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Summary

1. The recently issued new Framework for Economic Growth (FEG) underplays the need for continued investment in infrastructure for Pakistan. Waste, equivocal incentives and poor management in public infrastructure are indicated as reasons for prioritizing efficiency improvements, rather than 'hardware' investments, at the forefront of an overall growth strategy for Pakistan. This paper rather argues for a balanced approach, combining hardware with software investments for three reasons. First, the FEG itself acknowledges its findings are partial and rather calls for an urgent assessment of the infrastructure gaps of the country. Second, the diagnosis enclosed contributes precisely to a more comprehensive assessment and finds significant gaps in multiple sectors. Third, and more substantially, whereas it is clear that 'software' investments are needed to make public investment more efficient, they are no substitute to the pressing need for increasing one of the markedly lowest investment rates in infrastructure worldwide.

2. Public infrastructure in Pakistan has improved in the last 50 years but at a slow rate. Other similar countries—such as Malaysia, Sri Lanka and Egypt—have made substantially stronger progress. Regarding the transport sector, Pakistan has a comparatively low density of paved roads, a dismal quality of railroads and airports and only an acceptable quality of seaports with respect to selected comparator countries. Likewise, in the power sector, Pakistan has among the lowest electricity generating capacity and the highest power losses relative to the comparator group. Even worse, institutional shortcomings prevent electricity generation from reaching its capacity, resulting in systematic power outages and load shedding. Regarding the water sector, the access to potable water and sanitation in Pakistan is well below the typical comparator country, and only on irrigation infrastructure Pakistan performs well among the comparator group. The telecommunication sector shows better results for Pakistan. The fixed telephone density is relatively low; however, this is compensated by an active mobile telephone industry. Internet penetration and mobile phone density have increased quite significantly in the last decade.

3. Given that both trend and expected economic growth in Pakistan is lower than most if not all comparator countries, it is estimated that the changes in infrastructure for the coming years will be relatively low in Pakistan, much weaker than those in India, for instance. This does not mean, however, that more and better public infrastructure is not needed to improve social welfare or that it would not produce larger economic growth. In fact, it is estimated that if Pakistan were to improve its electricity, transport and telecommunications sectors to the corresponding levels of Malaysia, its GDP per capita growth rate would increase incrementally by 3.7%, with varying contributions from each sector (1.9% electricity, 0.6% transport and 1.2% telecommunications).

4. One important policy decision regarding infrastructure is the amount of public investment allocated to each sector. This has been declining in the last 15 years in Pakistan, reflecting undoubtedly the fiscal constraints facing the country. The decline is evident for all sectors but is particularly severe for electricity and transport. The current rates of public investment in infrastructure are unsustainably low, and it is recommended that they be increased to at least 2% of GDP, so as to recover the average rate in the previous decade. Whereas in other comparator countries the decline in public investment has been accompanied by an increasing participation of the private sector—private sector investment

in infrastructure in Pakistan has been rather timid, with the notable exception of telecommunications. An increase in private sector's role in both administration and funding is essential to improving quality in every sector, especially in electricity, ports and railroads. Thus, a target private investment rate of 2.5% of GDP for infrastructure is recommended, which amounts to the average for the country in the 2000s and the level to which successful large developing countries are converging. Overall, total investment in infrastructure should increase to about 4.5% in the next 3-5 years if Pakistan is seriously committed to reach sustained high rates of growth, the ones the country needs to generate employment and reduce poverty.

5. In order to attain such goal, an increased role of the private sector in the 'software' and financing of infrastructure investments will be critical. In this regard, the lessons from the contrast between the evolution of electricity and telecommunication sectors in the last decade are revealing. Whereas the electricity sector is an odd combination of public and private sector intervention, with equivocal incentives and burdensome regulations, the telecommunications sector is driven by the private sector, with streamlined regulations and strong competition. Notwithstanding the technological and economic differences across public infrastructure sectors, the successful experience of telecommunications in Pakistan represents an example to follow for all infrastructure provision.

Introduction

6. Public infrastructure in Pakistan has made some progress over the last five decades. However, compared to other similar countries, the rate of improvement in Pakistan has been among the slowest for the majority of public infrastructure sectors. This has matched the relatively weak economic growth performance of the country in recent decades, which has remained at or below the median country in the world. Moreover the infrastructure improvement has been insufficient to ameliorate substantially the infrastructure conditions of Pakistani citizens.

7. This paper analyzes the public infrastructure trends and gaps in Pakistan, especially by placing the Pakistani experience in an international context. It examines the major sectors of public infrastructure, including (a) transportation, (b) telecommunication, (c) electricity generation and (d) water, sanitation and irrigation.

8. First, using a wide array of indicators, the paper assesses how public infrastructure in Pakistan currently compares with infrastructure in several selected countries. These are chosen for their similarity to Pakistan in terms of geographic location, size or economic development. Second, the paper reviews the historical trends in key infrastructure indicators for each sector in Pakistan and the comparator countries, with the objective of understanding how current conditions evolved over time.

9. Third, using a cross-country and time-series econometric model, the paper projects the likely changes in selected infrastructure indicators for the next five years. The projected infrastructure changes are assumed to be those consistent with recent and future economic growth in Pakistan. Fourth, the paper assesses the infrastructure investment patterns in Pakistan, comparing them to the extent possible with those in selected countries and emphasizing the evolving role of public and private sectors. And fifth, the paper presents a summary of the main issues, concerns and key policies for a selection of public infrastructure sectors in Pakistan.

10. Before proceeding, the connection between the modeling sections of this paper and the policy recommendations that ensue needs to be clarified. They are complementary and not inconsistent with each other. The modeling attempts to measure the infrastructure need that is consistent with recent economic growth. Given Pakistan's limited fiscal space, this is a conservative and in a sense minimalist approach to estimating infrastructure gaps. It does not imply that further improvements are not possible or desirable. In fact, there is considerable evidence that suggests that large economic growth gains can be obtained if certain infrastructure investments are undertaken. This evidence is reviewed and applied to the case of Pakistan in the end. The policy recommendations are directed at improving the efficiency, productivity and volume of infrastructure provision in the country. These recommendations could generate infrastructure improvements well beyond what is expected if trends continue as in the recent past and much better than those of comparator countries. This is the case even for sectors that have fared relatively well in historical and international comparisons.

Benchmarking Infrastructure in Pakistan

11. This section studies the current conditions of infrastructure in Pakistan in contrast to other countries. In particular, it draws attention to nine developing countries as comparators, following three criteria: (a) large emerging economies in the South Asian region to which Pakistan is geographically close (Bangladesh, India and Sri Lanka); (b) large emerging economies in other regions (Egypt, Turkey and Brazil); and (c) large East Asian countries with successful economic performance (Thailand, Malaysia, and Indonesia). Thailand also serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010. For this analysis, various infrastructure indicators of quantity and quality of services are selected from the following sectors: transport, telecommunication, electricity and water, sanitation and irrigation. Each measure is averaged for the available years over the period 2006 through 2010.

12. The first category of infrastructure examined is transportation. To measure its development in quantity, we use total road length (in km) obtained from the International Road Federation (IRF). The data are normalized by the country's population and area.[1] From the same source, we also gather data on paved roads and create two measures. One is normalized in the same method as total road length, and the other is measured by the ratio of paved roads to total roads. Two other indices are compiled from the Global Competitiveness Report (GCR), rating the quality of port facilities and air transport. The indices range from 1 to 7 with higher values representing better quality. Figure 1A suggests that Pakistan's performance compares unfavorably with other countries in all transport indicators except for quality of ports. In terms of total road length, Pakistan is the lowest among the nine countries. The density of paved roads is also relatively low, falling behind the rest of the comparator countries except for Bangladesh and Brazil. The ratio of paved to total roads appears to be comparable to the average of the reference group, amounting to 65%, but this is due to the fact that the total road density is fairly low in Pakistan. The quality of ports is around the average level, providing a better quality than other comparator countries such as Indonesia and Brazil, while the quality of air transportation is poorer than the majority.

13. For the telecommunication sector, the indicators include the numbers of main phone lines, cellular mobile telephone subscribers, and internet users (per 1,000 population). The first two are obtained from the International Telecommunications Union (ITU), and the last is from the World Development Indicators (WDI) by the World Bank. Figure 1B shows that telecommunication service in Pakistan is yet to be developed, especially compared to the countries in other regions. The provision of main phone lines is substantially low, 26 per 1,000 workers, which is only one-tenth of Turkey's achievement and one-fifth of Egypt's. Cell phone and internet services in Pakistan are not as developed as the comparators in other regions, but exceed the neighboring countries of Bangladesh and India.

14. The third sector considered is electricity. Electricity generating capacity (in megawatts (MW), per 1,000 population) is compiled from the United States Energy Information Administration (EIA) as a proxy for the quantity of electricity. The quality of this sector is measured by two indicators, power loss as a percentage of total output taken from the WDI, and access to electricity in percentage of total population obtained from the

[1] Specifically, we divide road length (in km) by the square root of the country's population (per 1,000) multiplied by its area of arable land (in hectares).

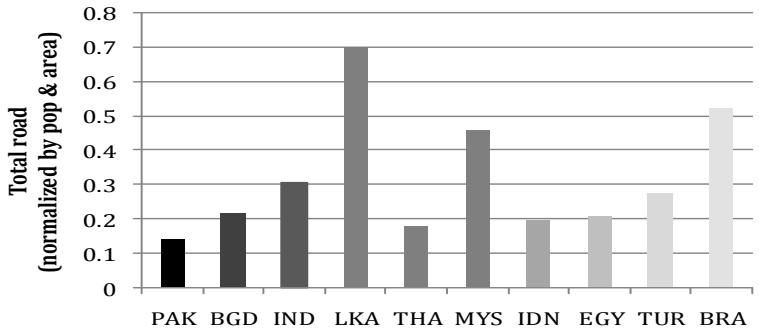
World Energy Outlook (WEO). It is observed that the quantity level of electricity infrastructure in Pakistan is substantially lower than the rest of the countries excluding Bangladesh, as illustrated by Figure 1C for electricity generating capacity. Moreover, Pakistan seems to struggle with frequent power losses of 20% in ratio to total output, which follows India with the highest ratio of power losses. Furthermore, access to electricity in Pakistan, 62%, is the second lowest among the group of comparator countries.

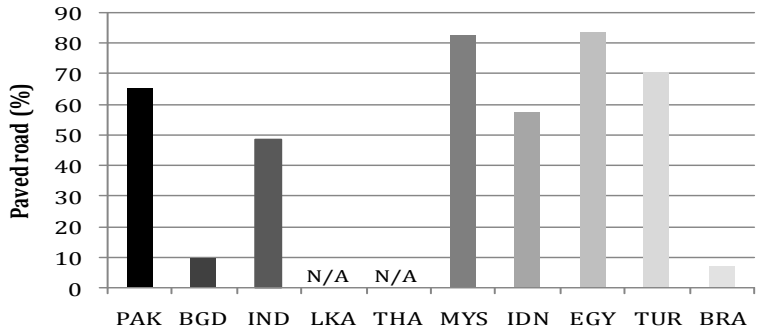
15. Lastly, water and sanitation sectors measured by percentages of population with access to improved water and sanitation facilities, respectively, are analyzed. Both data are drawn from the WDI. In addition, we use an indicator that measures irrigation infrastructure, that is, the percentage of irrigation potential equipped for irrigation provided by the Food and Agriculture Organization (FAO). Figure 1D shows that Pakistan has been among the least successful countries in providing access to improved water source and sanitation facilities. Only 45% of population in Pakistan has access to improved sanitation, whereas more than 80% of the population in many other countries including Sri Lanka, Thailand, Malaysia, Egypt, Turkey and Brazil do. By contrast, irrigation in Pakistan is well developed as 94% of its potential is equipped for irrigation.

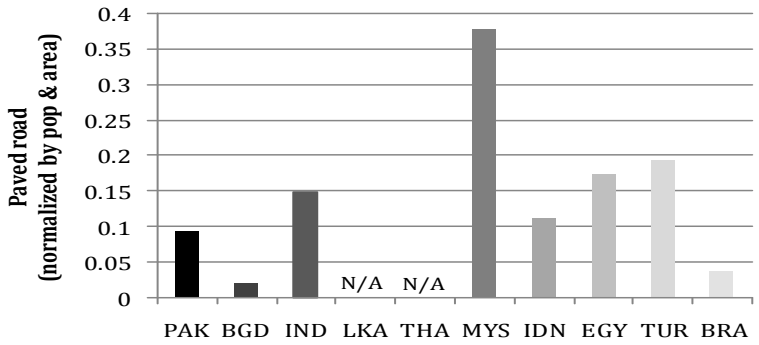
16. In sum, the descriptions presented above suggest that Pakistan has significant gaps to fill in so as to develop its infrastructure to match otherwise similar countries. The figures show that Pakistan's recent situation pertaining to irrigation development is the only one to stand out among the group of comparator. However, the current levels of other indicators in transport, telecommunication, electricity and water sectors in Pakistan are close to lowest or lower than majority of comparators.[2]

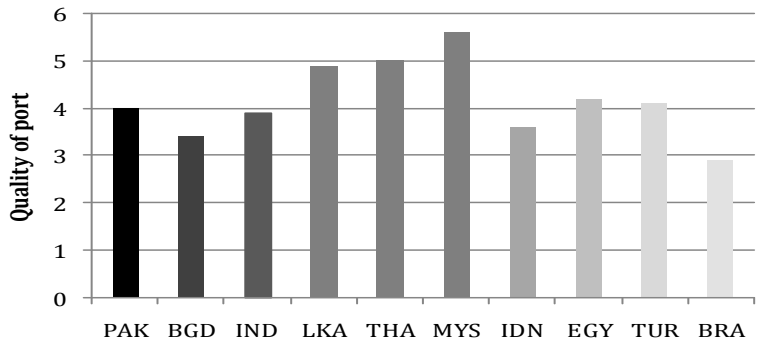
[2] For additional analysis of infrastructure in Pakistan, please refer to "Addressing Regulatory Software Barriers to Business Growth" by Kularatne and Lopez-Caliz (2012).

