

# Infrastructure in Latin America: An update, 1980-2006

César Calderón \*  
Luis Servén \*

The World Bank

*This version: May 2009*

## Abstract

This paper documents the trends in infrastructure in major Latin American economies over the last quarter century. Drawing from an expanded and updated data set, the paper sheds light on the region's infrastructure performance along four major dimensions. First, the paper documents the trends in the quantity of Latin America's infrastructure assets, using a comparative cross-regional perspective. Second, the paper presents a battery of indicators of the quality of infrastructure services, taking the same comparative perspective. Third, the paper reviews Latin America's performance in terms of the universality of access to infrastructure services. Lastly, the paper offers a detailed account of the trends in infrastructure investment in Latin America's six major economies since 1980, disaggregated by both sector of origin (public and private) and destination (power, transport and telecommunications).

**JEL Classification:** H54, O54

**Keywords:** Infrastructure, Public investment, Latin America

---

\* This work was partly supported by the Public-Private Infrastructure Advisory Facility (PPIAF). We are grateful to Patricia Macchi, Rei Odawara and Junko Sekine for excellent research assistance. Any remaining errors are our own. The views expressed in this paper are only ours and do not necessarily reflect those of World Bank, its Board of Directors, or the countries they represent.

## 1. Introduction

An adequate supply of infrastructure services has long been viewed as a key ingredient for economic development, both in the academic literature (starting with the work of Aschauer 1989) as well as in the policy debate (e.g., World Bank 1994). Over the last two decades, academic research has devoted considerable effort to theoretical and empirical analyses of the contribution of infrastructure development to growth and productivity. More recently, increasing attention has been paid also to the impact of infrastructure on poverty and inequality (Estache, Foster and Wodon 2002, World Bank 2003, 2006). While the empirical literature on these two topics is far from unanimous, on the whole a consensus has emerged that, under the right conditions, infrastructure development can play a major role in promoting growth and equity – and, through both channels, helping reduce poverty (Calderón and Servén 2008).

This report reviews the trends in infrastructure performance in Latin America. Drawing from both primary and secondary data sources, the report does two things. First, it documents the evolution of the quantity and quality of infrastructure as well as the access to infrastructure services over the period 1980-2006. Second, the report also offers a detailed account of infrastructure investment in six major Latin American countries (LAC6), updating the dataset constructed in earlier work by Calderón, Easterly and Servén (2003) and Calderón and Servén (2004). This information is collected from a wide array of national sources —from statistical institutes to ministries and monitoring agencies. The database underlying the report documents all these dimensions of infrastructure performance in Latin America over a long time horizon, and should be useful to both researchers and practitioners. The scope of this update has been largely determined by the availability of information, and hence it reflects the limitations of the sources. In this regard, the collection of data on infrastructure investment disaggregated by agent (public, private) and sector of destination is particularly challenging, and for this reason the information on investment presented here covers only the six largest Latin American economies (Argentina, Brazil, Chile, Colombia, Mexico, and Peru).

The rest of the report is organized as follows. Section 2 reviews the trends in the quantity, quality and access to infrastructure in Latin America. Section 3 turns to the trends in infrastructure investment in major Latin American countries. Section 4 concludes. The appendices give extensive details on the sources of the data described in the main text.

## 2. Trends in infrastructure: quantity, quality and access to services

We begin by reviewing the main trends in the availability, quality and accessibility of infrastructure over the last two decades. We focus on countries with population greater than 1 million in 2005. This yields a sample of 158 countries, of which 21 are in the Latin America and the Caribbean region.<sup>1</sup> Nevertheless, in some cases, constraints posed by data availability force us to limit the analysis to a narrower set of Latin American countries.

We focus on four core infrastructure sectors: telecommunications, power, land transportation, and water and sanitation. To place Latin America's trends in context, we take a comparative perspective. We use two sets of comparator countries. The first one comprises the middle and high-income countries of East Asia (EAP non-LICs). In this group of countries we find the seven "East Asian miracles" (Hong Kong, Indonesia, Korea, Malaysia, Singapore, Taiwan, and Thailand) and some of the region's fast-growing countries such as China, Cambodia, the Philippines and Vietnam. The second comparator is the entire set of middle-income developing economies excluding LAC countries (non-LAC MICs) for which information is available; this includes a total of 70 countries.<sup>2</sup> Further, we also assess the progress of these developing regions in terms of infrastructure indicators vis-à-vis 21 industrial economies of the OECD<sup>3</sup>.

Finally, we need to point out that there is a great deal of heterogeneity in infrastructure development (quantity, quality and access) across countries in the region. More details about the evolution of infrastructure development across individual LAC countries are found in Calderon and Servén (2004) and in the database.

### 2.1 Infrastructure stocks<sup>4</sup>

**Telecommunications** -- Figures 1 and 2 show the evolution of several telecommunications capacity indicators over the last quarter century. In each case we show the regional (or group) median. Figure 1 presents the number of main lines in operation per worker. It is apparent from

---

<sup>1</sup> This leads to the exclusion of smaller Caribbean islands with limited data availability, whose inclusion tends to distort region-wide statistics for Latin America and the Caribbean.

<sup>2</sup> We use middle-income economies rather than all developing countries because most Latin American countries belong to the former category. Like with the Latin American economies, we exclude countries whose total population is less than one million.

