ranking the infrastructure projects. Table 8 presents some stylized rankings, which relate infrastructure services according to input intensity of use, degree of spatial manifestation, typical development outputs, and commonly debated market failures. The infrastructure services listed often fall under the public sector, but in some cases may be a combination of public and private provision. For example, sanitation via off-site systems is typically provided by public utilities, but on-site sanitation such as septic tanks are generally private investments. The list is not meant to be exhaustive and provides ranks from 1 to 3, with 1 being the lowest relative weight, based on the existing literature on infrastructure services and its impacts.

How much financial resources should be allocated to infrastructure development, within infrastructure sectors, and other sectors (such as health, education, public safety, and national defense)? This is another question asked by all developing countries, but unfortunately, there is no rule to determine the investment allocations.[24] It depends on a country's priority, economic growth, and welfare objectives. Considering that infrastructure is both a means to facilitate this economic growth and development, and a measure of the former, one

[23] See, for example Berechman and Paaswell (2005); Karydas and Gifun (2006).
[24] Some existing literature attempted to address this question. Based on information from a previous study (Fay and Yepes, 2003), Estache and Fay (2010) estimate that developing countries might need 6.5% of their GDP, in average, during 2005–2015 period. Of which 2.3% would be needed to maintain the existing infrastructure and 3.2% for new infrastructure projects.

FIGURE 6: ELECTRICITY AND TELECOM FAVOR PRIVATIZATION WHILE TRANSPORT AND WSS[a] FAVOR PPPs



Source: World Bank Private Participation in Infrastructure Database.
Note: PPPs include lease contracts, concessions, and Greenfield projects under Build, Lease, Transfer (BLT) or Build, Operate, Transfer (BOT); while privatization includes Greenfield projects under Build, Own, Operate (BOO), merchant, or rental, and full divestitures. Partial divestitures are not considered due to the lack of information on the role of the private sector on the management of the facility. [a] WSS: Water Supply and Sanitation.

could expect that a higher share of GDP (including funds received from bilateral and multilateral donors) would need to be allocated for infrastructure investment. This is the case, at least, for developing countries, where there is greater scarcity of man-made and human capital related to infrastructure.

That said, there is a false dichotomy between prioritizing large-scale infrastructure versus addressing the needs of the poor. At a very basic level, this dichotomy is false because many large-scale infrastructure investments may concurrently facilitate economic growth and increase the welfare of poorer populations. An example of this is a large transport project that may primarily target facilitating trade of raw materials, but at the same time it may also connect isolated poorer populations to better services.

A more interesting debate is at which stage of development a particular infrastructure investment has a higher impact on economic growth versus welfare. For instance, a power distribution project may have large welfare impacts given that it enables education and health outcomes, which may in turn translate into future economic growth as a more educated, healthier labor force joins the labor market in the medium to long run. Yet, it may also facilitate growth in manufacture today, which in turn may promote short-term economic growth. Given that most power sources are limited, there is a clear policy choice related to power allocation for different usages. Instruments such as tariffs and other incentives play a vital role in allocating this scarce resource. Moreover, policy makers should be cognizant that attempting to apply the same standards across the board regardless of income may translate into no provision to the poor.

Ultimately, both types of investments are needed—those that clearly target economic growth in the short run and those that attempt to reduce poverty in the short run. The right combination as well as the level at which design and implementation take place is highly dependent on country level institutions, the policy makers' objectives, and the economic characteristics of the infrastructures under consideration.

POLICY OPTIONS TO PROVIDE BETTER INFRASTRUCTURE SERVICES

What exactly are the policy options that South Asian policy makers should focus on to improve the level and quality of services provision for their diverse populations?

First, rehabilitate and maintain existing assets. South Asian governments should invest in rehabilitating and maintaining

TABLE 8: RANKING OF PRIORITIZATION OF INFRASTRUCTURE INVESTMENTS ON A SCALE OF 1 (LOWEST) TO 3 (HIGHEST)