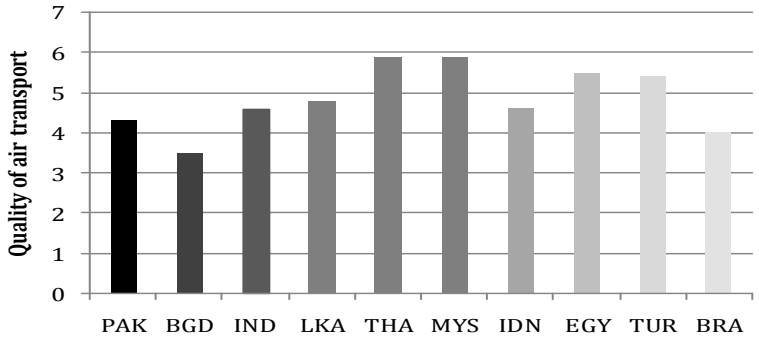
Figure 1A **Infrastructure Indicators (2006-10): Transport***





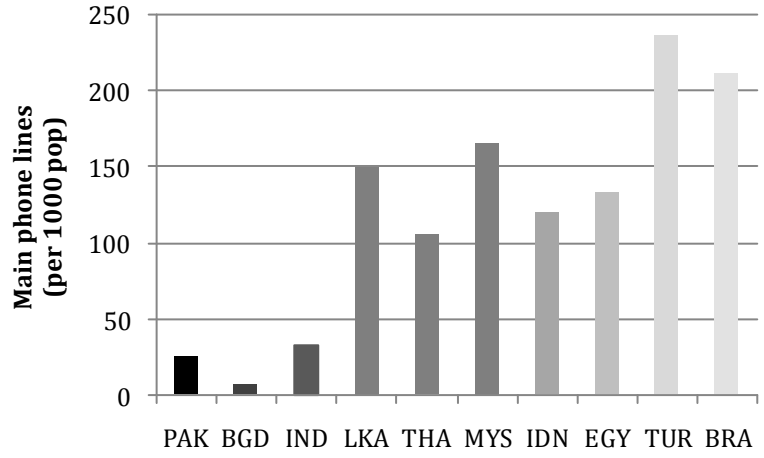


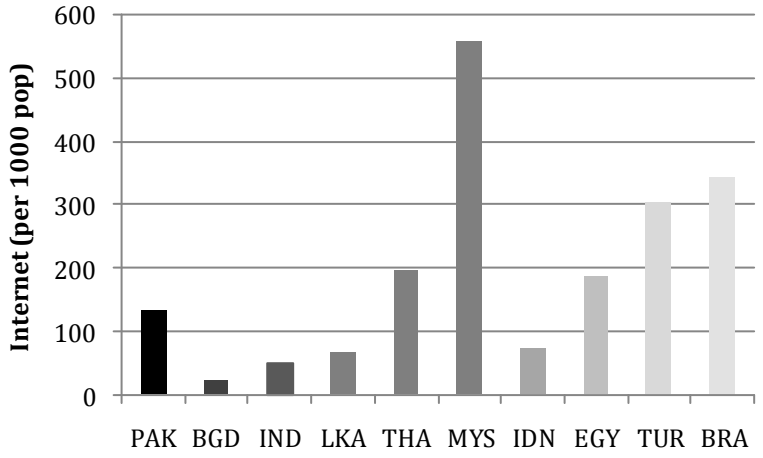


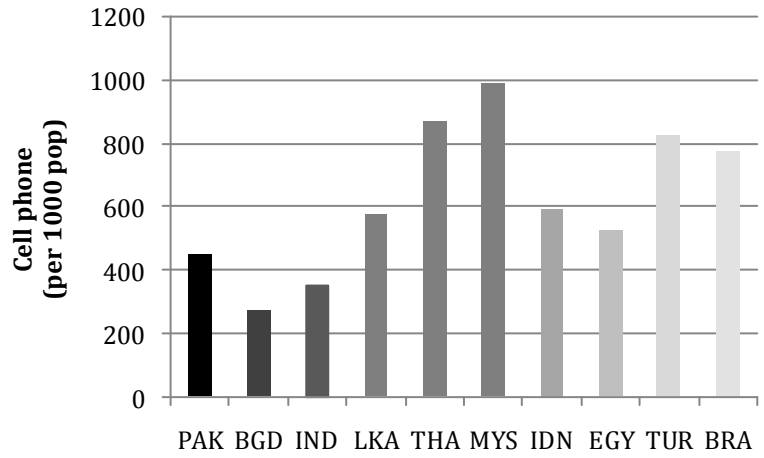


** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010*

Figure 1B **Infrastructure Indicators (2006-10): Telecommunications***

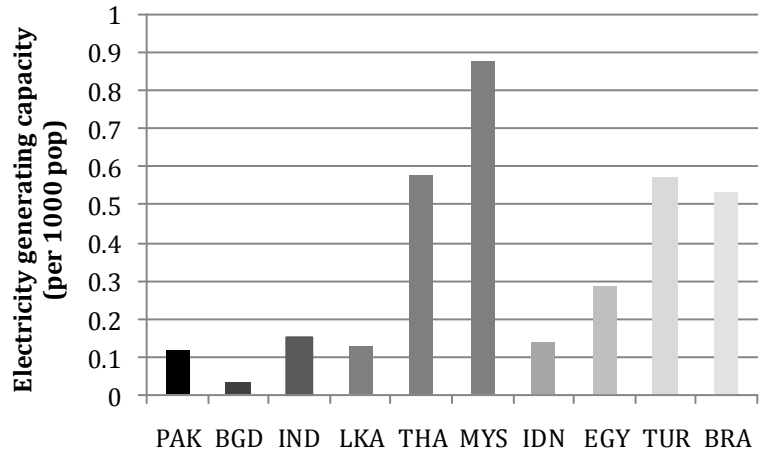


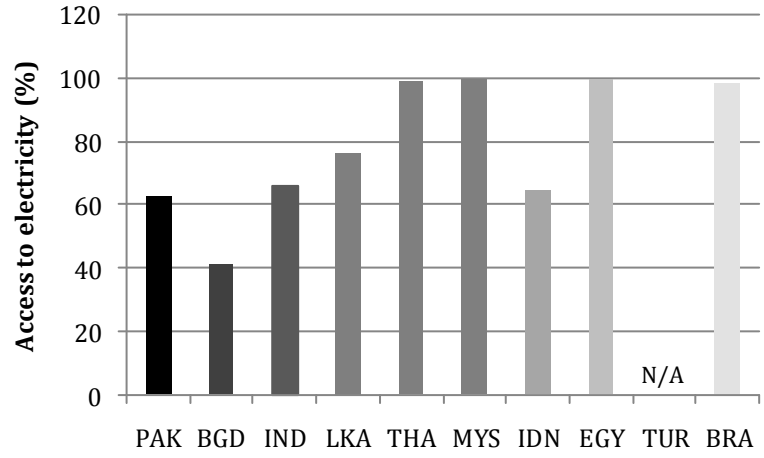


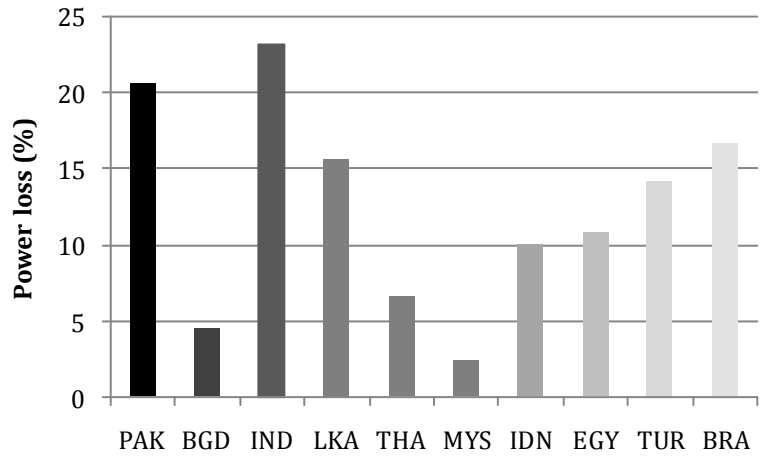


** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010*

Figure 1C **Infrastructure Indicators (2006-10): Electricity***

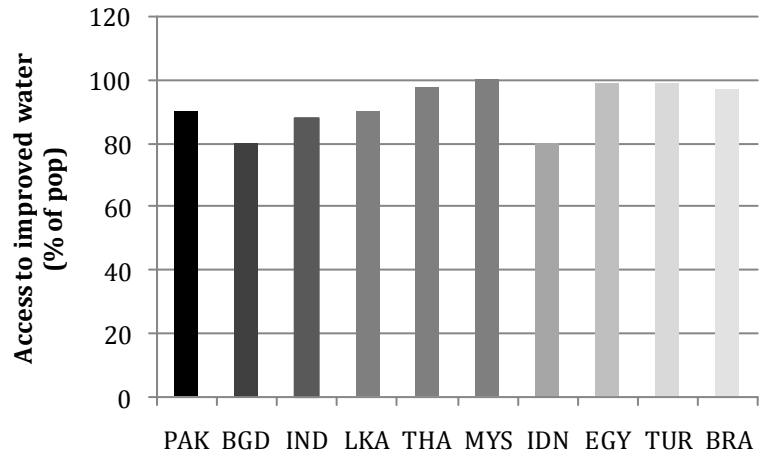


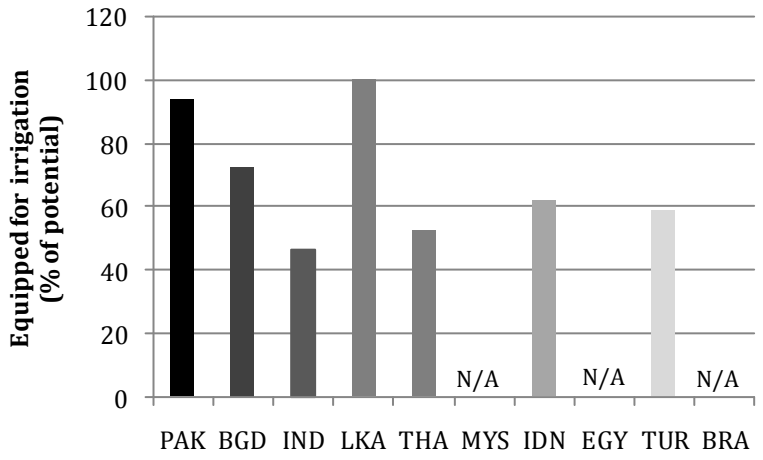


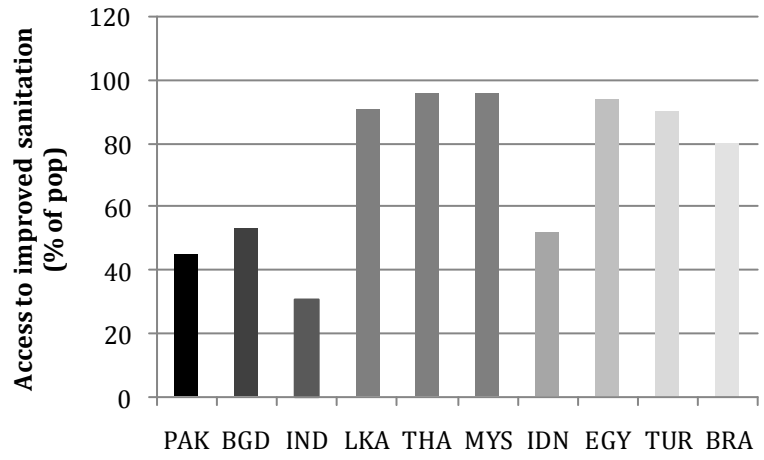


** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010*

Figure 1D **Infrastructure Indicators (2006-10): Water, Sanitation & Irrigation***







** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010*

Historical Trends in Infrastructure Indicators

17. Following the assessment of the current situation, this section presents a brief review of the historical development of infrastructure in Pakistan in comparison with selected benchmark countries, including India, Malaysia, Egypt and Brazil. The indicators shown in Figures 2A-D are chosen based on the criterion that data are available since at least the 1990s. For the transport sector, we observe in general that these countries have been on an upward trend over time. Paying attention to individual countries, however, we find that Pakistan has consistently underperformed in terms of length of total roads and paved roads compared to other countries. The level of total road length in the country remained lowest among the group over the past three decades. In addition, although the ratio of paved roads in Pakistan increased from 54% to 65% in the 1980s, the country went through a stagnant period between the late 1980s and late 1990s. It is only in the recent decade that Pakistan begun restoring its provision of paved roads.

18. Likewise, the telecommunication sector has been on a steady rise across countries on the whole. However, Pakistan's telecommunication sector has developed at a slower pace than other countries except for India. For example, while roughly 215 per 1,000 population in Brazil possessed main phone lines in 2010, only 20 per 1,000 population did so in Pakistan in the same year, which is equivalent to the figure that Brazil had in 1970s. The number of internet users in Pakistan has expanded since early 2000s, but it has spread not as quickly as Malaysia, Brazil and Egypt. By contrast, although cell phone subscribers started to rise in Pakistan one decade later than in Malaysia and Brazil, its rapid growth in the last 10 years is quite remarkable. Pakistan had the least number of cell phone subscribers, 5 per 1,000 population in 2001, but it increased sharply to 572 per 1000 population in 2010.

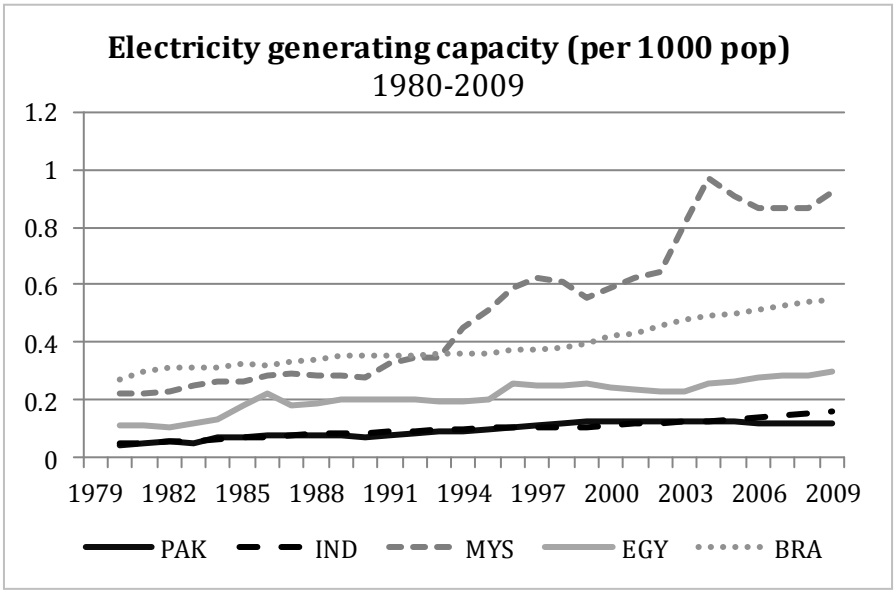
19. In the electricity sector, the electricity generating capacity has risen continuously over last three decades in majority of countries. Malaysia's capacity increased prominently since early 1990s in contrast to other comparators. Pakistan and India have been on a similar path and not made as much progress as rest of the countries. In terms of power loss, many countries stagnated in improving the situation from 1970s to 1990s and some countries such as India and Brazil have experienced even a slight rise in power loss. Pakistan reduced the power loss in the 1980s but again increased in the 1990s, reaching its peak of 30% in 1998. Over the last decade, the situations seem to have been ameliorated in all countries with a slow declining trend.

20. The indicators for water, sanitation and irrigation show a steady improvement over the last few decades for all countries. In Pakistan, access to improved water increased slowly over the period 1990 through 2008. India, which had a large gap with the comparators in 1990, noticeably grew its access to water and almost caught up with Pakistan in 2008. The lack of data for some periods makes it difficult to have a comprehensive picture for irrigation, but the available data indicate that Pakistan has historically performed well in utilizing irrigation infrastructure.

21. Overall, the infrastructure indicators display an upward trend over time across countries. Some countries advanced rapidly, while others experienced a stagnant phase during the course. The latter case applies to Pakistan: the country remained constant or progressed slowly in most sectors during earlier period, but began to improve over the recent

years. With that in mind, we now turn to evaluating the future needs in infrastructure of those countries.