<sup>3</sup> OECD is defined here excluding Korea and Mexico.

<sup>4</sup> A brief outline on the sources of the data of the physical indicators of infrastructure quantity and quality as well as the measures of access to infrastructure is provided in Appendix I.

the graph that Latin America has consistently lagged behind the other regions. In 1980, Latin America was roughly on par with EAP non-LICS and trailed non-LAC MICs by a relatively small margin. By 2000, Latin America had fallen behind the norm of EAP non-LICs. After 2000, the gap between Latin American and East Asia, as well as that vis-à-vis industrial countries, has narrowed somewhat, and the catch-up is primarily due to a fall in the number of main phone lines per worker among industrial countries and a growth slowdown in EAP non-LICs (see Table 1).

Figure 2, on the other hand, depicts the evolution of total phone lines, which is the sum of main lines plus mobile cellular subscribers —arguably a more relevant measure of the penetration of the telecommunications sector nowadays. The figure documents the impressive rise in the number of mobile phones after 1990 across all regions. Here we observe that while LAC grows at the same pace as non-LAC MICs, the expansion of the telecommunication sector has not been as fast as that of EAP non-LICs.<sup>5</sup>

**Power** – Figure 3 shows the trends in power generation capacity per worker. Along this dimension, Latin America has fallen behind not only East Asia, but also the rest of middle-income developing economies. In this category, the region’s lag vis-a-vis non-LAC MICs developed in the 1990s. Regarding EAP non-LICs, the representative country in LAC fell behind in power generation during the early 1990s and then has caught up slightly by early 2000s.

**Transport** – We examine the trends in land transport networks. Unlike with power and telecommunications, in this case we normalize the measures of network density by each country’s total geographic area, to adjust for the wide disparities in country size present in our cross-country sample.<sup>6</sup>

Figure 4 depicts the trends in the total length of the road network.<sup>7</sup> There is a huge gap between industrial and developing regions along this dimension, and it has widened considerably since 1990 —although in industrial countries the growth in road network density

---

<sup>5</sup> A perhaps more accurate measure of the availability of phone services is the connection capacity of local exchanges. Unfortunately, information on this measure is more limited, and does not extend to all the countries in figures 1 and 2.

<sup>6</sup> Using arable land area rather than total area leads to very similar rankings. For this exercise, we exclude Singapore and Hong-Kong from the set of East Asian comparator countries, in view of the particular physical characteristics (small area and very high population density) of both city-states.

virtually ceased after 2000, likely reflecting near-saturation (see Table 1). Among the three groups of developing countries shown, Latin America was on par with non-LAC MICs in 1980, but twenty six years later its road density has barely grown and, as a consequence, it is now below that of middle-income countries, and even further below East Asia's (see Table 1).

## 2.2 Infrastructure quality

Broadly speaking, there are two types of information on the quality of infrastructure: (a) officially-recorded data on quantitative measures of the quality of infrastructure services and, (b) survey-based information on the perception of experts or final users regarding the performance of infrastructure services — typically qualitative in nature. In this report we will basically show (for reasons of space), the first set of indicators.

Officially-recorded statistics on infrastructure quality are unfortunately much less complete than those on its quantity. This is particularly problematic in the case of telecommunications. Cross-country data on the telecommunications quality indicators that on conceptual grounds should be most informative — the frequency of telephone faults and unsuccessful calls— are extremely sparse. Thus, we complement this information showing data on the waiting time for installation of main lines, which in theory is a measure of excess demand, but in practice shows a significant positive correlation (see Calderón and Servén 2004) with the theoretically-preferable measures just cited, over the reduced sample for which the latter are available. Information on waiting times can be collected for a fairly large sample of country-year pairs.<sup>8</sup>

In the cases of power and transport, the situation is better, and we have fairly abundant data on two widely-used (albeit far from perfect) measures of quality — the percentage of power losses and the proportion of paved roads in the total.

It is worth noting that these infrastructure quality indicators show a high correlation with the infrastructure quantity indicators reviewed above. In a large panel data set, Calderón and Servén (2004) find sector-wise correlation coefficients (e.g., between power generation capacity and power losses, or between road density and road quality) around 0.5, significantly

---

<sup>7</sup> A preferable indicator would be the length of the network in lane-km equivalent. Unfortunately, such measure is not widely available.

<sup>8</sup> Table 2 shows that higher quality —measured by an index based on waiting time for installation of main lines— is associated with lower telephone faults (-0.19) and a higher percentage of phone faults clear next day (0.18). Note that these correlations are statistically significant.

different from zero at any reasonable significance level. The implication is that more abundant infrastructure typically comes along with better infrastructure.

In view of the limitations of these indicators of infrastructure quality, increasing effort has been devoted in recent years to the compilation of survey-based assessments of infrastructure performance. Two leading sources of such kind of data are (a) international surveys of business conditions, that reflect the views of international experts, and (b) firm-level surveys that capture the perceptions of infrastructure users. At present, however, the time-series dimension is in both cases very limited (virtually nil, in the case of firm surveys), and comparability over time and across countries is sometimes hampered by changes in the relevant survey questions.