			Development Challenges											
			Inputs Intensity[b]				Spatial Manifestation		Outputs		Externalities			
Infrastructure Services[a]			Capital	Labor	Land	Natural Resources	Urban	Rural	Economic Growth	Welfare	Agglomeration	Local Pollution	Climate Change	Green Growth
Power	Grid-connected Generation	Fossil Fuels (Gas, Coal, etc)	2	1	1	3	2	2	2	2	3	3	3	1
		Hydro	3	1	2	3	1	3	2	2	3	1	1	3
		Wind	3	1	2	3	1	3	2	2	3	1	1	3
		Geothermal	2	1	1	3	1	3	2	2	3	1	1	3
		Biofuels	2	1	1	2	1	3	2	2	3	1	1	3
	Off-grid Generation	Diesel	2	2	1	3	2	3	2	2	1	3	3	1
		Small Hydro	2	2	1	3	1	3	2	2	1	1	1	3
		Wind	3	2	1	3	1	3	2	2	1	1	1	3
		Solar	3	2	1	3	2	2	2	2	1	1	1	3
		Biofuels	2	2	1	2	1	3	2	2	1	1	1	3
	Transmission Grid		2	1	2	1	3	1	2	2	3	1	2	2
	Distribution Grid		2	1	1	1	3	1	2	2	3	1	2	2
Water	Piped water into dwelling		2	2	1	3	3	1	1	3	3	1	1	3
	Water well		1	3	1	3	1	2	1	3	1	1	1	2
	Protected spring		1	3	1	3	1	3	1	3	2	1	1	2
Sanitation	Piped sewer system		2	2	1	1	3	1	1	3	3	2	1	2
	Septic tank		1	3	2	1	2	2	1	3	1	3	1	2
Solid Waste	Collection and processing		1	3	2	1	3	1	2	3	1	2	2	2
Transport	Roads	Rural	2	2	2	1	1	3	3	2	3	2	2	2
		Urban	2	2	2	1	3	1	3	2	3	3	3	1
		Highway	2	2	2	1	2	2	3	2	3	2	2	2
	Railways		3	2	2	1	2	2	3	2	3	1	1	2
	Ports		3	1	1	1	3	1	3	1	3	1	1	2
	Airports		3	2	1	1	3	1	3	1	3	3	3	1

Notes: [a] The provision modalities considered for each infrastructure service are the best available technologies (BAT) to provide the specific infrastructure service. The BAT for a specific infrastructure service is the best ranked technology according to a cost-benefit analysis. In the case of power generation, the BAT varies by location; hence the different options; [b] Inputs intensity is based on BAT to provide the specific infrastructure service and the BAT for building the infrastructure needed to provide the infrastructure service.

infrastructure assets to deliver services efficiently and sustainably, moving away from the "build, neglect, and rebuild" mindset. Lack of adequate infrastructure maintenance is quite common across developing countries. In India, the Working Group on Roads for the National Transport Development Policy Committee reports a 40–50 percent shortfall in the maintenance allocation for state highways and major district roads. Under-spending on maintenance of infrastructure has direct and indirect costs. Without regular maintenance, physical infrastructure can rapidly fall into disrepair, requiring expensive reconstruction to bring it back to adequate standards. For example, the cost of full reconstruction of roads that have been poorly maintained is, on average, at least three times the cost of maintenance (World Bank, 2005). Lack of adequate maintenance triggers a progressive deterioration of the quality of the infrastructure services, which hurts users (e.g., higher costs because of imperfect and costly substitutes, worse social outcomes in health and education) and development outcomes. In India, the National Transport Development Policy Committee estimates that poor road maintenance costs the country about Rs 350 billion annually.

While funds for new construction are sometimes easier to obtain and implement, those for maintenance are more difficult as they need to be sustained on a regular basis. Different mechanisms can be implemented in different infrastructure sectors to improve maintenance. In the road sector, some governments have adopted or considered adopting a "road fund" type of arrangement for supporting maintenance. Under such arrangements, maintenance funds are assured from a mandated tax on gasoline and diesel, and are deposited into an assured and independently operated fund. A Board that includes the public sector, or the private sector, or possibly both oversees this fund.

Second, reform service providers and ensure financial/operational sustainability. Service providers should be financially viable, able to plan and implement sound investment strategies, and improve operational performance for the long term. This requires: i) Reliable, steady, and adequate revenue streams to fund operations and investment; ii) Capacity and independence without threat of political interference; and iii) Appropriate incentives for becoming and remaining more efficient.