Table 2A Trends in Infrastructure 1980-2009: Electricity



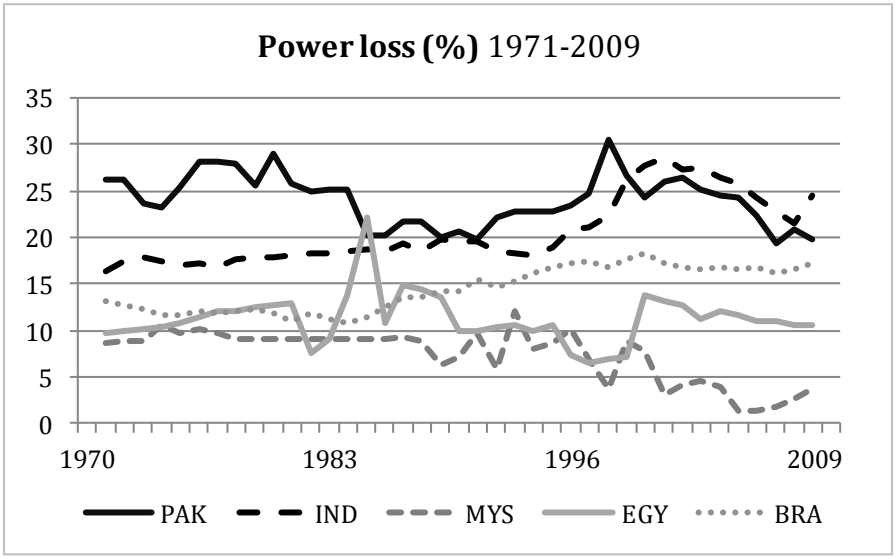
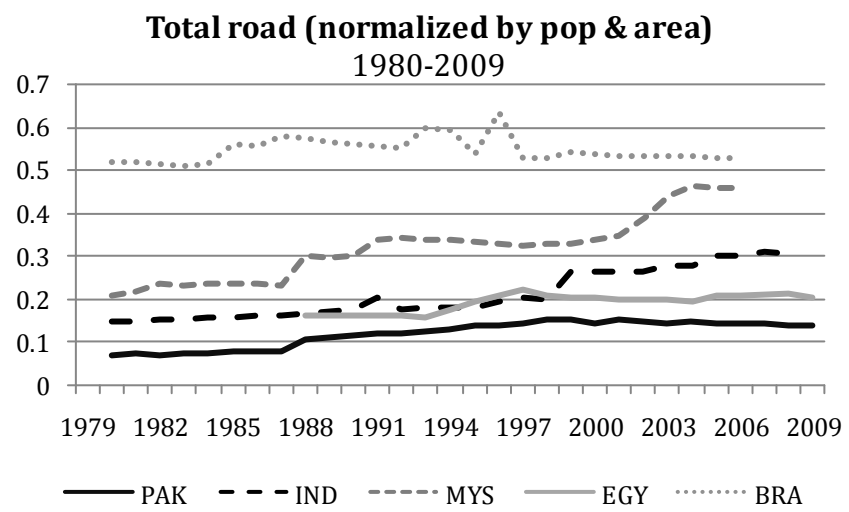
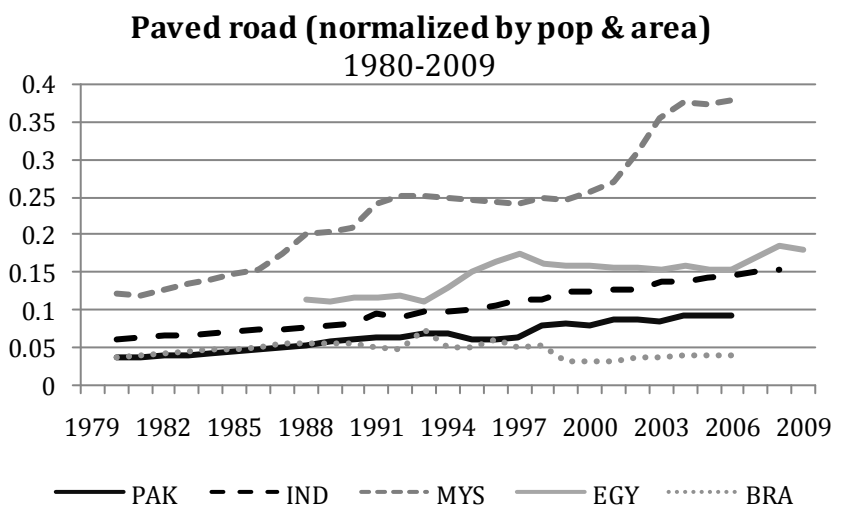


Figure 2B Trends in Infrastructure 1980-2009: Transport





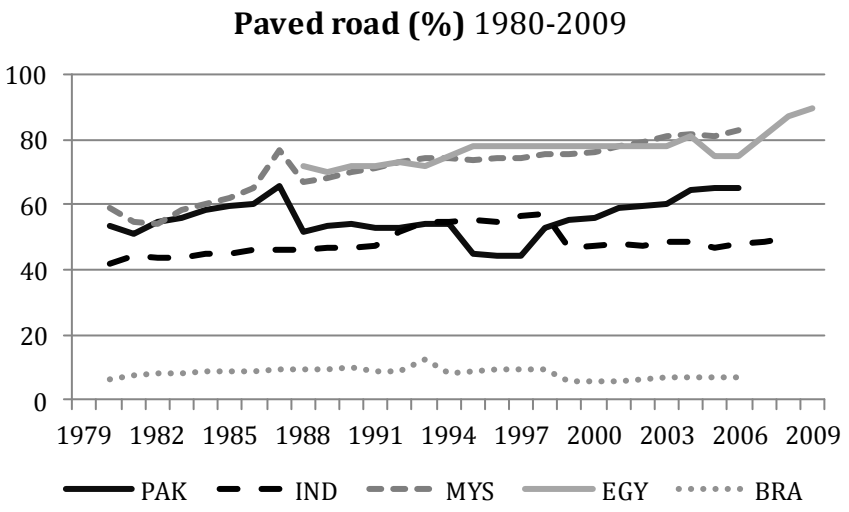


Figure 2C **Trends in Infrastructure 1980-2009: Telecommunication**

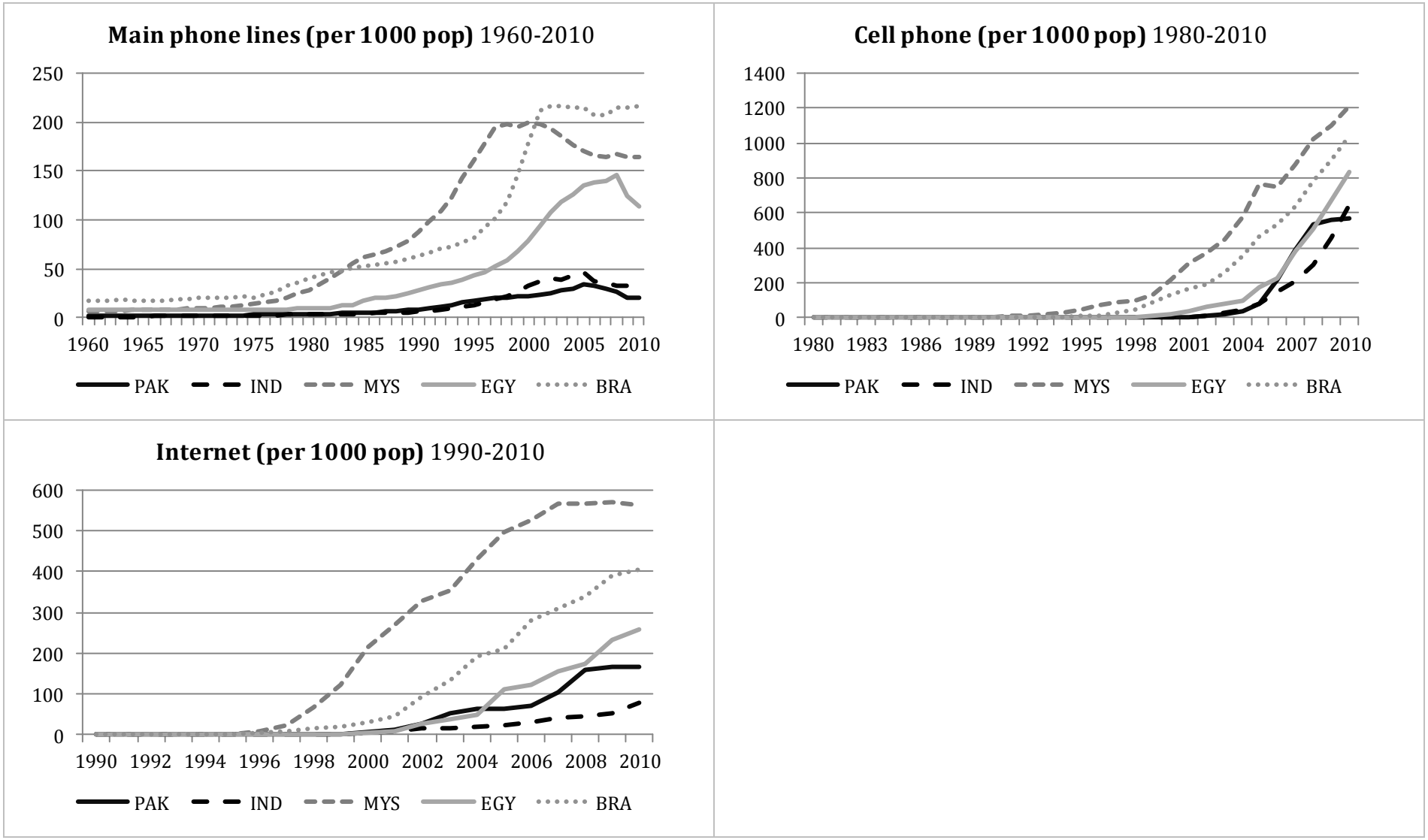
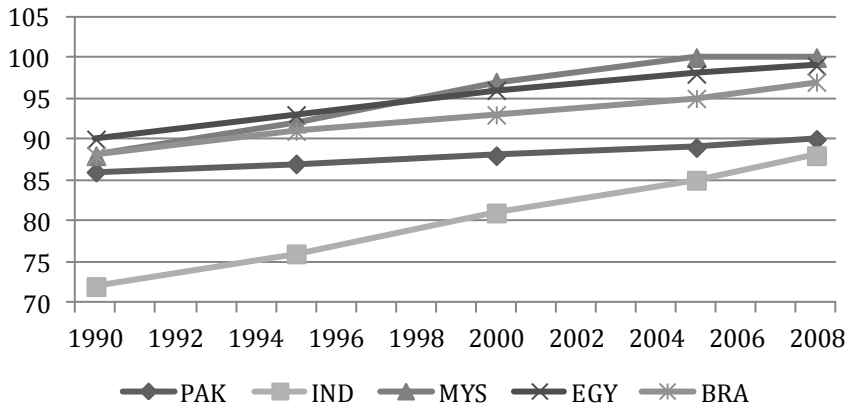
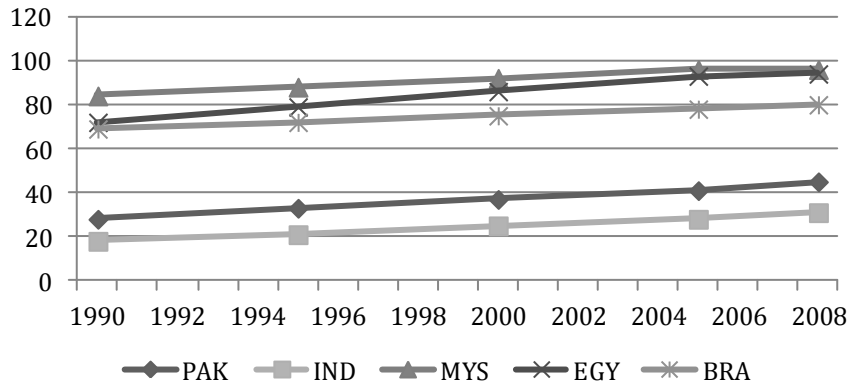
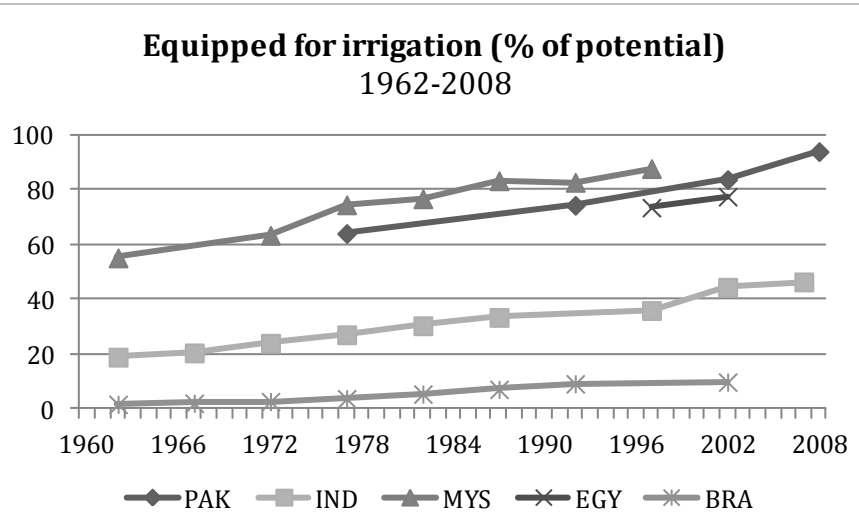


Figure 2D Trends in Infrastructure 1980-2009: Water, Sanitation & Irrigation







Projections for Infrastructure Improvements

22. The objective of this section is to estimate the level of infrastructure that is consistent with a given level and growth rate of real GDP per capita. The purpose is not to establish a causal link between infrastructure and GDP but to gauge the improvements in infrastructure in the coming years that are compatible with both the current size and expected expansion of the economy. As mentioned in the introduction, this is a conservative and minimalist approach. It does not preclude the importance of further improvements in infrastructure's volume and efficiency.

23. We conduct an econometric estimation using pooled cross-country and time-series data, with each infrastructure indicator as dependent variable and with the initial level of GDP per capita and the average growth rate of GDP per capita as explanatory variables. By including both the level and growth rate of the economy, we attempt to account for its static and dynamic relationships with infrastructure. For the regression sample, we include as many countries and years as possible, covering over 100 countries in most cases and spanning the period 1961 through 2010, divided into non-overlapping 5-year intervals. The panel is unbalanced, with each country having at most 10 observations. The regression equation for a given measure of infrastructure is the following,

$$Z_{it} = \beta_i + \beta_1 Y_{it-1} + \beta_2 (Y_{it} - Y_{it-1}) + \varepsilon_{it} \qquad (1)$$

24. Where the sub-indices i and t represent country and time period, respectively; Y_{it-1} represents the log of initial GDP per capita; $(Y_{it} - Y_{it-1})$ is the growth rate of GDP per capita (the average log difference over the period); β_i denotes the country-specific scale effect; and ε_{it} is the error term. The data on GDP are obtained from the World Bank's World Development Indicators. The predicted level of infrastructure, based on actual observations of GDP per capita and its growth rate, can be then expressed as:

$$\hat{Z}_{it} = \hat{\beta}_i + \hat{\beta}_1 Y_{it-1} + \hat{\beta}_2 (Y_{it} - Y_{it-1}) \qquad (2)$$

25. The regression results are presented in Table 1. The results are as expected in the sense that all measures of infrastructure are projected to improve as both the size and growth rate of the economy increase. That is, the results show that the initial level of GDP per capita and its growth rate carry highly significant coefficients in all cases, with positive signs where an increase in the infrastructure indicator denotes improvement (all indicators but one) and negative signs where an increase in the indicator denotes worsening (power loss). From equations (1) and (2), we can derive the current gap in infrastructure, $\hat{Z}_{it} - Z_{it}$; that is, the difference between the expected level of infrastructure (given the level and growth rate of GDP per capita) and its current condition. Similarly, we can measure the predicted change in infrastructure development—the gap between the current condition of infrastructure and the level of infrastructure expected given the present economic level and predicted economic growth. The projected infrastructure change for the next period is given by:

$$Z_{it+1} - Z_{it} = (\beta_i - \beta_i) + \beta_1 (Y_{it} - Y_{it-1}) + \beta_2 [(Y_{it+1} - Y_{it}) - (Y_{it} - Y_{it-1})] + (\varepsilon_{it+1} - \varepsilon_{it}) \qquad (3)$$

26. Applying the estimated coefficients from (2) into the above equation, equation (3) can be written as:

$$\widetilde{Z_{it+1} - Z_{it}} = \hat{\beta}_1(Y_{it} - Y_{it-1}) + \hat{\beta}_2\left[\left(\widetilde{Y_{it+1} - Y_{it}}\right) - (Y_{it} - Y_{it-1})\right] \quad (4)$$

27. Therefore, an estimate of the infrastructure improvement for the next period can be obtained using actual growth rates for the current period and projected rates for the next one. The data on growth projection $\left(\widetilde{Y_{it+1} - Y_{it}}\right)$ are taken from the World Economic Outlook Database by the International Monetary Fund. The first component of equation (4) on the right side, $\hat{\beta}_1(Y_{it} - Y_{it-1})$, is the product of the estimated coefficient and log difference of the initial GDP per capita between the two periods, that is, the growth rate of GDP per capita over the latest 5 years. The second component is the product of the estimated coefficient and the difference of GDP per capita growth rates between the two periods. Using this methodology, Figure 3 presents the estimated future infrastructure improvements for Pakistan and 9 comparator countries.