**Telecommunications** – Figures 5-7 show the evolution of three quality indicators of telecommunications: (a) an indicator based on the waiting time (in years) for installation of main telephone lines. This indicator has been rescaled (**how??**) to take values between 0 and 1, with higher values indicating higher quality of telecommunication services; (b) the number of telephone faults per 100 main lines, and (c) the percentage of phone faults cleared the next day, and (c) the number of telephone faults per 100 main lines. The data coverage is considerably more limited than in the graphs describing the quantity of telecommunications infrastructure shown earlier.<sup>9</sup> Along this dimension, Latin America's progress over the last two decades was spectacular, as the median waiting time was reduced from six months in 1980 to a few days by 2006, on par with the norm of non-LAC middle income countries. In rich countries the median waiting time fell to zero in the early 1980s, while in East Asia it did the same by 1990 (see Figure 5). On the other hand, Figure 6 shows that the number of telephone faults per 100 main lines has declined considerably to 5 in 2001-6 from 52 in 1991-6. In addition, not only the number of phone faults declined but also the percentage of faults cleared next day increased. In fact, the percentage of phone faults cleared next day increased from 55% in 1991-6 to approximately 87% in 2001-6 (see Figure 7).

**Power** – The percentage of transmission and distribution losses relative to total output offers a rough measure of the efficiency of the power sector. However, observed power losses include

---

<sup>9</sup> It covers roughly half of the countries, and approaches annual frequency only starting in the 1990s.

both ‘technical’ losses, reflective of the quality of the power grid, and pilferage (i.e. power theft), and unfortunately there is virtually no information on the relative importance of the two.

With this caveat, Figure 8 offers a comparative perspective over the period of analysis. In contrast with the declining trends in East Asia and industrial countries, Latin America’s power losses showed a severe deterioration in the 1980s and 90s (see also Table 1). The same happened among middle income countries. After 2000 this process has shown an incipient reversion, and median power losses in Latin America have fallen to around 15 percent of output. This is on par with the levels of 1990, but still more than twice as high as those shown by industrial countries and East Asia.

**Transport** – The only quality indicator widely available for this sector is the percentage of paved roads in the total road network, which is depicted in Figure 9. In the year 2006, a quarter of the road network (25 percent) was paved in the typical Latin American country, far behind the non-LAC MIC’s norm of 64 percent, and much further behind that of East Asia non-LICs, which by 2006 was closing the gap with the industrial-country norm.

### **2.3 Access to infrastructure services**

So far we have been concerned with the overall quantity and quality of infrastructure. But from the point of view of equality of opportunity and poverty reduction, another important dimension is the universality of access to infrastructure services – i.e., the extent to which existing infrastructure assets yield services to the broad population rather than just a few. One way to measure this phenomenon is through access rates. Figures 10-16 offer a comparative perspective on standard indicators of access to telecommunications, electric power, roads, water and sanitation. Coverage of information on access rates is limited, especially in the time series dimension, and therefore we confine ourselves to the cross-country dimension, except in the case of water, for which some time-series information is also available. In these figures we present the median access rates by region for the period 2001-6.

Figures 10-12 show indicators of access to telecommunication services across regions in the period 2001-6. On average, 40 percent of the population has a telephone in the LAC region –well below the rate of access for EAP non-LICs and non-LAC MICs (See Figure 10). On the other hand, the coverage of cellular network in EAP non-LICs is at the same level as that of industrial countries whereas the coverage of mobile phones reaches almost 90 percent of the population

in the LAC region (see Figure 11). Finally, the differences in the access to internet services across regions are depicted in Figure 12. While East Asia leads the pack, LAC has the lowest rate of access to internet—that is, less than 10 percent of the population has access to internet in the representative LAC country.

Figure 13 reports the percentage of the population with access to electric power. The indicator is available only for developing countries. Latin America’s median access rate equals 87 percent, short of the 90 percent of other middle-income countries, and far behind the 98 percent observed in the successful East Asian economies. Venezuela, Chile and Costa Rica exhibit access rates on par with East Asia’s. At the other end, less than two-thirds of the population enjoys access to electricity in Bolivia and Honduras.

A widely-used indicator of access to transport is given by the percentage of the rural population living within a short distance (2 km) of an all-season passable road. Figure 14 shows that Latin America trails East Asia as well as other middle-income economies along this dimension. Among LAC countries, access to transport is particularly poor in Nicaragua, where it reaches just over one-fourth of the population.

Figure 15 offers a cross-regional perspective on access to safe water. We use the percentage of population with access to safe water, including treated surface water and untreated but uncontaminated water such as from springs, sanitary wells, and protected boreholes. Latin America has caught up with other middle income countries, to reach a median access rate of 93 percent. Both East Asia’s successful economies as well as industrial countries enjoy universal access to safe water. In Latin America, a number of countries (notably Ecuador and Paraguay) have shown major progress since 1990, although at present few countries show access rates comparable to those of East Asia.

Rates of access to sanitation are shown in Figure 16. Along this dimension, Latin America ranks below other middle-income countries. At just under 80 percent, its access rate is still far from the almost-universal coverage observed among successful East Asian economies. Uruguay is the only Latin American country to have reached universal access. In Bolivia and Nicaragua, less than half of the population enjoys access to sanitation.