Third, establish solid legal, policy, and regulatory frameworks. South Asian governments need to have solid legal and policy frameworks; as well as transparent, well designed, and implemented regulatory framework for both public and private operators; in order to attract private investment in line with the best organizational form for each service. For example, governments across the region need to set the conditions for an even bigger role of the private sector in a service such as power generation, which is better suited for liberalization than PPPs. Additionally, they shift the public resources and efforts toward other services where the public sector has the comparative advantage (Box 1). Fortunately, when the private sector investment in infrastructure in SAR, it tends to choose the optimal organizational forms. These frameworks provide clarity to the private sector, increasing the attractiveness of private participation in infrastructure projects. They also allow the public sector to clearly define responsibilities and manage the risks associated with private sector participation. A stable yet dynamic regulatory framework for infrastructure services is particularly critical for: i) Attracting and supporting desired levels of investment, ii) Ensuring service sustainability, iii) protecting customers, and iv) Guarding the public interest.

Fourth, decentralize service provision in an appropriate manner. SAR countries should be rethinking how much to decentralize (i.e., distribute the administrative powers or functions of a central authority over a less concentrated area) as a means of improving service delivery for the smallest units of society (households and individuals). As the World Bank's 2004 World Development Report puts it: "Decentralization can be a powerful tool for moving decision making closer to those affected by it. Doing so can strengthen the links and accountability between policymakers and citizens—local governments are potentially more accountable to local demands. It can also strengthen them between policymakers and providers—local governments are potentially more able to monitor providers. But local governments should not be romanticized. Like national governments they are vulnerable to capture—and this might be easier for local elites on a local scale."

In practice, the experience with trying to decentralize infrastructure service delivery is mixed—the biggest problem often being a mismatch (often financial or fiscal in nature) between responsibilities in infrastructure service delivery and

BOX 1: OPTIMAL ROLES FOR THE PUBLIC AND PRIVATE SECTORS

There is no single service provision approach that is better than the alternatives for all infrastructure services and under all degrees of institutional development. In this report, we examine four possible organizational forms—with varying levels of public and private participation: (i) traditional provision, (ii) PPP, (iii) regulated privatization, and (iv) liberalization (deregulated privatization). Following Engel et al. (2009), we assume that private firms build, operate, and maintain the infrastructure under all of these forms, and hence, the benefits of each form stem from the incentive structure—not the degree of private participation. Depending on the features of each infrastructure service, one of the four organizational forms brings the highest social welfare.

When market liberalization is optimal

Power generation is an example of an infrastructure service that is produced under constant or decreasing returns to scale, and for which user fees can be charged. In cases like this, the optimal organizational form is market liberalization (that is, privatization plus price deregulation). Competition together with private ownership induces firms to select optimal life-cycle cost saving investments and provide the optimal service quality, thereby solving the trade-off between productive efficiency and quality considerations.

When traditional provision is optimal

In the case of flood control, which is a non-excludable service, it is not possible for the government to set service standards that are enforceable. Furthermore, quality considerations dominate productive efficiency, making traditional provision the optimal organizational form. If the costs of quality reduction were not as important as the benefits of reducing life-cycle cost, then a PPP would be preferred over traditional provision. Similarly, if it were not possible to charge fees for the use of a service, but service standards could be designed and enforced, then a PPP would be the optimal organizational form.

When PPPs are optimal

This occurs when the service is produced under increasing returns to scale (i.e., natural monopoly) or there are technical aspects that create barriers to entry (e.g., the scarcity of radio spectrum for wireless communications), conditions that would rule out market liberalization. So in a case like power transmission —which is a natural monopoly, and where expansion requires significant network planning—PPPs would dominate over regulated privatization. PPPs have the advantage of leaving the government with the authority to decide on future expansions. The same applies for most transport services.

When regulated privatization is optimal

This occurs when competition is not feasible (e.g., because of increasing returns to scale or technical and/or legal entry barriers), user fees can be collected, the government can design and enforce service standards, and planning is best done at the firm level. Hence, regulated privatization is optimal for power distribution, and ICT services (fixed and mobile). In the latter case, network externalities are important, creating the need to regulate interconnection charges. Regulated privatization is also optimal for sanitation and water services, particularly at the distribution level in the latter case. An issue of planning and coordination in the use of a natural resource that is beyond the project level arises in water production or catchment, which makes PPPs the optimal organizational form in water production.

the ability to execute such responsibilities. But when decentralization succeeds, it is thanks to: (i) A fully democratic, transparent, and inclusive (of the beneficiaries) local decision process; (ii) The cost of local decisions fully borne by local government; and (iii) No spillover of benefits to other jurisdictions.