28. As we proceed to the comparisons, it should be noted that when we examine the relative contributions of the two components in determining the infrastructure improvement, we find that the first component—the GDP per capita growth rate over the last 5 years—accounts for a large share of the explanations in the infrastructure change. In the case of Pakistan, it explains approximately 88% of the predicted future change for total road length, 86% for main phone lines, 92% for electricity generating capacity, and similar values for other measures. The expected economic growth over the next period explains between 10% and 20% of the change in infrastructure development. However, to the extent that growth in future periods is correlated to growth in recent periods, both components should be taken jointly to represent the economy's long-term trends and their effect on infrastructure development.

29. The general result is that the projected infrastructure improvement in Pakistan is lower than those of most if not all comparator countries. This is not because Pakistan has already made enough progress in infrastructure, rather this result is derived from the fact that economic growth has been and will likely remain much lower in Pakistan than in most other countries. First of all, we find that Bangladesh, India, and Sri Lanka—the large emerging economies in the South Asian region—will likely have a higher degree of improvement in all infrastructure sectors than Pakistan will. The largest difference is with regard to India, which is expected to raise the quantity and quality of roads, electricity, telecommunication, water and sanitation by two to three times more than Pakistan. For example, the predicted improvement for paved road (in % of total road) in Pakistan is approximately 1.7% increase over the next 5 years, whereas the need in India is 5%. The difference in the projected infrastructure changes is also large with respect to the other two South Asian countries: while Pakistan is projected to increase the main phone lines by 21 per 1,000 population, Bangladesh should raise it by 43 per 1,000 population and Sri Lanka by 50 per 1,000 population. The economies of those three neighboring countries grew at much higher rates over the last 5-year period than Pakistan did, as illustrated in Figure 4. The average GDP per capita growth between 2006 and 2010 was 6.9% in India, 5.4% in Sri Lanka and 4.6% in Bangladesh, while in Pakistan, it was only 2%. Likewise, for the period 2011-15, Pakistan is expected to grow at less than 3% per year, while its South Asian neighbors are projected to grow at an annual rate of at least 5%. Accordingly, the projected infrastructure improvements in Pakistan are comparatively lower than those in countries in the same region.

30. Comparing Pakistan with Thailand, Indonesia and Malaysia—which represent large East Asian countries with successful economic performance—we first observe that the projected infrastructure changes for Pakistan are slightly less than Thailand, the median country, and Malaysia in all the cases. For instance, Pakistan is projected to raise electricity generating capacity by 0.047MW per 1,000 population, while Thailand will likely raise it by 0.064 and Malaysia by 0.058. This accords with the fact that GDP per capita growth rates of both Thailand and Malaysia in the last and coming periods are 0.5% to 1% higher than that of Pakistan. Indonesia is projected to improve its infrastructure by nearly twice as much as Pakistan in all sectors. Taking internet as an example, Indonesia is expected to increase internet users by 106 per 1,000 population, while Pakistan by 55 per 1,000 population. This higher improvement can be attributed to the fact that Indonesia grew in the last 5 years and is expected to grow in the next 5 years by 2 percentage points more than Pakistan did and will.

31. Lastly, we examine the projection of Pakistan with reference to the large emerging countries in other regions, namely, Brazil, Turkey and Egypt. The three countries are expected to have an economic growth rate of 2% to 3% over the next 5 years, which is similar to Pakistan's expected growth rate. The projected infrastructure changes will vary due to different economic growth rates that these countries experienced over the last 5 years. Brazil is projected to develop infrastructure in all categories slightly more than Pakistan. The projected infrastructure improvements in Turkey are roughly equal to those in Pakistan for all infrastructure measures. For example, both Pakistan and Turkey are expected to reduce power loss (in % of total output) by about 2.5%. With regard to Egypt, Pakistan is projected to improve infrastructure in most sectors less than Egypt will, except in water and sanitation infrastructure for which the projected improvement is similar for the two countries.

32. Although the projected infrastructure improvements vary across countries and sectors, we can observe in common that Pakistan's infrastructure development is likely to be lower than in other countries for almost all infrastructure measures.[3] As discussed above, this is mainly due to the fact that economic growth in Pakistan has a weaker trend than in comparator countries.

[3] To check the robustness of the results, we conducted regressions including urbanization ratio as additional determinant. The projected infrastructure improvements for Pakistan, based on the regression results presented in Annexure 2, remained very similar to Figures 3A-D.

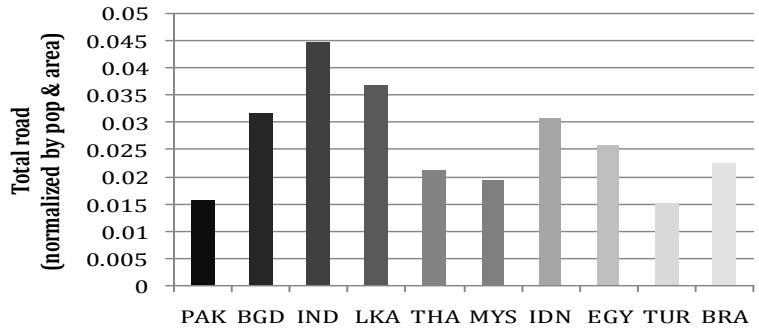
Table 1 Relationship between Infrastructure and Both the Level and Growth Rate of GDP

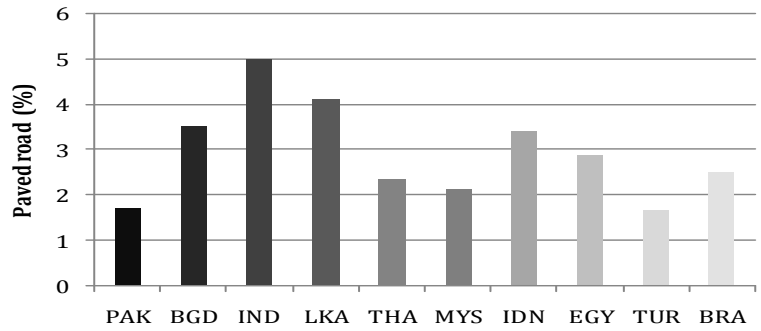
	Dependent Variable: Infrastructure Index							
	Transport					Telecommunication		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Explanatory variables:	Total road length (normalized)	Paved road (% of total road)	Paved road length (normalized)	Quality of port (index 1-7)	Quality of air transport (index 1-7)	Main phone lines (per 1000 pop)	Cell phone (per 1000 pop)	Internet users (per 1000 pop)
Initial GDP per capita (constant 2000 US$, in logs)	0.133 *** [11.66]	14.777 *** [17.77]	0.185 *** [19.30]	2.998 *** [5.12]	1.910 *** [4.52]	178.347 *** [28.99]	747.183 *** [18.24]	447.989 *** [13.94]
GDP per capita growth (log difference of GDP per capita, average over the period)	0.219 * [1.96]	24.329 *** [2.93]	0.212 ** [2.25]	12.256 *** [3.31]	5.388 ** [2.02]	323.99 *** [5.22]	2503 *** [8.71]	1051.6 *** [5.25]
Constant	-0.522 *** [6.15]	-67.161 *** [10.82]	-1.125 *** [15.77]	-19.951 *** [4.27]	-10.661 *** [3.16]	-1194.7 *** [26.07]	-5426.3 *** [17.68]	-3292.1 *** [13.50]
No. of observations	1013	998	983	203	203	1067	808	588
No. of countries	128	129	127	112	112	129	129	129
R-squared	0.14	0.27	0.31	0.23	0.19	0.48	0.34	0.3
Period	1961-2010	1961-2010	1961-2010	2001-2010	2001-2010	1961-2010	1976-2010	1986-2010

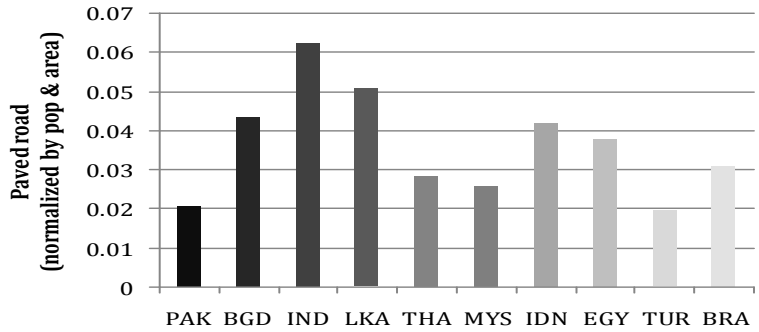
Table 1 Relationship between Infrastructure and Both the Level and Growth Rate of GDP (...contd)

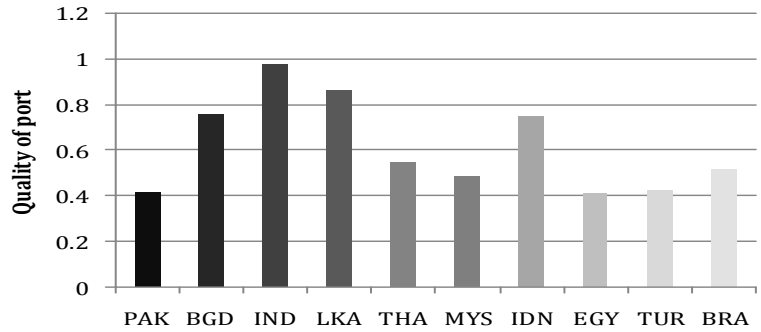
	Dependent Variable: Infrastructure Index					
	Power			Water, Sanitation, Irrigation		
	[9]	[10]	[11]	[12]	[13]	[14]
Explanatory variables:	Electricity generating capacity (per 1000 pop)	Power loss (% of total output)	Access to electricity (% of pop)	Access to improved water (% of pop)	Access to improved sanitation (% of pop)	Equipped for irrigation (% of potential)
Initial GDP per capita (constant 2000 US$, in logs)	0.417 ***	-2.356 ***	32.867 ***	9.645 ***	9.918 ***	15.387 ***
	[17.94]	[4.81]	[6.35]	[9.83]	[10.59]	[10.33]
GDP per capita growth (log difference of GDP per capita, average over the period)	0.443 ***	-2.183	82.303 **	48.553 ***	44.177 ***	37.411 **
	[2.73]	[0.50]	[2.29]	[8.76]	[7.98]	[2.30]
Constant	-2.408 ***	30.96 ***	-167.5 ***	9.593	-5.928	-72.005 ***
	[13.79]	[8.07]	[4.63]	[1.31]	[0.85]	[6.95]
No. of observations	789	816	135	582	577	344
No. of countries	127	112	68	125	124	85
R-squared	0.33	0.03	0.4	0.21	0.22	0.3
Period	1976-2010	1961-2010	2001-2010	1986-2010	1986-2010	1961-2010

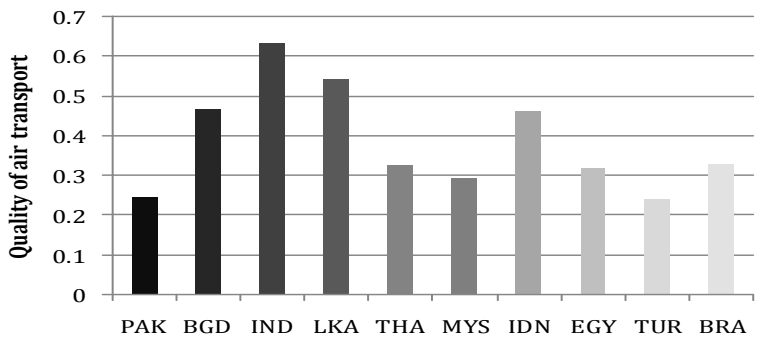
Figure 3A **Projected Change (2011-15): Transport***