#### **2.4 Correlation among infrastructure indicators**

Table 2 reports the correlation between quantity and quality indicators of infrastructure. These correlations are computed using annual data for the period 1980-2006 and



show a great deal of co-movement among infrastructure quality and quantity measures. For instance, quantity indicators of telecommunications, electricity and land transportation have a positive and statistically significant pattern of co-movement. Their degree of association ranges between 0.31 and 0.61. Quality indicators are also significantly correlated. Higher quality in telecommunication services is positively related with higher road quality and improved quality in electricity provision. Lower electricity transmission and distribution losses are associated to lower waiting time for main line installation (-0.36) and to higher share of paved roads (-0.31).

Quantity and quality indicators of infrastructure are also positively correlated. An expansion of main lines and/or mobile networks is directly associated with lower time for installation, lower phone faults and a higher percentage of faults cleared the next day. Also, an expansion of power generating capacity is associated with lower power losses (-0.3), while an enlargement of the road network is usually correlated with a larger share of paved roads (0.52).

Although not reported in Table 2, Calderon and Servén (2008) show that measures of quantity and access as well as quality and access are directly related as well. Higher quantity and quality of infrastructure is positively correlated with improved access to electricity and land transportation. Finally, the rates of access to telecommunications also rise with the coverage of main lines and mobile phones. These correlations range between 0.67 and 0.76.

### **3. Trends in infrastructure investment**

We next review the trends in infrastructure investment in major Latin American economies. We focus on six countries for which the requisite data could be collected. The list includes the region's six biggest economies -- Argentina, Brazil, Chile, Colombia, Mexico and Peru.<sup>10</sup>

To ensure comparability across countries, we continue to focus on the same core infrastructure sectors in the previous sections: telecommunications, power, land transportation (roads and railways) and water. Thus we exclude the petroleum sector, which in some of the region's countries attracts large volumes of investment, as well as ports and airports, for which consistent data across countries could not be collected.

---

<sup>10</sup> Partial information was also collected on Bolivia, Ecuador and Venezuela. Data for these countries is less complete, and presents some inconsistencies that we have not been able to resolve yet. For this reason, we opt for not including them here.

For each country, we used a variety of national sources, summarized in Appendix II.<sup>11</sup> Regarding public investment, an effort was made to capture the investment expenditures of different levels of government as well as those of public enterprises. However, the available sources do not always make this possible – they sometimes omit investment by local governments (municipalities) altogether, while in other cases they do not clarify the extent to which it is captured by the data. For this reason, the figures reported below have to be taken with some caution.

Keeping this caveat in mind, Figure 16 offers a comparative perspective on the performance of infrastructure investment across Latin America's major economies. The top panel depicts the trajectory of total infrastructure investment – defined to include surface transport (i.e., roads and railways), power, telecommunications and water – relative to GDP. Three facts can be noted. First, in recent years the level of infrastructure investment shows considerable variation across countries – from less than 1.2 percent of GDP in Mexico in 2006, to 4.3 percent in Chile in the same year. Second, in most countries infrastructure investment experienced a decline around the mid 1980s, which in several cases has not been reversed. Third, Colombia, Chile and Peru witnessed a substantial infrastructure investment expansion in the late 1990s although the expansion has tapered off after 2001.

The middle panel of Figure 16 depicts the time path of public infrastructure investment as percent of GDP. In all but one of the countries shown, public infrastructure investment declined sharply in the late 1980s. The exception was Colombia, where the decline was very slight and on average public investment remained roughly unchanged (albeit with major fluctuations) until the late 1990s – after which it has also been on the decline.

The evolution of private infrastructure investment is depicted in the bottom panel of Figure 17. In five of the six countries shown, private investment took off in the late 1980s or early 1990s. The exception is Brazil, where the private sector was already undertaking substantial infrastructure investment in the early 1980s. Among the other countries, Chile exhibits the earliest, and largest, rise in private investment, to around 3.5 percent of GDP at present. Since 1998-99, however, private investment has declined in all countries shown.

Table 3 provides a regional overview of infrastructure investment, by sector of origin (public and private) and destination. The table compares the early 1980s with the most recent

---

<sup>11</sup> In addition to these sources, for some countries we also used a number of internal World Bank documents.

years —more specifically, 1981-6 vis-à-vis 2001-6. Between those two periods, total infrastructure investment fell in all countries except for Chile where it grew approximately 1.8 percent of GDP. The biggest falls took place in Brazil and Mexico (3 and 1.2 percent of GDP, respectively). Region-wide, total infrastructure investment declined by around 1.7 percent of the aggregate GDP of the countries under analysis.

Behind these totals, the table also shows that public investment declined in every one of the countries listed. The largest declines were again those of Brazil and Argentina, in excess of 2 percent of GDP in both cases. The smallest was that of Colombia, at 1.45 percent of GDP. In contrast, private investment rose in all countries except Brazil, where it remained roughly unchanged. The rise in private investment was particularly marked in Chile (approximately 3.5 percent of GDP) and Colombia (1.1 percent of GDP). These are also the countries where public investment has remained at relatively high levels.