POLICY OPTIONS TO HELP THE POOREST GAIN BETTER INFRASTRUCTURE

At the same time as South Asian governments are moving to improve the overall level and quality of infrastructure services, they must take deliberate steps to improve the access of the poor—keeping in mind the following five principles.

Access is fundamental, but usage determines impact. That is why policy makers should complement access to infrastructure with policies to incentivize the use of services, or make potential benefits more obvious or attainable. One way to do this is to focus on subsidizing (implicitly or explicitly and with sunset clauses) the infrastructures that provide the greatest public benefit (public good) in contrast to those that provide large private benefits. This should be true across infrastructure sectors as well as within sectors. Another way is to focus on improving women's access to services, as the improvement in household outcomes can be larger when women

benefit fully from access. Still another way is to focus on enhancing quality and maintenance, which are major issues in South Asia, as there are an average 42 power shortages a month and 21 water shortages a month.

Ability-to-pay for access to infrastructure services cannot be the only instrument to determine provision. Infrastructure services have strong market failure characteristics, underscoring the need for adequate regulation. Some infrastructures are still close to natural monopolies (such as pipe water and off-site sanitation services). Many are associated with strong externalities (negative and positive) and public good (and bad) characteristics, as in the case of a lack of pollution treatment or a lack of access to cooking gas. Information issues also abound. Moreover, since infrastructure may act as a spur to growth, relying on the ability-to-pay criterion might undercut efforts to reduce poverty.

Some infrastructure programs are too costly to be sustainably implemented without cost-recovery mechanisms that allow them to be self-supporting. The trade-off between providing access to infrastructure services and fully charging for these services is seldom an easy one to equate. It involves understanding the economic characteristics of particular infrastructure sectors and the technology available for provision under different physical, political, and socio-economic conditions. Take the case of piped water provision, which is a private good. It has important market failures associated with it, but essentially individual households have clear incentives to pay for a superior service compared to other forms of getting water in an urban environment. Yet, piped water is seldom charged to attain full cost recovery and often relies on direct or indirect subsidies that burden public budgets. Nonetheless, the expansion of piped water provision is often part of political manifestos during election campaigns. Now take the case of flood control, which is a public good. Direct cost recovery mechanisms (like tariffs) are difficult to design, but the lack of adequate flood control in a locality for example can cause substantial costs to households via the loss of private assets and lives. Budgetary allocation for flood control is often inadequate and the service is underprovided.

The likely aim of the policy maker is to attain a certain degree of balance in infrastructure access (especially basic infrastructure), while allowing for wealthier populations to shoulder most of the burden of improving coverage for all. Given the equality achieved in improved water in South Asia, one would be tempted to conclude that this objective is present as the service expands. But this conclusion might conceal rent-seeking behavior, where the wealthier capture proportionally larger amounts of rents that otherwise could be used for expansion and quality improvement for all and not just a few. The literature also argues that infrastructure service expansion is closely linked to rent seeking, since richer districts are better able to lobby the government for infrastructure provision (Cadot et al., 1999).

Although subsidies may improve affordability among underprivileged groups, they can also have the effect of increasing income inequality. Subsidies tend to be captured by those who have political connections, which, at least among unconnected households, tend to be the more middle class households. Wodon and Ajwad (2002) found that in Bolivia and Paraguay, the marginal benefit of improved access to a service tended to be two to three times higher among the upper two quartiles. Thus, while all income quartiles benefited from decentralization, the richer 50 percent benefited more than the poorer 50 percent, a net effect that would tend to increase income inequality. Estache (2005) points out that in Latin America as much as 60 to 80 percent of cross-subsidy schemes "were aimed at households well above the poverty threshold, while as much as 80 percent of poor households failed to benefit." Thus, it is not surprising that even as absolute levels of connection increase, regressivity in access to infrastructure may still prevail.

MENU OF INSTRUMENTS

These principles, in turn, would point to the following menu of instruments:

Subsidies for connection rather than service consumption. To avoid some of the drawbacks of subsidies, policy makers can adopt measures that reduce the cost of providing network services or improve the ability of poor households to pay for service at a given cost (Komives et al., 2005). These would be available only to unconnected households, reducing or eliminating the price customers have to pay to connect to the system. Alternatively, policy makers can

subsidize lower service levels that the better off find less attractive, such as social connections.