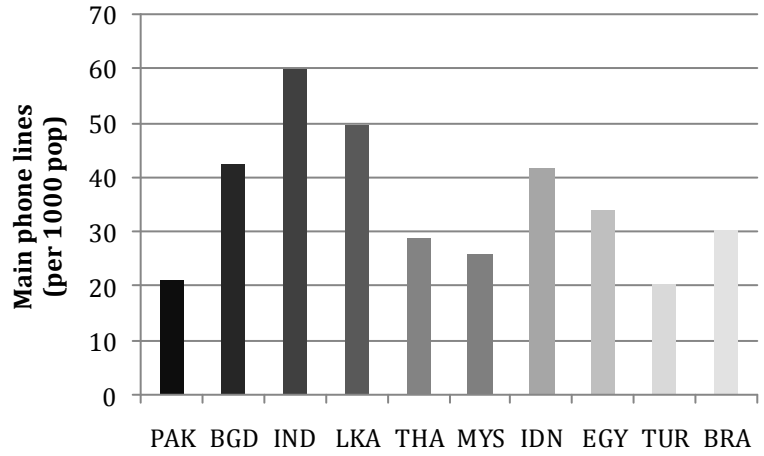


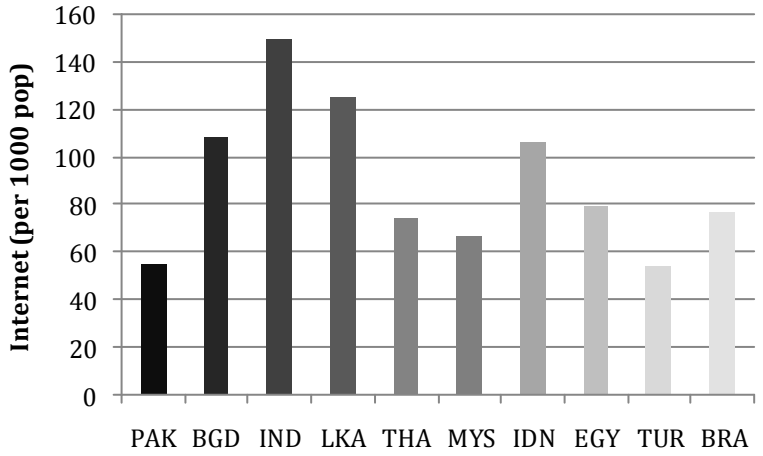


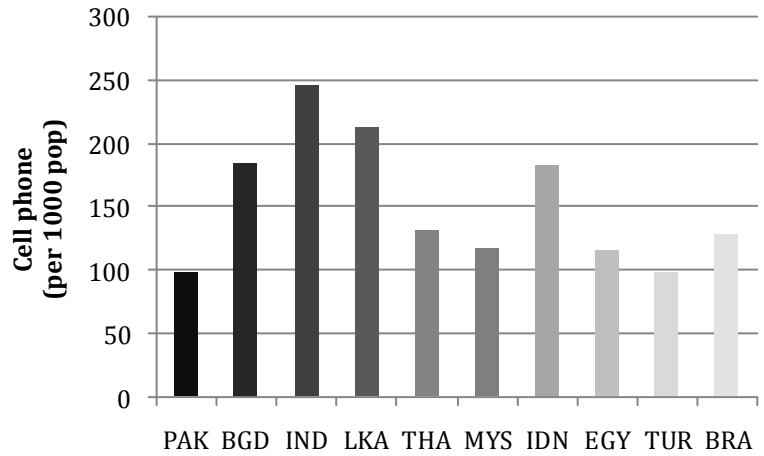


** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010.*

Figure 3B **Projected Change (2011-15): Telecommunication***

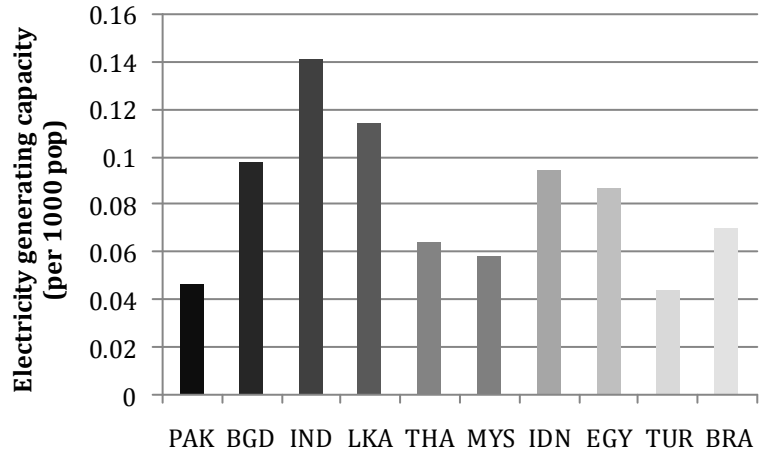


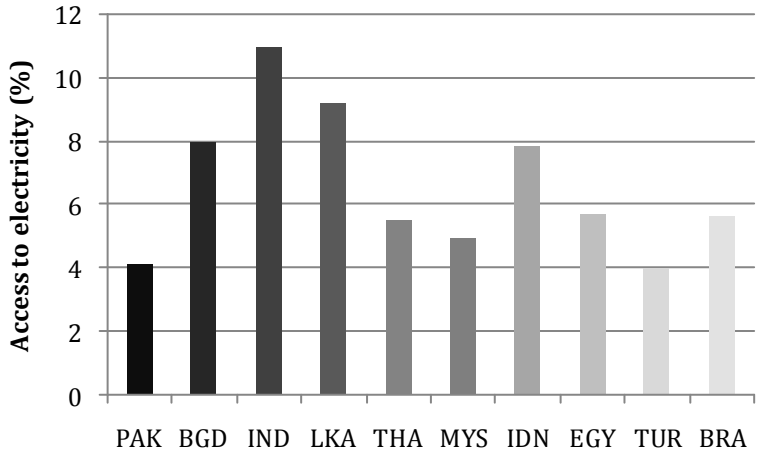


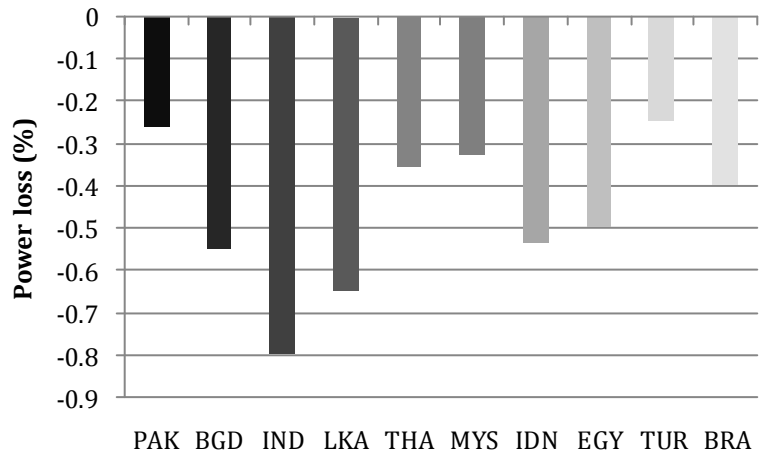


** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010.*

Figure 3C **Projected Change (2011-15): Electricity***

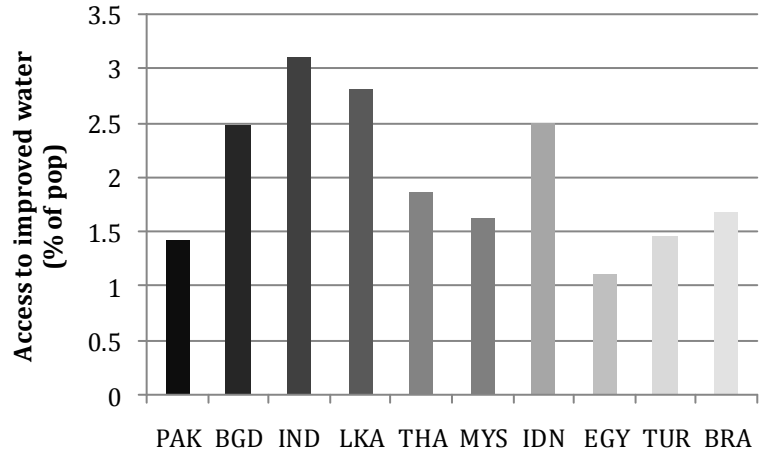


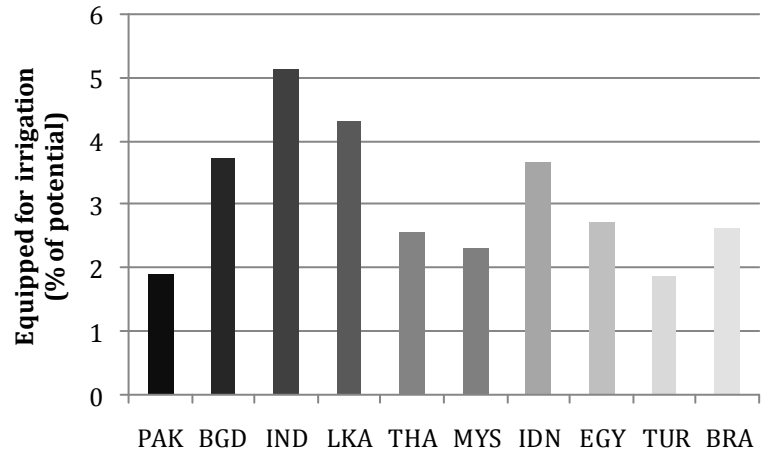


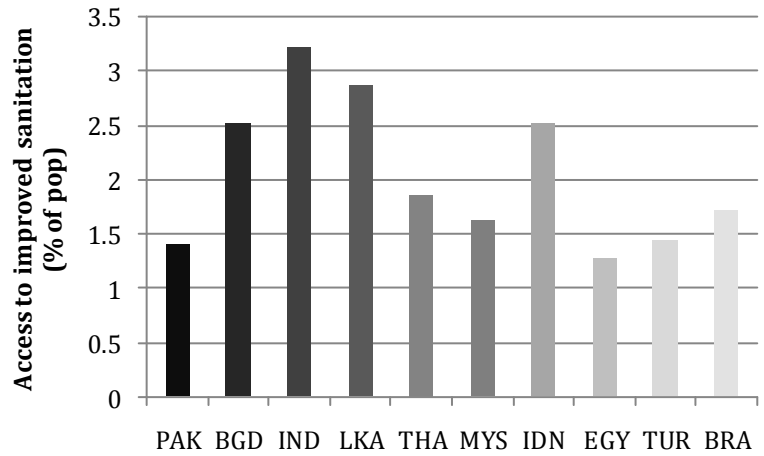


** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010.*

Figure 3D **Projected Change (2011-15): Water, Sanitation & Irrigation***

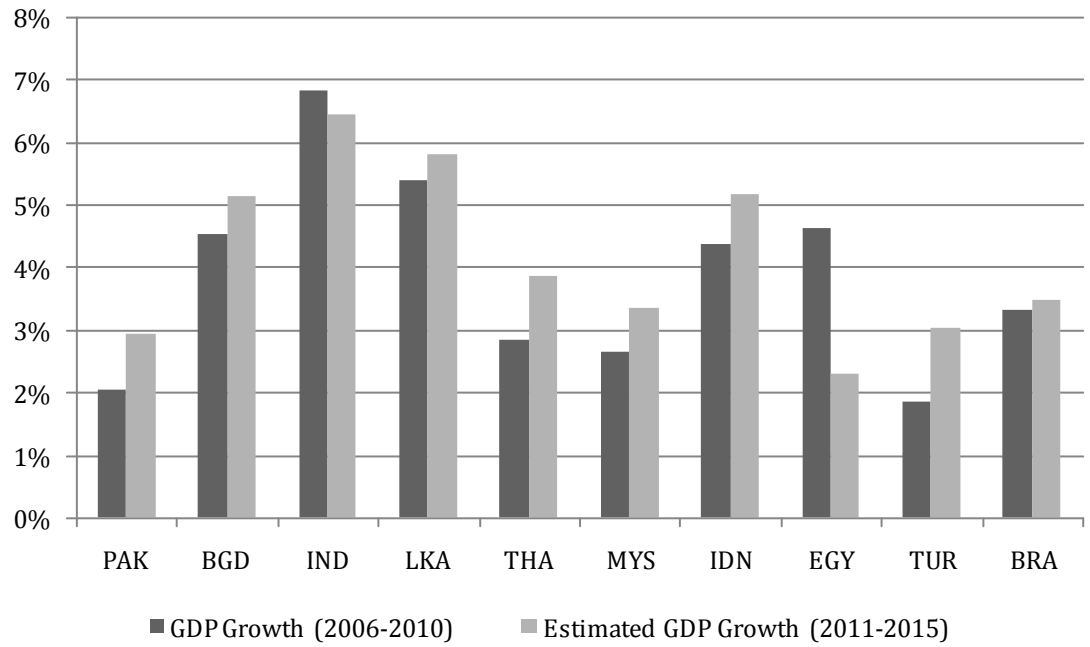






** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010.*

Figure 4 **Average GDP per capita growth in 2006-10 and 2011-15***



** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010.*

Infrastructure Investment

33. This section reviews the long-term trends in infrastructure investment across countries. Figures 5 provide an overview of the level of infrastructure investment in Pakistan and other 7 countries, divided into two groups: 4 Asian countries (Pakistan, India, Malaysia, and Indonesia) in Figure 5A, and the median country (Thailand) plus 3 countries in other regions (Egypt, Turkey, and Brazil) in Figure 5B. The figures present the trends of total, public and private investment as a share of GDP for over the last two decades. The respective investment figure comprises investment in three sectors, including electricity, transport, and telecommunication. Due to the unavailability of data, investment in water, sanitation and irrigation is not covered in this section.

34. The top panels of Figure 5A and 5B illustrate that total investment in infrastructure has been slightly declining over time in most countries. Almost all countries hit the lowest level of investment in the late 1990s and early 2000s. The fall is more evident in the late 1990s in Asian countries, including Pakistan. In Pakistan, the share of infrastructure investment in GDP seemed to be relatively low in 1980s, but it steadily rose from around 3% up to 5% until 1997 and then began to fall under 4%. The investment rate increased again in the mid 2000s, reaching over 6% and exceeding other comparators; however, it has dropped significantly in the last 3 years. Overall, Egypt maintained the highest share of infrastructure investment in GDP in earlier periods marking over 10% in late 1980s. Subsequently, it decreased gradually, and Turkey as well as the Asian countries caught up with Egypt in the 1990s. Particularly, the growth of investment in Thailand during the early 1990s was remarkable, although it fell sharply following the Asian financial crisis in 1997.

35. The middle panels represent the share of public infrastructure investment in GDP. As the figures display, public investment rates in these countries show a downward trend, which apparently served as the principal cause of a declining tendency in the total investment rates. Malaysia is an exception as the country's public investment rate in infrastructure remains roughly constant between 2% and 3% over the 1990s and early 2000s, while other countries reduced their public investment rates during the same periods. In Pakistan, there was a sharp decline between 1996 and 1998, and continued to decrease in the last decade to less than 1%.

36. In contrast to public investment, the private infrastructure investment rate exhibits an upward trend in the majority of countries. It is clear in case of Pakistan where private investment in infrastructure has increased to the extent that it surpassed public investment in the last decade. The share of private investment in other countries such as India and Turkey has also risen to equal that of public investment. In Malaysia and Thailand, countries with remarkable achievements in public infrastructure, the rise in private investment seemed to have occurred in the 1990s, earlier than in the other comparator countries. In sum, for the majority of countries, private investment has become a significant source of infrastructure development in the last two decades.

37. We now turn to reviewing the trend in infrastructure investment in Pakistan by further disaggregating the data by destination of industry. The data covers the period from

1981 to 2010 and refers to capital expenditures relative to GDP.[4] Figure 6(a) illustrates how private investment has exceeded public investment in the latest decade. The aggregate figure for Total Investment however, masks important sectoral differences.

38. Figure 6(b) presents a historical trend in Pakistan's investment in the electricity sector. It shows that public investment has been a dominant force over the last three decades and is still a primary source of investment at present. In 1980s, the source of investment in electricity sector was completely dependent on public sector, which steadily rose above 2.5% of GDP. The level of public investment was stable during early 1990s, but it drastically dropped in 1997 and has declined to less than 0.5% of GDP in the 2000s. The private sector started to take part in electricity investment in the mid 1990s after the government adopted the strategic plan for restructuring the power sector in 1992, which called for the privatization of the electric power sector. Subsequently, private investment experienced a sharp increase in 1995, totaling roughly 1% of GDP, but the boom lasted only the following few years. Over the last decade, private investment reached barely 0.5% of GDP and continued to decrease to about 0.2% of GDP.

39. The investment trends in transport and telecommunication sectors are depicted in Figure 6(c). Due to the availability of data, private investment in transportation and telecommunication are aggregated, while public investment can be disaggregated between the two sectors. For public investment, we can observe that investment in transport sector consistently declined in the 1980s and stagnated during the 1990s. Although it slightly rose in 2004, it again decreased over the latest years and hit the lowest record of less than 0.3% of GDP in 2010. Public investment in telecommunication sector continuously increased in the 1980s and maintained its level in the 1990s; however, it went down significantly since 2003. In contrast to the downward trend in public investment, private investment in transport and telecommunication swelled substantially after 2002. In 1980s and 1990s, private investment in the two sectors amounted to less than or close to 1% of GDP, but it jumped to 4% in 2006. This was most likely caused by the increasing participation of private sector in the telecommunication services.

40. The data on investment in water, sanitation, and irrigation sectors are only available for public investment and for the period from 1996 to 2010; therefore, they are not included in the total investment in Figure 6(a). Figure 6(d) offers the trends in public investment in these sectors, of which water and sanitation are combined, while irrigation is separated. Public investment in water and sanitation had been on the decrease from the late 1990s to the mid 2000s. It slightly increased in 2006 and 2007, and thereafter declined again in recent years. Similarly, public investment in irrigation continued to fall down to less than 0.1% of GDP in the late 1990s, but grew exponentially since 2003 up to 1% of GDP in 2008, and then dropped in the past two years.