The breakdown of these trends by infrastructure sector also deserves comment. Investment in power and transport fell in a majority of countries. In contrast, investment in the telecommunications sector rose in all countries in the table. This in turn reflects the different patterns of public and private investment across sectors. While there is some diversity across countries, in general public investment fell more markedly in the power and transport sectors, while the increase in private investment was concentrated in the telecommunications sector. Indeed, private sector involvement outside telecommunications remains relatively modest in all countries except Chile.

Figure 18 provides additional detail on the trends in region-wide infrastructure investment over the last two decades. The top panel plots aggregate investment as well as its breakdown by sector of origin. The sharp decline in public investment that started at the end of the 1980s has been offset only partially by rising private investment, and as a result aggregate investment is today 1.7 percentage points of region-wide GDP below the levels of the 1980s.

Panels (18.3) and (18.4) show that investment in power and transport followed a time pattern similar to that of total infrastructure investment. In contrast, panel (18.2) shows that investment in the telecommunications sector behaved in a radically different manner: the (modest) decline in public investment was more than offset by booming private investment, and as a result by the late 1990s the ratio of aggregate investment in the sector to region-wide GDP had more than doubled. After 2001, however, investment in telecommunications has experienced a sharp fall. Finally, panel (18.5) depicts the trends in investment in the water

sector. In spite of incipient private participation, here the public sector still retains a dominant position. The trend decline in public investment appears to have bottomed out in the mid 1990s, and after that year total investment in the sector has shown a recovery, to reach levels close to those of the early 1980s.

Figures 19 through 24 report total, public and private investment by sector of destination for each of the economies under consideration. Most of them conform to the region-wide trends summarized above. The major exception is Chile (Figure 21), where investment was on the rise in every one of the infrastructure sectors considered until the late 1990s – largely as a result of active private sector involvement. In the early 2000s, however, private investment in transport and telecommunications has followed a declining trend. In Peru (Figure 24) the private sector has also taken the lead in most industries (again with the exception of water), but after 1998-99 private investment has been on the decline, and overall investment levels remain quite low.

#### 4. Preliminary evidence on the cyclicity of infrastructure investment

As an illustration of the potential uses of the information just summarized, we report some preliminary results on the cyclical properties of investment in infrastructure. Researchers have found that fiscal policies are predominantly pro-cyclical among emerging market economies —and, in particular, in Latin America (Gavin and Perotti, 1997; Talvi and Végh, 2005; Kaminsky, Reinhart, and Végh, 2005). Pro-cyclical fiscal policies are usually the result of governments in EMEs cutting taxes and raising expenditures during booms, while being forced to adopt contractionary policies during busts when domestic and external credit constraints become binding and stringent.

Our goal is characterize the cyclical properties of infrastructure investment by origin (public and private) and by sector. Table 5 shows panel estimates of the cyclicity of aggregate infrastructure investment, by origin (private vis-à-vis public) and by sector (telecommunications, energy, and roads). Specifically, we run the following regression:

$$d\left(\frac{I}{Y}\right)_{it} = \mu_i + \eta_t + \alpha\left(\frac{I}{Y}\right)_{i,t-1} + \beta dy_t + \varepsilon_{it}$$

where  $(I/Y)$  is the investment coefficient of country  $i$  at time  $t$  for the aggregate and sectoral investment in infrastructure and  $dy$  is the growth in real GDP. The coefficient estimates for the panel regressions in Table 4 control for country and time effects but do not account for

endogeneity. A next step would be to control for that by using a list of external instruments as suggested in previous work.<sup>12</sup>

Table 4 shows that total infrastructure investment is highly pro-cyclical (with a coefficient estimate of 1.44). By sector, total investment in roads and rails and telecommunications are also pro-cyclical while total investment in electricity has not systematic co-movement with the business cycle. Public investment in infrastructure is mostly a-cyclical whereas private investment is pro-cyclical. However, public investment in roads and rails is positively correlated with output fluctuations, whereas the pro-cyclicality of private investment is mainly explained by private investment in telecommunications.

## 5. Conclusions

This paper has reviewed the trends in infrastructure performance across Latin America over the last quarter-century. On the one hand, the paper documents the evolution of infrastructure quantity and quality, as well as the universality of access to infrastructure across the region, in comparison to industrial economies, East Asian countries and other middle-income-countries (MICs). This is done for key infrastructure sectors: telecommunications, electricity, transportation, and water and sanitation. On the other hand, the paper offers detailed information on the performance of public and private infrastructure investment across major Latin American countries, disaggregated by agent (public and private) and sector of destination (telecommunications, electric power, water and sanitation, and land transportation).

Overall, this update does not find big changes in the major trends in infrastructure quantity and quality in Latin America : despite the progress made in some infrastructure sectors, the region still lags significantly behind East Asian countries and other MICs both in terms of quantity and quality of infrastructure. Regarding access to infrastructure, we again find that despite gaining ground over the years, Latin America is still behind East Asia and other MICs.

We also find that total investment in infrastructure still remains well below the levels of the early 1980s in the major Latin American countries with the exception of Chile. Driven by

---

<sup>12</sup> While Rigobon (2004) uses the terms of trade as an instrument of real output, Galí and Perotti (2003) use the GDP of trading partners. Jaimovich and Panizza (2007), on the other hand, use a variation of the Galí-Perotti instrument: a real external shock that consists of the weighted average of GDP growth of the country's export partners, where the weights are given by the GDP ratio of exports of the corresponding country with its partners.

private initiative, Chile, Colombia and Peru show a substantial expansion in infrastructure investment in the late 1990s, but that expansion waned after 2001.