Targeted interventions. Usually these instruments are centered narrowly on a certain district or group that is perceived as underserved. This approach has the advantage of fewer spillovers—that is, there is less likelihood that the intervention ends up benefitting those who were not intended to be its beneficiaries. In Mexico, this is now being tried with a program that provides conditional cash transfers for the poorest segments of the population, named Oportunidades ("Opportunities"). Under this program, energy subsidies were channeled using the same targeting mechanisms so these funds are reaching the poorest population in the country. A note of caution here, however, is that because these interventions are operating only within impoverished and underserved areas, they may face issues like inadequate staffing, funding, technical capacity, and lack of political will (Menéndez, 1991).

Institutional groups. There are also a number of options to design programs to reduce elite capturing and increase the power of impoverished groups to allocate resources toward their priorities. These include:

- ***Institutional re-centering***. Organizations can be created whose primary concern is to reduce poverty through providing infrastructure. For instance, Bolivia's Emergency Social Fund was a temporary organization that was created to finance infrastructure projects in underserved communities.
- ***Community participation.*** Incorporating transparent mechanisms for underserved people to easily provide input into the design and decision-making process behind infrastructure projects could pote low them to compete with the more informal mechanisms that richer populations use to influence decision-making (Menéndez, 1991).[25]

Innovative mechanisms. Service delivery mechanisms need to evolve to respond to the challenges of coverage, affordability, use, and sustainability. This is particularly important given that poor households tend to pay more for services when they have to obtain them through non-network solutions. For example, community-based organizations and user groups can contribute to planning and operations; NGOs can help with monitoring and evaluation, promoting social accountability and raising awareness; and the private sector can get involved with investment and delivery (Andres and Naithani, 2013). These alternative mechanisms, which are context-specific, are becoming part of the policy toolkit as they are tested and mainstreamed.

CONCLUSIONS

If South Asia hopes to meet its development goals and not risk slowing down—or even halting—growth, poverty alleviation, and shared prosperity—it is essential to make closing its huge infrastructure gap a priority. Even though SAR's economic growth follows that of EAP, its access to infrastructure rates (sanitation, electricity, telecom, and transport) are closer to that of SSA—the one exception being water, where SAR is comparable to EAP and LAC. According to businesses in South Asia, infrastructure is a major or severe hindrance to their growth, and electricity is the largest problem. Transport is also an obstacle for regional and international trade. The good news is that policy makers do not have to choose between growth and welfare, as there is enormous potential for them to be mutually supportive.

The cost to close this gap by 2020 will be an estimated US$ 1.7 to US$ 2.5 trillion. If investments are spread evenly over these years, SAR needs to invest between 6.6 and 9.9 percent of 2010 GDP per year—an increase of three percentage points over the current 6.9 percent invested by SAR countries in 2009, up from 4.7 percent in 1973. This increase was driven mainly by the region's large investment in electricity generation.

The challenge of increasing access to infrastructure services across South Asia is compounded by the inequality in the distribution of existing access for households and individuals. That is why providing some level of access is a start—even if those services are not of the highest quality. At the same time policy makers should take into account which types of services best fit each population's needs (such as septic tanks for

[25] The way incentives are designed play an important role in mitigating rent seeking. Community Driven Development Projects are particularly concern with elite capture even within poor communities.

a mountainous region but sewerage lines for a more accessible urban area). Our study sheds light on who has access in terms of space (a current framework) and in terms of time (future generations). Countries with higher per capita income (like the Maldives and Sri Lanka) enjoy better access to infrastructure services both spatially (geographically within the country) and income. This is despite the fact that conflict areas are clearly worse off. Among sectors in SAR countries, some, such as water, tend to be more equally distributed than others (such as sanitation, energy, and phones). One surprising discovery is the widespread use of firewood for cooking, especially among the poor. Moreover, within SAR countries, some states and districts have better access than others. In addition, leading regions within a country typically have better access but lagging regions do not necessarily have worse access. However, if a poorer country or a poorer state can have better access to a given infrastructure service than in a richer country or a richer state, then there is hope that policy makers can adopt measures that will improve access in a manner that increases shared prosperity.

There is no simple explanation for these inequalities, although certainly geography matters, policy intent matters, and some household characteristics matter. At the country level, household characteristics like location and education are the main explanatory factors. Location seems obvious, but education does not—unless it is linked to income poverty and remoteness of household location (even among rural areas). At the state level, education actually starts to become a bigger factor than at the country level. While the contribution of gender of the head of the household seems negligible at the country level, there are a number of states (and districts within them) where access is clearly biased towards male-lead households.