[4] The disaggregated data on investment in electricity, transportation, and telecommunications are compiled from the Tables for Gross Fixed Capital Formation in Private Sector, Public and General Government Sectors by Economic Activity in the *Pakistan Statistical Yearbook* (various years). The data on water, sanitation and irrigation are obtained from Federal Civil Accounts, Accountant General of Pakistan, 1995-96 to 2009-10; Finance Accounts Punjab, Accountant General Punjab, 1995-96 to 2009-10; Finance Accounts Sindh, Accountant General Sindh, 1995-96 to 2009-10; Finance Accounts Khyber Pakhtunkhwa, Accountant General Khyber Pakhtunkhwa, 1995-96 to 2009-10; Finance Accounts Balochistan, Accountant General Balochistan, 1995-96 to 2009-10.

41. All in all, the disaggregated comparison at the sectoral level tells that while public investment has been falling in all the sectors of interest (except for irrigation) over the last three decades, private investment has showed a different trend. Private investment in the power sector has struggled to grow, whereas in the telecommunication sector it has been expanding in the 2000s. The larger share of private investment in overall infrastructure observed in recent years is primarily driven by its participation in transport and telecommunication services, and most likely the latter. The investment in electric power sector appears to be facing a serious stagnation by both private and public sectors.

Figure 5A Infrastructure Investment (% of GDP)

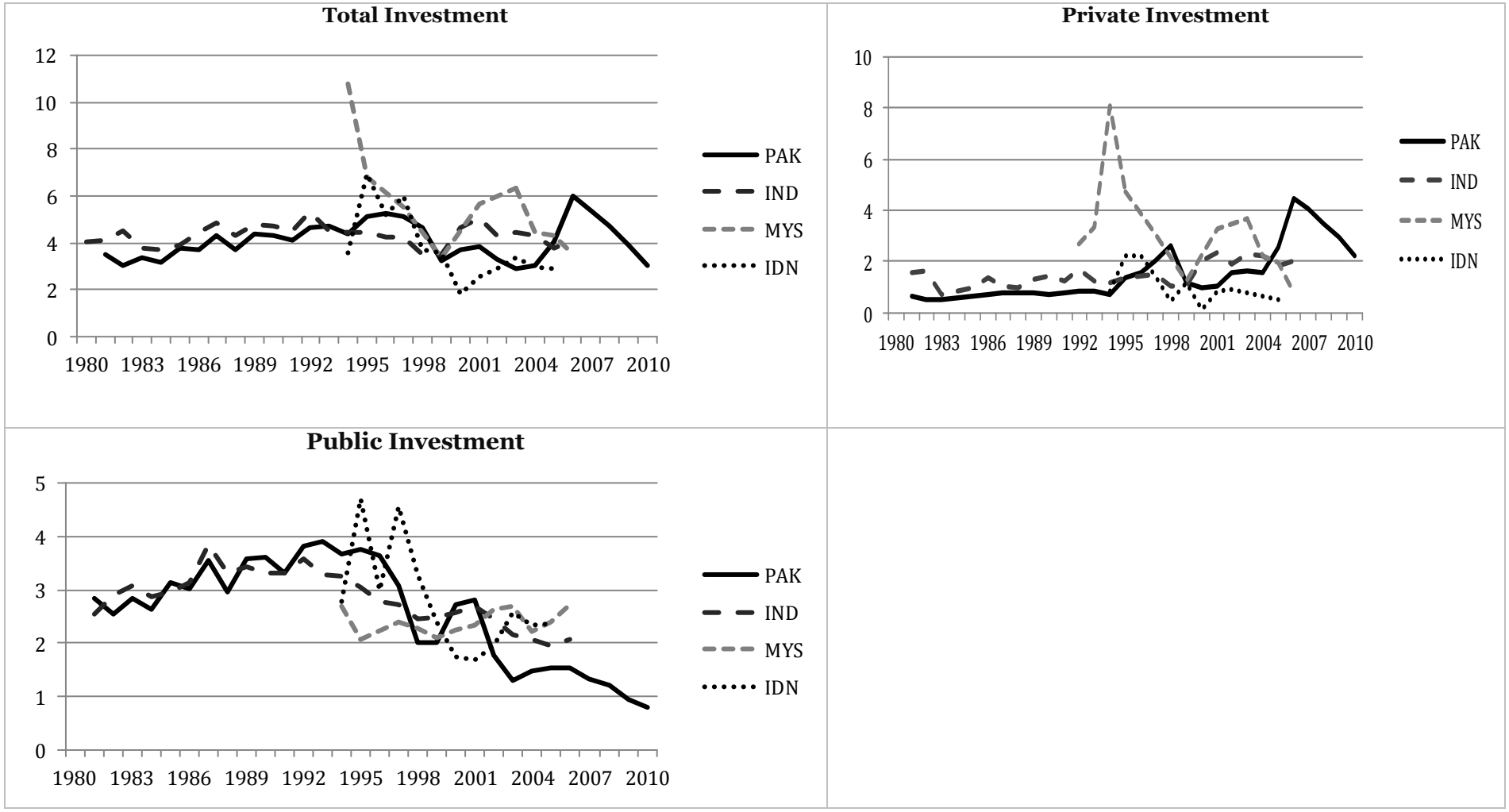
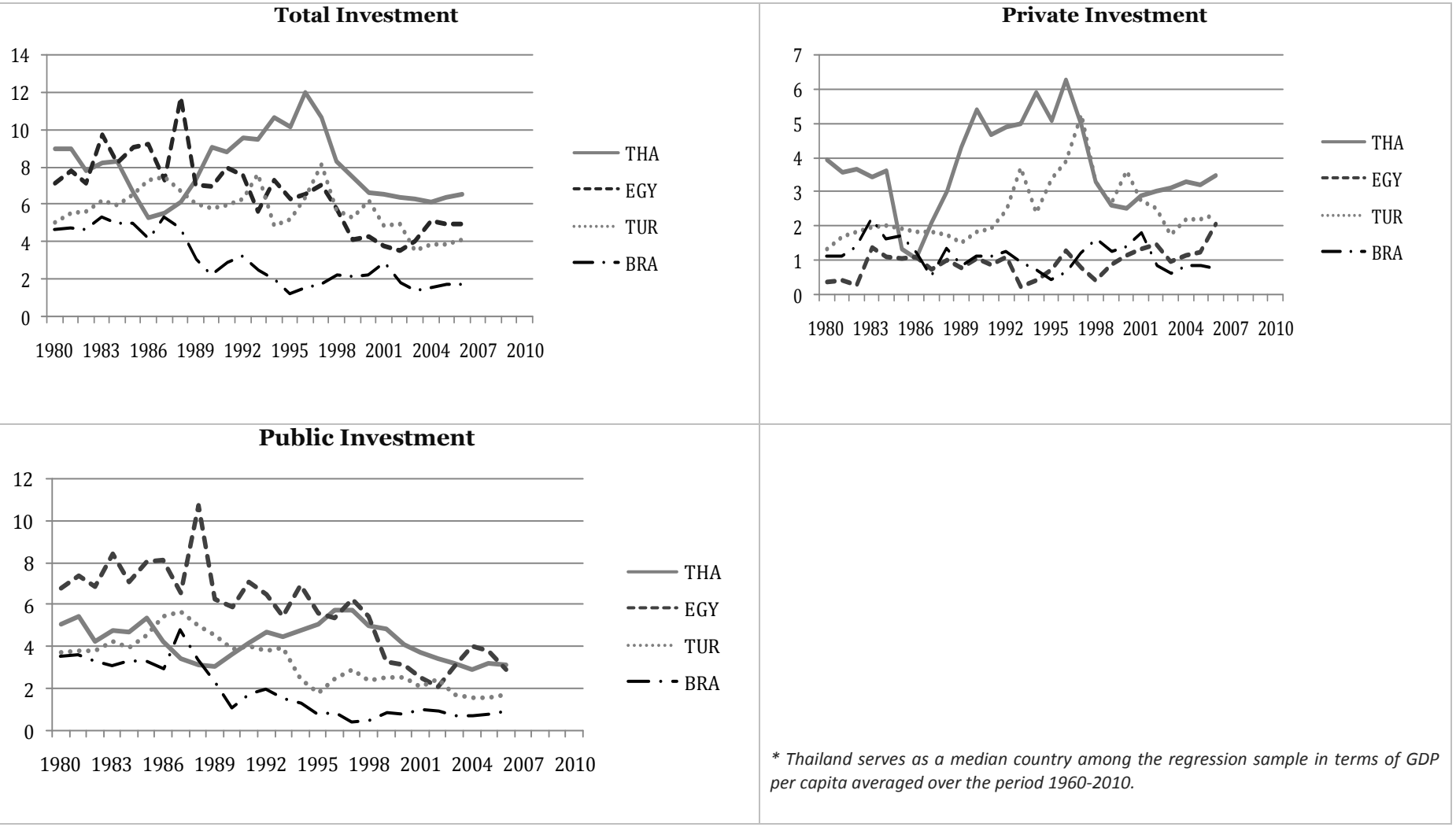
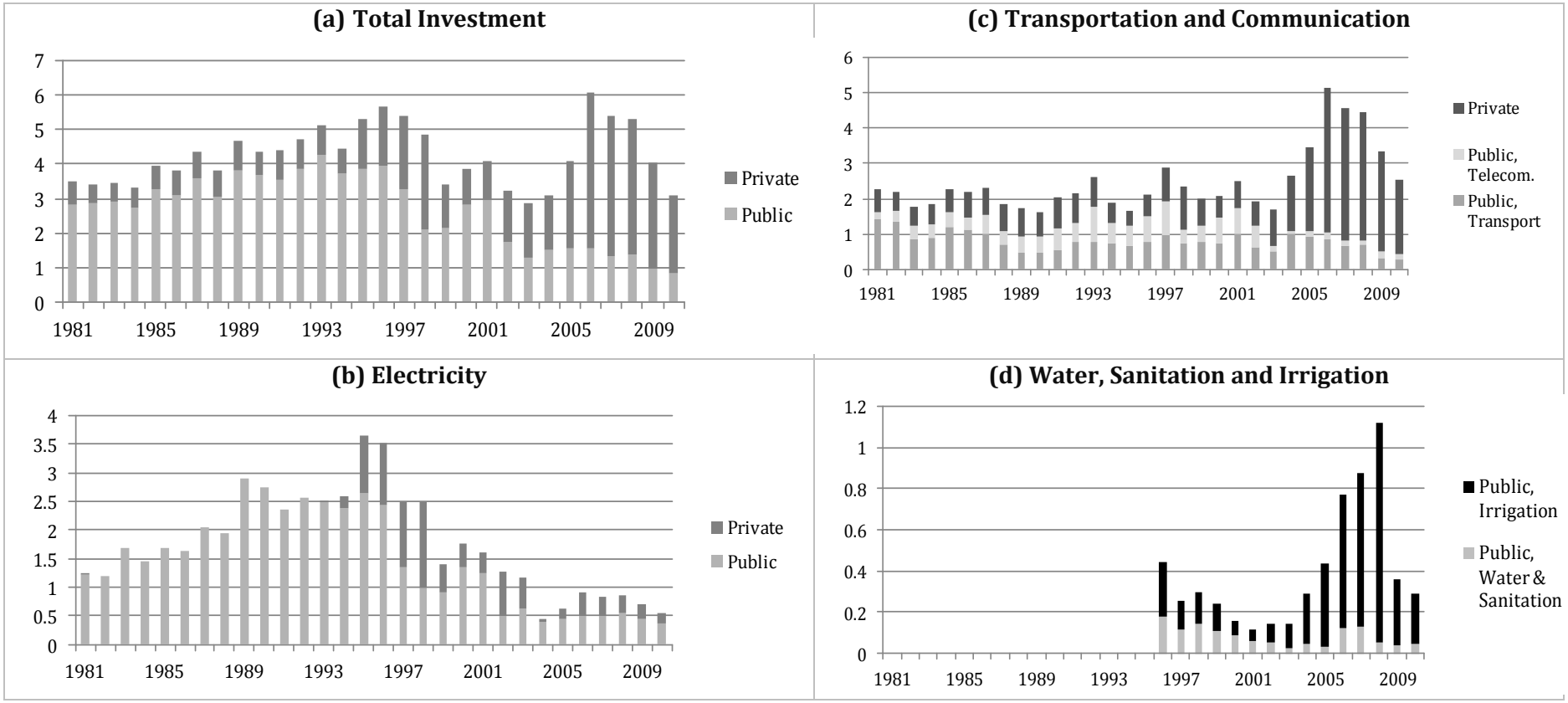


Figure 5B Infrastructure Investment (% of GDP)*



** Thailand serves as a median country among the regression sample in terms of GDP per capita averaged over the period 1960-2010.*

Figure 6 Infrastructure Investment in Pakistan by Sector (% of GDP)



Selected Sectoral Issues

42. This section presents a brief account of the main issues, concerns, and key policies for a selection of public infrastructure sectors in Pakistan. Specifically, it discusses the situation of roads, railways, electricity and irrigation in the country. The sectors have been chosen in consultation with World Bank experts located in Pakistan and the analysis presented below draws from their recent work.

Roads[5]

43. The key challenges facing the national road system can broadly be grouped into the following three areas: road network deficits; financing and management issues; and sector governance and institutional constraints. First, the National Highways network primarily consists of 'low capacity roads'—of the 10,000 km of national highways, about 75% are 2-lane roads, about 20% are 4-lane divided highways and only 5% are 6-lane highways. The traffic capacity of roads is further reduced by many constraints like the presence of pedestrians and other non-motorized traffic. Moreover, the operating conditions are exacerbated by extensive commercial activities located along the roads, poor physical condition of the roads and lack of traffic management in towns. The results are very low travel and trip speeds, and an unsafe driving environment.

44. Secondly, sustainability of road maintenance financing has progressed but needs to be further strengthened. A Road Maintenance Account (RMA) was set up in 2003 to ensure a stable and secure source of funding for network maintenance. RMA is primarily financed from tolls collected on the network (76%) and from the government annual maintenance grant. The National Highway Authority (NHA) has significantly increased its direct revenues. With these efforts, the financing gap has been reduced but still remains. NHA's FY 2007-08 maintenance plan estimated maintenance needs at Rs 10.5 billion against a budget allocation of Rs 8.4 billion leaving 20% of maintenance needs unfunded. NHA recently reviewed its toll rates and recommended the government a 50%, 25% and 20% increase for cars/jeeps, wagons/buses and trucks respectively. Revenues are expected to increase to a level which covers the cost of maintenance in 2012. The fiscal sustainability of the road development program is also uncertain. The road development program envisaged by the government would require a significant increase in budgetary resources allocated to road sector compared to the past. This would require reallocation of resources within the government's annual overall public sector development program to ensure fiscal sustainability.

45. Thirdly, institutional governance in the sector remains weak. RMA does not fully achieve the objective of improving good governance with respect to financial management of road maintenance resources. The practice of providing loans to NHA to finance its development program since its creation in 1991 is also clearly unsustainable and undermines NHA's financial standing. As NHA's own revenue base is barely sufficient to cover the costs of operations and maintenance of the existing road network, it has built up a huge and growing stock of debt to the government, which presently stands at around Rs 421 billion. In addition, the appropriateness of the decentralization framework for roads remains to be confirmed. The primary issue is comparative performance of road networks in provinces and

[5] The information in this section is obtained from the paper on Pakistan Road Sector by Zafar Raja (2011).

at the federal level as well as complementarities of networks. Road planning currently is not coordinated among the agencies responsible for the road network at federal or provincial levels. Furthermore, the capacity both in the public and private sectors of public works remains insufficient in view of the developments envisaged for road network in the future.