Finally, we should stress that, for reasons of space, much of this paper has focused on the regional level and on comparisons across world regions. But the regional aggregates conceal a considerable degree of heterogeneity across countries within the same region. This is particularly the case in the case of Latin America and the implication is that a much more specific analysis is needed to identify country-specific priorities for infrastructure development. Hopefully, the dataset collected for this report will be a useful tool for such task.

## References

- Calderón, C., W. Easterly and L. Servén (2003): Latin America's Infrastructure in the Era of Macroeconomic Crises. In: Easterly, W., Servén, L., eds., *The Limits of Stabilization: Infrastructure, Public Deficits, and Growth in Latin America*. Stanford University Press and the World Bank, pp. 95-118
- Calderón, C., and L. Servén (2003): The Output Cost of Latin America's Infrastructure Gap. In: Easterly, W., Servén, L., eds., *The Limits of Stabilization: Infrastructure, Public Deficits, and Growth in Latin America*. Stanford University Press and the World Bank, pp. 95-118
- Calderón, C. and L. Servén (2004): Trends in infrastructure in Latin America, World Bank Policy Research Working Paper 3401.
- Calderón, C. and L. Servén (2008): Infrastructure and economic development in Sub-Saharan Africa, World Bank Policy Research Working Paper 4712
- Canning, D. (1998): A Database of World Stocks of Infrastructure, 1950-95. *The World Bank Economic Review* 12, 529-47.
- Easterly, W. and L. Servén (2003): *The limits of stabilization: infrastructure, public deficits and growth in Latin America*. Stanford University Press.
- Estache, A., Foster, V. and Wodon, Q., 2002. "Accounting for Poverty in Infrastructure Reform: Learning from Latin America's Experience." WBI Development Studies, Washington, DC: The World Bank.
- Galí, J., and R. Perotti (2003): Fiscal policy and monetary integration in Europe. *Economic Policy*, 18(37), 533-572
- Gavin, M., and R. Perotti (1997): "Fiscal policy in Latin America," In: Bernanke, B.S. and J. Rotemberg, eds., *NBER Macroeconomics Annual 1997*, Cambridge, MA: The MIT Press, pp 11-72
- Jaimovich, D., and U. Panizza, 2007. Pro-cyclicality or Reverse Causality? Inter-American Development Bank, Working Paper 599, March
- Kaminsky, G.L., Reinhart, C.M., Végh, C.A., 2005. When It Rains, It Pours: Procyclical Capital Flows and Macroeconomic Policies. In: Gertler, M., Rogoff, R., eds., *NBER Macroeconomics Annual 2004*. Cambridge, MA: The MIT Press, pp. 11-82
- Rigobon, R., 2004. Comments to Kaminsky, Reinhart and Vegh. In: Gertler, M., Rogoff, R., eds., *NBER Macroeconomics Annual 2004*. Cambridge, MA: The MIT Press
- Roberts, P., S. KC, and C. Rastogi (2006): Rural access index: A key developing indicators. Transport Papers TP-10. Washington, DC: The World Bank, March
- Talvi, Ernesto and Carlos A. Végh, 2005. Tax Base Variability and Pro-cyclical Fiscal Policy in Developing Countries. *Journal of Development Economics* 78, 156-190
- World Bank, 1994. *World Development Report: Infrastructure for Development*. Washington, DC, The World Bank.
- World Bank, 2003. *Inequality in Latin America and the Caribbean*. World Bank Latin American and Caribbean Studies.
- World Bank, 2006. *World Development Report: Equity and Development*. Washington, DC, The World Bank.

## **Appendix I**

### **Data on stocks and access to infrastructure**

#### **I.1 Indicators of Physical Infrastructure Stocks<sup>13</sup>**

We have updated the infrastructure database that we assembled in Calderon, Easterly and Servén (2003) and Calderon and Servén (2004) adding annual information on physical indicators of quantity and quality of infrastructure endowments. Here we outline the sources of the data.

*Telecommunications.* Our indicators of quantity of telecommunication assets are the number of main lines connected to local telephone exchanges and the number of mobile phone subscribers. Both series are a good proxy of the capacity of the telecommunications systems and the data are taken from the International Telecommunications Union (ITU) Statistical Yearbook. A measure of the quality of infrastructure in telecommunications is better approximated by indicators such as the percentage of unsuccessful calls, telephone faults (per 100 main lines), and the percentage of faults cleared next day. Unfortunately, information on the first measure was collected only for 1991-5 and it stopped being updated. Information on telephone faults (number and percentage cleared) is sparse but available for a wider array of countries since 1990s. Since we require a longer time series for our regression analysis we construct a measure of the quality of telecommunication services by creating an index based on the waiting time for the installation of main lines. The data is also obtained from ITU's statistical yearbook and the index takes values between 0 and 1 –with higher values indicating higher quality.