Given the size of the gap and limited fiscal and financial resources, it is essential for SAR to prioritize infrastructure investments. We propose a generic methodological framework for doing just that, building on the existing literature. It is not desirable to have a single methodology, providing a single ranking of infrastructure investments, because of the complexities of infrastructure investments. Rather, a multidisciplinary approach should be taken. Decision makers will also need to account for factors that are often not easily measured. While having techniques that enable logical frameworks in the decision making process of establishing priorities is highly desirable, they are no substitute for consensus building and political negotiations.

SAR also needs to rethink the infrastructure service paradigm to bring in the private sector and decentralize administrative powers functions. The sheer size of the gap and the macroeconomic situation in South Asia dictate that the region taps other funding sources. However, this situation should also be seen as an opportunity to rethink and improve how infrastructure services are delivered. One way to do this is by broadening service provision to give the private sector a bigger role—whether through PPPs or regulated privatization and market liberalization. Another way is by giving greater administrative powers and functions to lower levels of governments, although the degree to which such decentralization is desirable will depend on the nature of the investment, the reason it is being provided, how it is being financed, and where it is located.

Policy choices should be aimed at increased shared prosperity. Key principles to keep in mind are: (i) Access is fundamental but usage determines impact; (ii) Ability-to-pay for access cannot be the only instrument to determine provision; (iii) Some infrastructure programs are too costly to be sustainably implemented without cost-recovery mechanisms that allow them to be self-supporting; (iv) Market failures need to be corrected to avoid rent-seeking behavior; and (v) Subsidies should be designed in a way that they do not exacerbate income inequality. The menu of possible instruments includes subsidizing connections (rather than service consumption), adopting targeted interventions, creating organizations dedicated to reducing poverty through providing infrastructure, and asking NGOs to help with monitoring and evaluation, promoting social accountability, and raising awareness.

If shared prosperity is one of the ultimate goals of policy makers, it is important to get accurate infrastructure data. The existing data allowed us to create a baseline for tracking progress in closing the infrastructure gap and to answer some questions about who has access to infrastructure services now and how that is likely to affect future generations—and thus the equality of opportunities across the region. This work can be expanded and improved by considering more

circumstances, along with exploring alternative indicators of access, use, and quality of infrastructure services. However, in order to do that, better data is needed. Without it, private and public investments may miss their targets of leveling the playing field and end up increasing inequality of infrastructure service provision.

REFERENCES

Ajwad, M. I., and Q. Wodon. 2002. "Who Benefits from Increased Access to Public Services at the Local Level? A Marginal Benefit Incidence Analysis for Education and Basic Infrastructure." In *Washington DC: World Bank Economists' Forum* (Vol. 2, pp. 155–175).

Andres, L. and S. Naithani. 2013 "Mechanisms and Approaches in Basic Service Delivery for Access and Affordability." Washington DC: World Bank.

Andres, L., D. Biller, and M. Herrera-Dappe. 2013. "Infrastructure Gap in South Asia: Infrastructure Needs, Prioritization, and Financing." Washington DC : World Bank.

Bangladesh Bureau of Statistics and UNICEF. 2007. *Multiple Indicator Cluster Survey (MICS) 2006.* Dhaka, Bangladesh: Ministry of Planning and UNICEF.

Berechman, J. and R. E. Paaswell. 2005. "Evaluation, prioritization and selection of transportation investment projects in New York City," *Transportation,* Vol. 32, pp. 223–249

Biller, D., L. Andres, and M. Herrera Dappe. 2013. "Inequality of Access to Infrastructure Services in South Asia ." Washington DC: World Bank.

Cadot, O., L. H. Röller, and A. Stephan. 1999. "A political economy model of infrastructure allocation: an empirical assessment," (No. FS IV 99–15). Discussion papers//WZB, Wissenschaftszentrum Berlin für Sozialforschung, Forschungsschwerpunkt Marktprozeß und Unternehmensentwicklung.

Debroy,B. and L. Bhandari. 2003. "District-level Deprivation in the New Millennium." Rajiv Ghandi Institute for Contemporary Studies and Indicus Analytics.

Debroy, Bibek. District-level deprivation in the new millennium. Delhi: Konark Publishers, 2003.