46. To help the government achieve Vision 2030, NHA developed a 10-Year Business Plan for the FY 2009-10 to FY 2018-19. The outcomes of the business plan have been defined, each with strategic objectives and operational targets, in nine areas: 1) corporate management—to manage roads like a business, adopt corporate structure, and strengthen governance and accountability to deliver a high level of road user and civil society satisfaction; 2) network financing—to secure funding for development projects and all future maintenance activities and implement fee-for-service principles to ensure financial sustainability; 3) network development—to develop network capacity and raise service standards to fully meet future traffic demand in support of projected economic growth; 4) network operations—to operate the network efficiently, provide safe, free and reliable flow of trade and passenger traffic and improve journey time reliability; 5) network maintenance—to maintain the network in good serviceable condition and provide a reliable service throughout the year to uphold Pakistan's internal and external trade competitiveness; 6) financial management—to strengthen capacity and internal controls to ensure un-qualified audited annual financial statements; 7) procurement—to implement efficient procedures and operate a Procurement Monitoring System to enhance transparency; 8) environment and social—to mainstream good environmental and social impact management practices to minimize the adverse impacts of road network construction and operations; and 9) human resource development—to have well-trained, highly motivated professionals, appropriately rewarded.

Railways[6]

47. Pakistan Railways (PR) is enduring the worst crisis since its formation. Since 2007-8, passenger traffic has reduced by 16% and freight traffic by 70%. Revenue has fallen by 6% while working expenses have increased by 80%. Labor-related costs and pensions alone were 120% of revenue earned in 2010-11. Through 2011, the number of locomotives available for use reduced by an average of 10 each month. By August, only 8 locomotives were available for freight and 140 for passenger services compared to 100 and 170 respectively in 2008. Since then things have got even worse. PR cannot survive without emergency financial assistance to get the locomotive fleet running, but short-term financial aid is only a stop-gap, not a long-term response to PR's problems. Pakistan's railways cannot be an efficient and effective transport mode without radical surgery. The railway sector in Pakistan does not have the governance, institutional structure, management processes or regulatory framework to offer any possibility of success in a very competitive, 21st century transport market.

48. While PR has until recently been able to cover its working expenses, it had to rely on government funds for a large part of its capital expenditure. There are many opportunities in the railway sector for private investment, be it in relatively simple areas such as freight wagons or terminals or in the newer areas that have emerged such as wholesaling passenger trains and allowing the private sector to purchase and maintain rolling stock and provide on-

[6] The information in this section is taken from Pakistan Railways Issues and Revitalization Proposals provided by Amer Durrani (2011).

board services. At a time when government funds are limited, it makes sense to seek out private investment wherever possible, including an increasing role in providing improved services to the public.

49. In September and October in 2011, a series of workshops were held in Pakistan where PR's stakeholders, inside and outside government and the transport industry, discussed as to how the current situation might be improved. The proposals were put forward based on the suggestions by the participants and grouped into five core themes as follows: 1) public governance—a new railway law separating the roles and responsibilities of government from service providers, mandating and defining rights and obligations of a Pakistan Railways Corporation and liberalizing access to rail infrastructure for private freight trains; 2) funding—a short-term emergency funding plan, to be replaced in due course by a statutory framework defined in the new law, based on targeted support for unsustainable historic pension liabilities, non-economic passenger services and lines mandated by the government; 3) PR corporate identity and structure—Pakistan Railways Corporation (PRC) to be created without non-core activities or surplus labour, which would remain with the government, and to be given strong corporate governance with a qualified board and management and operated through freight, passenger and infrastructure subsidiaries; 4) transport operations—all possible actions to get existing locomotive fleet running again and earning revenue and rationalize the network to be served depending on availability of national and provincial financial support for non-economic lines; and 5) private participation in operations—PRC to seek opportunities consistent with established international practice to obtain private investment and skills in supporting its activities, and private freight train operating companies to have right of access to use the public network for access fee.

Electricity[7]

50. Some 91% of Pakistanis use electricity and nearly 70% from the grid. The quality of the service is uneven as shortages of electric power are part of daily life and have been for years. Pakistan has recently been caught in a cycle of worsening electricity shortages that have resulted in unrest in major cities in Pakistan. Although some of this may be politically motivated, it reflects the fact that there is considerable anger among both businesses and households. Many businesses have either to invest in captive power generation capacity or face closure and possible bankruptcy. Individual households are also badly affected in pursuing their daily lives, and these frustrations appear to have spilled over. There are indications that gas supply will further tighten in the winter of 2011-12, leading to more shortages and reduced availability for electricity generation, threatening the already weak stability of the power sector.

51. In broad terms there are three underlying causes for electricity shortages. The first is that the physical characteristics and institutional structure of the electricity sector limit the ability of either government or sector participants to control costs. Costs are out of control for a variety of reasons. One is heavy dependence on oil. In the past seven years, Pakistan's thermal power generation has shifted away from domestic, low-price gas and towards imported, market-price furnace oil. Of the total of 86TWh of electricity generated in Pakistan in FY04-05, gas was used for about 50% and oil (practically all furnace oil) accounted for 16

[7] The information in this section is taken from the paper Pakistan Power Sector: An Update by Kazim Saeed, Mohammad Saqib and Richard Spencer (2011) with inputs from Anjum Ahmad, Rashid Aziz and Bjorn Hamso.

percent. By contrast, in FY 2010-11, gas accounted for 28% and oil for 35% of the 102.6TWh generated. The increased dependence on oil has pushed generation costs up, particularly since the steep rise in global commodity prices in 2008. High losses, especially in generation and distribution, are another factor that prevents sector participants from managing costs properly. It has been found that the current thermal efficiency of publicly owned thermal plants is substantially below its design efficiency. For example, an actual efficiency at the Jamshoro thermal power station is found to be about 20% lower than the design rates. The main cause of the efficiency degradation originates with poor operations practices and lack of adequate maintenance. In addition, a good deal of electricity that is generated is lost in transmission and distribution systems that also have insufficient capacity and are consequently inefficient. It is estimated that for every kilowatt hour (KWh) of demand, 1.3 KWh must be generated. Some plants also suffer theft in transit between oil depots and power plants. Such corruption, together with weak governance at the power generation companies (GENCOS) and distribution companies (DISCOS) as well as the government's interference in operational decision-making inhibit commercial operations and therefore prevent the actors from taking decisions which are based on profit-maximizing or even cost-minimizing criteria.

52. The second cause for shortages of electricity is that there is just not enough capacity to meet demand that is continuing to grow at an estimated 7%-8% per year. Although there is a nominal installed capacity of nearly 23,500 MW in Pakistan, much less is available to generate. For instance, the present gross capacity of the Jamshoro thermal power station is estimated to be 581 MW against a total of 850 MW nameplate installed capacity. The country faces challenges particularly in baseload generation, that is, the minimum amount of power required to meet demands based on reasonable expectations of customer needs. A baseload plant is designed to run for about 6,000 or more hours per year, only shutting down for maintenance and operating under low marginal costs. The past 3-year data for the period 2007-10 suggests that in Pakistan some 8,000 MW is needed for more than 70% of the year, which would typically be met from plants working as baseload. However, counting all the winter-available hydro and the nuclear plants, Pakistan currently has only about 3,300 MW of baseload capacity. In other words, Pakistan is critically short of baseload plants. Chronic shortages of power feed a vicious circle: the plant that is available has to be run harder and spends more hours in service, consequently aging more rapidly.

53. The third is what might be described as the 'short blanket' problem: revenues are insufficient to meet expenditures, which has led to a cycle of indebtedness and acute shortages of liquidity within and beyond the power sector. Power sector tariffs do not cover the full costs of operating the power system. In addition, the collections of revenue that the distribution companies bill are very low. Accumulated arrears across the whole sector in FY 2010-11 amounted to some Rs.285 billion, equally divided between public sector consumers which owe Rs. 142 billion and private sector consumers which owe Rs.143 billion. Of the total amount Rs. 168 billion is six months or more overdue. Furthermore, subsidies for power sector are unsustainable from a fiscal standpoint. The subsidies paid by federal government for the power sector in FY 2010-11 amounted to Rs. 343 billion, overrunning the budget by Rs. 256 billion, equivalent to about 2% of GDP and 7.5% of total government revenues. One of the major consequences of this overrun is that the government is often late in paying its contribution to DISCOS and Karachi Electric Supply Company (KESC) which in turn adds to the costs of the sector and contributes to circular debt.

54. The resultant refusal of fuel suppliers and power generators to continue to supply exacerbates shortages created by insufficient generation capacity and inefficient distribution. As a result, the sector remains in a vulnerable state of unstable equilibrium. Since 2007, the government has maintained a load shedding program to cope with the shortages. It is managed by the National Transmission and Dispatch Company (NTDC) which allocates energy to each of the distribution companies. They in turn institute rotating load shedding by closing down 11kV distribution feeders so as to match demand with available load. In the first week of October, 2011, a series of both foreseeable and unforeseeable events occurred which reduced the generating capacity available to Pakistan Electric Power Company (PEPCO) from about 14,000MW to 9,800MW while demand rose to 17,500MW; the shortfall peaked on October 1, 2011 at over 7,700MW. Although the government responded by setting up the load-shedding program followed by other stopgap measures, the October crisis clearly exposed the vulnerability of the electricity sector in Pakistan.

Irrigation[8]

55. Water is central to the political, social, and economic well-being of Pakistan. Pakistan relies on the irrigation system for basic food security and supply of water for all sectors of the economy. Agriculture despite its declining share in GDP, currently estimated at 22%, remains central to the country's economy. It is the single most important source of employment and exports, accounting for two-thirds of employment and 80% of exports. Not less importantly, about 30% of electricity generation and all domestic, municipal and industrial water are supplied from the irrigation system.

56. Given the agro-climatic conditions of the country, irrigation is essential for growing crops. Irrigated land supplies more than 90% of agriculture production. The main source of water is the Indus River Basin with its intensive infrastructure: the Indus River and its tributaries, three major multi-purpose storage reservoirs, 19 barrages, 12 inter-river link canals, 43 major irrigation canal commands (covering over 14 million hectares), and over 120,000 watercourses, delivering water to farms and other productive uses. Annual river flows are about 180 billion cubic meters (m^3) of which about two-thirds are diverted from the river system to canals annually. The canal system is also a major source of recharge for groundwater aquifers. In fresh groundwater areas, groundwater is pumped by tubewells to supplement canal supplies. Groundwater resources are substantial, with more than 600,000 tubewells in the country contributing significantly to water supplies in areas underlain by fresh groundwater.

57. The irrigation system is organized in a hierarchical manner starting from dams and/or barrages to main canals (i.e. primary canal level), branches and distributary canals (i.e. secondary level canals), and to watercourses and on-farm field channels. Dams, barrages, and main canals are owned and managed by public sector, with dams owned and operated by the federal government, and barrages and main canals managed by provincial governments. Watercourses are managed by communities (through organizations such as Water Users Associations) and on-farm field channels are managed by the farmers.

[8] The information in this section is obtained from the Note on Irrigation Sector written by Mahwash Wasiq (2011)

58. The key challenges in the irrigation sector are: (i) low surface water delivery efficiency (only about 35%-40% of water from canal head reaches the crop root zone), with major losses in watercourse command areas; (ii) wasteful on-farm water use and low water productivity; (iii) poor operation and maintenance (O&M) and low cost recovery; (iv) water distribution inequities; (v) lack of storage capacity and control structures and limited availability of water resources; (vi) waterlogging and salinity; (viii) poor management of ground water resources including over-extraction of ground water in most parts of the country; and (ix) a constrained investment capacity. Many of these challenges are governance-related, while others are due to increasing water stress, with limited additional water resources that can be mobilized, coupled with the looming threat of climate change.

59. Some of these issues, in particular poor O&M of the government-owned upper tiers of the system and inequities in water distribution, are a manifestation of institutional weaknesses in the sector. This is mainly due to the near exclusive control by public sector entities, characterized by usual inefficiencies of centralized bureaucracies, lack of corporate skills and poor client (farmer) focus and accountability. The poor level of service provided to water users has been matched by an equally poor level of water charge (*abiana*) collection with a resultant gap between the monies collected and the expenditure required for adequate O&M of the irrigation system.

60. In order to address these issues the Government of Pakistan initiated reforms in water resources and irrigation and drainage sectors in the late 1990s. The reforms were aimed at improving water resources management, enhancing water use efficiency and productivity, and facilitating active participation by water users in management processes. The reforms resulted in the restructuring of the Public Irrigation Departments (PIDs) by creating autonomous Provincial Irrigation and Drainage Authorities (PIDAs) at provincial level, with commercially oriented Area Water Boards (AWBs) to manage main and branch canals and Farmers' Organizations (FOs) to manage distributary and minor canals. The reform objectives would be achieved through (a) greater transparency in water measurements and pricing as accounting and enhanced monitoring are introduced; and (b) preparation of asset management plans and improved methodology for determining O&M requirements.

61. These reforms have been implemented in Punjab, Sindh, Kyber Pakhtunkwa (KP) and Balochistan provinces, with various degrees of progress and success. The reform program is perhaps most advanced in Sindh Province. Sindh has passed an ordinance, namely the Sindh Water Management Ordinance of 2002, providing underlying legal basis for the new institutions as well as defining their role in the sector. Sindh has also established three AWBs in the left bank of the Indus, covering about 1.8 million hectares of land or 30% of the irrigated area in the province. The FOs have been established on almost all distributary canals in these AWBs. Punjab has also implemented reform programs in eight canal commands, covering about 6.5 million hectares, and has started establishing FOs. Reform programs have also started in Balochistan and Khyber Pakhtunkhwa provinces, but they lag behind considerably.

Conclusions and Policy Recommendations

62. Public infrastructure in Pakistan has improved in last 50 years but at a disappointingly slow rate for majority of sectors. Other similar countries—Malaysia, Sri Lanka and Egypt—have made substantially stronger progress. Regarding transport sector, Pakistan has a comparatively low density of paved roads, a dismal quality of railroads and airports, and only an acceptable quality of seaports. With respect to power sector, both electricity generation and distribution are quite inefficient in Pakistan, having among the lowest electricity generating capacity and the highest power losses with respect to selected comparator countries. Even worse, serious institutional shortcomings prevent electricity generation from reaching its capacity, resulting in systematic power outages and load shedding. Regarding water sector, the access to potable water and sanitation in Pakistan is well below the typical comparator country, and only on irrigation infrastructure Pakistan performs as one of the best in the group. The telecommunication sector shows better results for Pakistan. The fixed telephone density is relatively low; however, this is compensated by a very active mobile telephone industry. Internet penetration and mobile phone density have increased quite significantly in the last decade.

63. The link between public infrastructure and economic growth goes in both directions. On one hand, more and better public infrastructure generates higher economic growth. On the other hand, stronger economic growth induces expansion of public infrastructure. Using this conceptual framework, this paper provides an estimate for projected changes in infrastructure for Pakistan in the next five years. These changes depend crucially on actual economic growth in recent years and projected growth for future years. Given that both trend and expected economic growth in Pakistan is lower than most if not all comparator countries, the projected changes in infrastructure in all sectors are relatively low in Pakistan, much weaker than those in India, for instance.