*Power Generation.* The dimension of the electricity infrastructure of a nation is measured by the electricity generation capacity (in kilowatts). We have assembled a database with annual observations for the period 1950-2005 drawing from the United Nations' *Energy Statistics*, the United Nations' *Statistical Yearbook*, and the U.S. Energy Information Agency's *International Energy Annual*.<sup>14</sup> Our quality measure is the electric power transmission and distribution losses, expressed as a percentage of electric power output, and obtained from the World Bank's *World Development Indicators* and the U.S. Energy Information Agency's *International Energy Annual*.

*Roads.* Our measure of the quantity of roads is given by the length of the road network (in kilometers) and the data was collected from the International Road Federation's (IRF) *World Road Statistics* and from national sources. On the other hand, the percentage of paved roads in the network is the proposed measure of quality and the data is also obtained from the IRF's *World Road Statistics*. We should remark that the data on roads can be sparse and present unusual fluctuations. To deal with these irregularities we proceed to clean the data using data from national sources and interpolation methods.

#### **I.2 Indicators of Access to Infrastructure**

---

<sup>13</sup> This section draws heavily from Calderon, Easterly and Servén (2003).

<sup>14</sup> The International Energy Annual (IEA) is the Energy Information Administration's main report of international energy statistics, with annual information on petroleum, natural gas, coal and electricity beginning in the year 1980. See webpage: <http://www.eia.doe.gov/iea/>



In this paper we present some stylized facts on the access to infrastructure services of Latin American countries compared with other MICs and selected regions. We describe the definition and sources of the data of these access measures.

*Access to telecommunications.* We gather data for the percentage of population with telephone and internet, as well as the coverage of the cellular network from the International Telecommunications Union (ITU) database.

*Access to electricity.* Using the data collected from different household surveys, it is computed the percentage of population with access to the electricity network. The data refers to commercial sales of electricity and do not include unauthorized connections (World Energy Outlook, 2002). The data for IDA countries is obtained from the RMS Report “Focus on Results: The IDA 14 Results Measurement System and Directions for IDA 15” compiled by David Cieslikowski.

*Access to transportation.* We use the rural access index (RAI) developed by Roberts et al. (2006). This index is a headline transport indicator that highlights the role of access and mobility in reducing poverty in poor countries. The measurement of RAI is from household survey results and obtained from Roberts et al. (2006).

The rural access index measures the percentage of rural people who live within two kilometers (i.e. 20-25 minute walk) of an all-season road. In turn, an “all-season road” is a road that is motorable all year round by the existing means of rural transport (that is, a pick-up or a truck which does not have four-wheel-drive).<sup>15</sup>

*Access to water and sanitation.* We collected data from the World Health Organization and the United Nations Children’s Fund, Joint Monitoring Program report on: (a) the percentage of population with access to “improved water” (household connection, public standpipe, borehole, protected dug well, protected spring, and rainwater collection), and the percentage of the population with access to “improved sanitation” (connection to a public sewer, connection to a septic system, pour-flush latrine, simple pit latrine, ventilated improved pit latrine).

### **1.3 General sources of information**

- Economic Commission for Latin America and the Caribbean. Statistical Yearbook for Latin America and the Caribbean. Santiago de Chile, CEPAL
- International Road Federation. World Road Statistics, Various Years. Geneva, Switzerland: IRF.
- International Telecommunications Union. World Telecommunication Development Report, Various years. Geneva, Switzerland: ITU.
- United Nations. Energy Statistics Yearbook. New York, NY: United Nations
- World Bank. Investment Climate Assessment (ICA), Various countries, various years. Washington, DC: The World Bank
- World Bank. World Development Indicators, CD-ROM. Washington, DC: The World Bank

---

<sup>15</sup> Note that the index addresses the issue of occasional interruptions of short duration during inclement weather (e.g. heavy rainfall), particularly on lightly trafficked roads. For a more detailed description of the methodology, see Roberts et al. (2006).

World Economic Forum. The Global Competitiveness Report, Various years. Geneva, Switzerland.

## **Appendix II**

### **Investment in Infrastructure in Major Latin American Countries**

#### **Description of the Database**

Our data set covers six (6) major Latin American economies and consists of annual figures of private and public infrastructure investment in sectors such as telecommunications, power, gas, roads, railroads, and water. The data spans the period 1980-2006.

In order to gather annual data on public and private infrastructure, we looked at a large list of references. This includes yearbooks from international organizations, and national sources. Among the latter, we looked at general government investment plans, balance sheets of state-owned enterprises, and so on. Here we provide in detail our list of references. In what follows, we provide an exhaustive list of references for the data collected for LAC 6 countries.

#### Country References

##### **ARGENTINA**

###### **Public investment coverage.**

General Government. Includes investment by Public Federal Offices such as Dirección Nacional de Vialidad (Roads), Secretaría de Energía (Power) and Secretaría de Comunicaciones (Telecoms). It also accounts for investment at the provincial level. (Regional figures in power are consolidated by the Secretariat of Energy, which depends upon the Ministry of Economy).

###### **General Information**

Fundación de Investigaciones Económicas Latinoamericanas (1992). Capital de Infraestructura en la Argentina: Gestión Pública, Privatización y Productividad. Buenos Aires, Argentina.

Fundación de Investigaciones Económicas Latinoamericanas (1996). La Programación de la Inversión Pública en la Argentina. Buenos Aires, Argentina.