Department of Census and Statistics. 2009–10. "Household Income Expenditure Survey (HIES)." Ministry of Finance and Planning, Colombo.

Engel, E., R. Fischer, and A. Galetovic. 2009. "Public-Private Partnerships: When and How." Centro de Economía Aplicada, Universidad de Chile, HYPERLINK "http://ideas.repec.org/s/edj/ceauch.html" Documentos de Trabajo 257.

Estache, A. 2005. "On Latin America's Infrastructure Experience: Policy Gaps and the Poor." ", in J. Nellis and N. Birdsall (2005), *Reality Check: The Distributional Impact of Privatization in Developing Countries,* Center for Global Development. 281–296.

Estache, A. and M. Fay. 2010. "Current Debates on Infrastructure Policy." Globalization and Growth: Implications for a Post-Crisis World. M. Spence and D. Leipziger Eds. World Bank, Washington, DC.

Fay, M. and T. Yepes. 2003. "Investing in Infrastructure: What is needed from 2000–2010". Policy Research Working Paper 3102, World Bank, Washington, DC.

Institute for Population Sciences. 2007–08. "District Level Household Survey (DLHS-3)." Ministry of Health and Family and Welfare, Delhi.

Karydas, D.M. and J.F. Gifun. 2006. "A method for the efficient prioritization of infrastructure renewal projects," *Reliability Engineering & System Safety,* Vol. 91, No. 1, pp. 84–99.

Kojima, M. 2011. "The Role of Liquefied Petroleum Gas in Reducing Energy Poverty." *Extractive Industries for Development Series* No. 25, World Bank, Washington, D.C.

Kojima, M., R. Bacon, and X. Zhou. 2011. "Who Uses Bottled Gas? Evidence from Households in Developing Countries," *Policy Research Working Paper* No. 5731, World Bank, Washington, DC.

Komives, K., J. Halpern, V., Foster, Q. Wodon, and R. Abdullah. 2005. "Water, Electricity, and the Poor: Who Benefits from Utility Subsidies?, World Bank, Directions in Development, Washington, DC.

National Institute of Population Studies (NIPS) [Pakistan], and Macro International Inc. 2008. *Pakistan Demographic and Health Survey (DHS) 2006–07.* Islamabad, Pakistan: National Institute of Population Studies and Macro International Inc.

National Statistics Bureau. 2011. "Bhutan Living Standards Survey (BLSS) 2007." Royal Government of Bhutan, Thimpu, Bhutan.

Menendez, A. 1991. *Access to basic infrastructure by the urban poor* (No. 28). World Bank Publications.

Ministry of Health and Family (MOHF) [Maldives] and ICF Macro. 2010. *Maldives Demographic and Health Survey (DHS) 2009.* Calverton, Maryland: MOHF and ICF Macro.

Ministry of Health and Population (MOHP) [Nepal], New ERA, and ICF International Inc. 2012. *Nepal Demographic and Health Survey (DHS) 2011.* Kathmandu, Nepal: Ministry of Health and Population, New ERA, and ICF International, Calverton, Maryland.

Organization for Economic Co-operation and Development (OECD)/ International Energy Agency (IEA). 2010. "World Energy Outlook 2010." Paris: France.

Paes de Barros, R., F. H. Ferreira, J. R. Molinas Vega, and J. Saavedra Chanduvi. 2009. "Measuring Inequality of Opportunities in Latin America and the Caribbean." Washington DC: Palgrave MacMillan and The World Bank

Vulnerability Analysis Unit. 2007–08. "National Risk Vulnerability Assessment (NRVA)." Ministry of Rehabilitation and Rural Development and Central Statistics Organization, Government of Afghanistan, Kabul.

World Bank. 2004. "World Development Report 2004: Making Services Work for Poor People." Washington: World Bank.

World Bank Public-Private Infrastructure Advisory Facility (PPIAF). 2013. "Public-Private Infrastructure Advisory Facility Database." World Bank, Washington DC. http://ppi.worldbank.org/index.aspx

World Bank. 2005. "Why Road Maintenance Is Important and How to Get it Done." Transport Note No. 4.

World Bank. 2013. "*World Development Indicators."* http://data.worldbank.org/country

World Health Organization (WHO)/United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) for Water and Sanitation. 2013. http://www.wssinfo.org/documents-links/documents/?tx_displaycontroller[type]=country_files

THE WORLD BANK

Australian Aid