64. This does not mean, however, that more and better public infrastructure is not needed to improve social welfare or that it would not produce larger economic growth. In fact, the growth effect of an exogenous increase in infrastructure can be quite sizable. Using the regression results obtained in the cross-country and time-series study of Loayza and Odawara (2010), we can gauge the growth impact of a substantial infrastructure improvement in Pakistan. If Pakistan were to improve its electricity, transport, and telecommunications sectors to corresponding levels of Malaysia, GDP per capita growth would increase by 3.7%, with contributions from each sector as follows, 1.9% from electricity, 0.6% from transport and 1.2% from telecommunications.[9] The growth gains are large indeed, but so would the efficiency improvements and funding requirements to achieve them.

65. Table 2 presents a summary of policy recommendations for short- and medium-term for different areas of public infrastructure. They are based on analysis previously presented in the paper, both historical/international comparisons and the selected sectoral discussion. Most of the recommendations are directed to improving infrastructure efficiency and, in the medium run, stimulating infrastructure investment. If priority sectors for policy action are

[9] Loayza and Odawara (2010) estimate the effect of three infrastructure indices on GDP per capita growth. The indices are created as follows. Electricity Index: First principal component of power loss (as % of electricity output) and electricity generating capacity (in MW per 1,000 workers, in logs). Transport Index: First principal component of share of paved roads in overall road network and length of roads (in km standardized by population and surface area, in logs). Telecommunication Index: Main telephone lines per 1000 workers (in logs).

those where most quantity and quality deficits are observed, then electricity is the sector that requires stronger priority action in all aspects, from tariff pricing and debt collection to power generation and distribution. It is, in this sense, followed by transport (where railways and road maintenance are particularly lacking), then irrigation (which has advanced in some provinces, notably Sindh, but is lagging in others), and finally telecommunications (which in so far as mobile phones and internet access is concerned represents a remarkable success case).

66. One important policy decision regarding infrastructure is the amount of public investment allocated to each sector. This has been declining in the last 15 years in Pakistan, reflecting undoubtedly the fiscal constraints facing the country: a large and rising public debt and a high share of expenditures taken up by price subsidies and public sector wages. The decline is evident for all sectors but is particularly severe for electricity and transport. The actual levels of public investment in infrastructure are unsustainably low, and we recommend that they be increased to about 2% of GDP, the average rate in previous decade.

67. Whereas in other comparator countries the decline in public infrastructure investment has been accompanied by an increasing participation of the private sector (e.g., Egypt and Turkey), in Pakistan private sector investment in infrastructure has been rather timid. In transport, the private sector has not become a major player. After some surge in private investment in electricity in the mid and late 1990s, it has become quite sluggish in recent years. The only exception is telecommunications, where the private sector has taken a lead role in both investment and management. An increase in private sector participation in both administration and funding of public infrastructure is essential to improving its quality in every single sector, albeit with some differences: larger in electricity, ports, railroads and telecommunications, and lower in roads and irrigation (where public good characteristics of infrastructure are more pronounced). With this in mind, we recommend a target private investment rate for infrastructure of about 2.5% of GDP, which amounts to the average for the country in the 2000s and the level to which successful large developing countries are converging.

68. Finally, the contrast between the evolution of the electricity and telecommunication sectors in the last decade is both interesting and revealing. The electricity sector is plagued with problems related to insufficient capacity, inefficient operation and poor service. The sector's deficiencies have become so pervasive that they are negatively affecting the whole nation and its economy. In contrast, the telecommunication sector has progressed at a remarkably fast pace, extending its coverage manifold and cutting its costs radically. Almost everyone has access to a good cell phone service in Pakistan. There are policy and institutional reasons for this sharp difference: whereas the electricity sector is an odd combination of public and private sector intervention, with equivocal incentives and burdensome regulations, the telecommunications sector is driven by the private sector, with streamlined regulations and strong competition. Notwithstanding the technological and economic differences across public infrastructure sectors, the successful experience of telecommunications in Pakistan represents an example to follow for all infrastructure provision.

Table 2 **Policy Recommendations**

Objectives	Short-Term Actions	Medium-Term Actions
Provide sufficient funding for operations and maintenance (O&M) and for development of new infrastructure	Ensure that essential O&M is funded by direct outlays by government and by user fees	- Increase public investment back to 2% of GDP - Encourage private investment to reach 2.5% of GDP
Raise electricity generating capacity and distribution to meet growing power demand	- Resolve the "circular debt" problem between providers and government - Improve billing and collections for both households and firms - Increase tariffs to technically optimal levels	- Privatize the generation and distribution of electricity - Regulate the privatized companies to prevent monopolistic practices - Consider incentives for the technological shift to hydroelectric power generation
Expand transportation network and improve quality of its services	- Eliminate the financing gap of the Road Maintenance Account by raising toll rates, as recommended by the National Highway Authority (NHA) - Negotiate pension and other liabilities of Pakistan Railways with the view of privatizing them in the medium term - Negotiate pension and other liabilities of port authorities with the view of privatizing them in the medium term	- Provide direct funding to NHA through the government budget in order to implement its 10-Yearr business plan. Absorb its outstanding debt. - Privatize the development and operations of railroads through a concession scheme - Privatize the development and operations of most if not all airports and seaports through a concession scheme
Increase the telecommunications network while keeping its user costs low	- Continue the successful model of private providers with some government regulation to prevent monopolistic practices	- Encourage private participation in remote areas, where telephone and internet services are absent or too expensive
Improve water resource management and enhance water use efficiency	- Complete the irrigation reforms started in Sindh and Punjab provinces: achieving proper water measurement and pricing and developing plans for asset management and operations and maintenance	- Provide the institutional framework and funding to implement the irrigation reforms in the remaining provinces, especially in Khyber Paktunkhwa and Balochistan

Box 1 **Review of Literature Linking Public Infrastructure & Economic Growth**

Over the past few decades, an extensive body of literature has examined the linkages between infrastructure and economic growth. While majority of studies to date suggest that infrastructure positively affects economic growth, the degree of effects vary according to the samples, measures of infrastructure and econometric methodologies employed in the analysis. By comparing 30 studies with 80 different specifications, Straub (2008) provides a comprehensive review on this subject and finds that, for example, positive effects of infrastructure tend to be observed in the sample of developed countries or when using physical indicators of infrastructure. The literature review below concentrates on the studies applied to Pakistan and its region.

A recent study by Straub and Hagiwara (2011) analyzes the relationship between infrastructure and growth with a sample of 102 developing economies, of which five belong to South Asia including Pakistan. The study considers physical infrastructure indicators for four different sectors (telecommunication, energy, transport and water). In the growth regression analysis, they introduce specifications with interactions between an infrastructure proxy and regional dummies including one for South Asia. For most indicators, the results of cross-country estimations show that the contributions of infrastructure to growth turn out to be positive and significant, to a much higher degree than the overall sample, when interactions with the South Asia dummy and other Asian regional dummy are introduced. The authors attribute such positive effects largely to having higher factor accumulation, but assert that the indirect effect of infrastructure on productivity is, however, ambiguous.

Faridi, Malik, and Bashir (2011) explore the impact of transportation and telecommunication on economic growth in Pakistan by using Solow growth model. Roads in kilometers and number of telephone lines are used as proxies for infrastructure indicators for respective sectors, covering the period 1972 through 2010. The study finds that transport infrastructure is positively and significantly correlated with GDP. In particular, one per cent increase in transportation infrastructure of Pakistan leads to 0.09 per cent rise in GDP on the average. Conversely, the analysis shows that communication infrastructure is negatively associated with GDP. It is estimated that one per cent increase in the number of telephone lines in the country results in 0.08 per cent drop in GDP. The authors claim that this is due to improper use of communication and propose the country to create training and skill programs for labor.

On a similar line, Hashim et al. (2009) study the link between telecommunication infrastructure and economic development in Pakistan for the period between 1968 and 2007. They employ two infrastructure indicators: one is teledensity that represents the total number of fixed telephones and mobile phones over population; the other is investment in telecommunication sector, for which estimation of investment in telecommunication and transport sector is used as a proxy. The regression results indicate that the effects of both variables on GDP are positive and significant.

Other studies present different findings. Looney (1997) examines the effects of infrastructure, such as energy and transport, on Pakistan's economic development, highlighting its relation to private sector investment. By applying a vector autoregressive (VAR) methodology, the paper reveals that the role played by public infrastructure in expanding the country's economy since 1973 were rather minor. The variance decomposition simulations indicate that only 1.5% of variance in GDP can be explained by general infrastructure. Furthermore, less than 5% of the variance in private investment in large scale manufacturing account for infrastructure. The author observes that the expansion of infrastructure was largely driven by the needs of private sector investment in manufacturing instead of stimulating the private capital formation. Similarly, but in a larger context, Ghani and Din (2006) investigate the impact of public investment on economic growth in Pakistan using the VAR approach. Their empirical analysis shows that public investment has a negative but insignificant impact on economic growth, which questions the efficiency of public investment.

Closely related to this approach, Iqbal and Nadeem (2006) investigate the causal relationship among social, real, monetary and infrastructure development in Pakistan. The composite indicators in those four areas are constructed using principal component. For infrastructure development composite indicator, 17 variables related to road, railway, telephone, energy and other few sectors are taken into account. The authors employ

Granger causality test in a vector error correction model for the period 1971-72 to 2003-4 and find that in case of Pakistan, infrastructure development causes social development, while it fails to cause real economic as well as monetary growth.

Although the level of infrastructure in Pakistan is more or less comparable to that of their neighboring countries, the government recognizes in its Framework for Economic Growth (2011) that other factors such as management and productivity play an important role in hindering the country's competitiveness. However, comparators used are limited to a few underperforming economies. For instance, low productivity of transport infrastructure is leading to a loss of nearly 5% of GDP in Pakistan annually. In the ranking of Connectivity Scorecard, which measures not only physical connectivity but also assesses how productively the hardware and infrastructure are utilized, Pakistan was ranked 25th out of 25 developing countries. As much as the lack of infrastructure in certain sectors is concerned, effective utilization and management of infrastructure must be accompanied in order to achieve the desired growth.

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Annexure 1: Data Sources

Variable	Definition / Unit	Source
TRANSPORT		
Length of total roads	km, sqrt of 1000 population * mean arable land	International Road Federation
Paved roads	km, sqrt of 1000 population * mean arable land	International Road Federation
Paved roads	ratio to total road	International Road Federation
Quality of port facilities and inland waterways	index 1-7	Global Competitiveness Report
Quality of air transport	index 1-7	Global Competitiveness Report
TELECOMMUNICATION		
The number of main phone lines	per 1000 population	International Telecommunications Union
Cellular mobile telephone subscribers	per 1000 population	International Telecommunications Union
The number of internet users	per 1000 population	World Development Indicators
ELECTRICITY		
Electricity generating capacity	megawatts, per 1000 population	U.S. Energy Information Administration
Power loss	% of total output	World Development Indicators
Access to electricity	electrification rate (%)	World Energy Outlook
WATER AND SANITATION		
Access to improved water sources	% of population with access	World Development Indicators
Access to improved sanitation facilities	% of population with access	World Development Indicators
Irrigation	% of irrigation potential equipped for irrigation	Food and Agriculture Organization Aquastat
INVESTMENT (Pakistan)		
Investment (Transport, Telecommunication, Electricity)	% of GDP	Pakistan Statistical Yearbook (National Accounts, Gross fixed capital formation)
Investment (Water, Sanitation, Irrigation)	% of GDP	Federal Civil Accounts; Finance Accounts Punjab, Sindh, Khyber Pakhtunkhwa, Balochistan
INVESTMENT (Cross-country)		
Investment (Total, Public, Private)	% of GDP	Calderón, Odawara, & Servén (2010)
OTHER		
GDP per capita	constant 2000 US$, logs	World Development Indicators
Population		World Development Indicators
Arable land	hectares	World Development Indicators

Annexure 2: Robustness Check

	Dependent Variable: Infrastructure Index							
	Transport					Telecommunication		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Explanatory variables:	Total road length (normalized)	Paved road (% of total road)	Paved road length (normalized)	Quality of port (index 1-7)	Quality of air transport (index 1-7)	Main phone lines (per 1000 pop)	Cell phone (per 1000 pop)	Internet users (per 1000 pop)
Initial GDP per capita (constant 2000 US$, in logs)	0.105 ***	10.646 ***	0.169 ***	1.816 **	1.282 **	146.25 ***	617.19 ***	404.83 ***
	[7.617]	[10.901]	[14.659]	[2.360]	[2.277]	[20.245]	[13.418]	[10.883]
GDP per capita growth (log difference of GDP per capita, average over the period)	0.166	16.338 **	0.182 *	7.468 *	2.842	268 ***	2046.8 ***	917.12 ***
	[1.481]	[2.015]	[1.923]	[1.789]	[0.931]	[4.427]	[7.010]	[4.410]
Initial urban population (% of total population)	0.002 ***	0.332 ***	0.001 **	0.127 **	0.068 *	2.678 ***	13.473 ***	4.950 **
	[3.598]	[7.493]	[2.364]	[2.300]	[1.671]	[7.867]	[5.740]	[2.273]
Constant	-0.421 ***	-52.517 ***	-1.069 ***	-17.889 ***	-9.565 ***	-1086.2 ***	-5137.8 ***	-3229.8 ***
	[4.728]	[8.297]	[14.257]	[3.843]	[2.808]	[23.358]	[16.893]	[13.222]
No. of observations	1013	998	983	203	203	1067	808	588
No. of countries	128	129	127	112	112	129	129	129
R-squared	0.148	0.315	0.314	0.273	0.214	0.508	0.367	0.306
Period	1961-2010	1961-2010	1961-2010	2001-2010	2001-2010	1961-2010	1976-2010	1986-2010

Notes:
1. Fixed-effects estimator is used in the regressions.
2. Absolute values of t-statistics are presented below the corresponding coefficients.
*3. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.*

Annexure 2: Robustness Check (cont'd)

	Dependent Variable: Infrastructure Index					
	Power			Water, Sanitation, Irrigation		
Explanatory variables:	[9] Electricity generating capacity (per 1000 pop)	[10] Power loss (% of total output)	[11] Access to electricity (% of pop)	[12] Access to improved water (% of pop)	[13] Access to improved sanitation (% of pop)	[14] Equipped for irrigation (% of potential)
Initial GDP per capita (constant 2000 US$, in logs)	0.349 *** [13.326]	-4.269 *** [7.189]	24.878 *** [3.847]	4.246 *** [4.116]	4.303 *** [4.483]	7.826 *** [4.012]
GDP per capita growth (log difference of GDP per capita, average over the period)	0.190 [1.141]	-6.662 [1.519]	50.750 [1.317]	31.352 *** [5.938]	26.406 *** [5.158]	28.995 * [1.874]
Initial urban population (% of total population)	0.007 *** [5.272]	0.167 *** [5.463]	0.808 * [1.983]	0.617 *** [10.217]	0.647 *** [11.448]	0.481 *** [5.604]
Constant	-2.244 *** [12.895]	36.792 *** [9.416]	-151.18 *** [4.158]	18.047 *** [2.707]	2.763 [0.448]	-40.956 *** [3.641]
No. of observations	789	816	135	582	577	344
No. of countries	127	112	68	125	124	85
R-squared	0.362	0.073	0.430	0.360	0.398	0.373
Period	1976-2010	1961-2010	2001-2010	1986-2010	1986-2010	1961-2010

Notes:
1. Fixed-effects estimator is used in the regressions.
2. Absolute values of t-statistics are presented below the corresponding coefficients.
*3. *, **, and *** denote significance at the 10 percent, 5 percent, and 1 percent levels, respectively.*