Harris, Clive, 2003. *Private Participation in Infrastructure in Developing Countries: Trends, Impacts, and Policy Lessons*. Washington, DC: The World Bank.

Ministerio de Planificación Federal, Inversión Pública y Servicios (2006). Presidencia de la Nación: Tres Años de Gestión, 2003-2006. Buenos Aires, Ministerio de Planificación Federal

Ministerio de Planificación Federal, Inversión Pública y Servicios (2007). Presidencia de la Nación: Cuatro Años de Gestión, 2003-2007. Buenos Aires, Ministerio de Planificación Federal

Secretaria de Hacienda, "Cuenta de Inversion 1994-97." Buenos Aires, Sub-Secretaria del Presupuesto.

###### **References on Infrastructure Sectors**

Adrián Romero, C., 1998. Regulación e Inversiones en el Sector Eléctrico Argentino. CEPAL Serie Reformas Económicas 5.

- Celani, M., 1998. Determinantes de la Inversión en Telecomunicaciones en Argentina. CEPAL. Consejo Federal de la Energía Eléctrica (CFEE). Informe institucional, various years. Buenos Aires, Argentina: Ministerio de Planificación Federal, Inversión Pública y Servicios
- Delgado, R., 1998. Inversiones en Infraestructura Vial: La Experiencia Argentina. CEPAL Serie Reformas Económicas 6.
- Dirección Nacional de Vialidad. Anuario Vial. Buenos Aires, Argentina: Ministerio de Infraestructura y Vivienda. See webpage: <http://www.vialidad.gov.ar>
- Dirección Nacional de Vialidad. Gestión 2003-2006. Buenos Aires, Argentina: Gerencia de Planeamiento, Investigación y Control.
- Galiani, S., Gertler, P., Schargrotsky, E., Sturzenegger, F., 2001. The Benefits and Costs of Privatization in Argentina: A Microeconomic Analysis. Universidad de San Andrés, Mimeo, December.
- Galiani, S., Gertler, P., Schargrotsky, E., 2005. Water for Life: The Impact of the Privatization of Water Services on Child Mortality. *Journal of Political Economy* 113, 83-120
- Instituto Nacional del Agua (INA). Memoria, Various years. Buenos Aires, Argentina: Ministerio de Planificación Federal, Inversión Pública y Servicios
- Secretaría de Comunicaciones. Estadísticas. Buenos Aires, Argentina: Comisión Nacional de Comunicaciones, Ministerio de Infraestructura y Vivienda. See webpage: <http://www.secom.gov.ar/>
- Secretaría de Energía, 2001. Informe Decenal del Sector Eléctrico, 1991-2000. Various Years. Buenos Aires: Dirección Nacional de Prospectiva.
- Secretaría de Energía. Informe del Sector Eléctrico, Various Years. Buenos Aires: Ministerio de Economía y Obras y Servicios Públicos.
- Secretaria de Transporte, 2000. Compendio Estadístico del Sector Transporte en la Argentina. Buenos Aires, Argentina: Ministerio de Planificación Federal, Inversión Pública y Servicios.
- Subsecretaría de Recursos Hídricos. Memoria de Gestión Enero-Diciembre, Various Years. Buenos Aires, Argentina: Ministerio de Economía y Obras y Servicios Públicos.

## **BRAZIL**

### **Public investment coverage**

Federal Government, state governments and state-owned enterprises (as described by Ferreira and Malliagos, 1999). In the case of water, coverage of states' investments may be limited.

### **General Information**

- Afonso, José Roberto Rodrigues, 2005. *Managing Fiscal Space in Brazil*. Washington, DC: The World Bank, April
- Afonso, José Roberto Rodrigues; Araújo, Erika Amorim; Biasoto Júnior, Geraldo, 2005. *Fiscal Space and Public Investments in Infrastructure: A Brazilian Case Study*. Instituto de Pesquisa Economica Aplicada (IPEA), Texto para Discussao 1141, December
- Conselho de Infra-estrutura, 2005. *A Infra-Estrutura no Brasil em 2005*. Brasilia, Fevereiro
- Ferreira, P.C., 1996. *Investimento em Infra-estrutura no Brasil: Fatos Estilizados e Relacoes de Longo Prazo*. *Pesquisa e Planejamento Economico*, 26(2), August.
- Ferreira, P.C.; Malliagos, T.G., 1998. *Impactos Produtivos da Infra-estrutura no Brasil: 1950-95"*. *Pesquisa e Planejamento Economico*, 28(2), August
- Ferreira, P.C.; Malliagos, T.G., 1999. *"Investimentos, Fontes de Financiamento e Evolucao do Setor de Infra-estrutura no Brasil: 1950-96"*. FGV EPGE Ensaio Economicos No. 346.

Frischtak, Claudio R., 2007. "O Investimento em Infra-estrutura no Brasil: Histórico recente e perspectivas." 4º Seminário ANBID de Mercado de Capitais, December  
Rigolon, F.J.Z., 1998. O Investimento em Infra-estrutura e a retomada do crescimento economico sustentado. Pesquisa e Planejamento Economico, 28(1), April.

### **References on Infrastructure Sectors**

Agência Nacional de Telecomunicações. Estatísticas. See webpage: <http://www.anatel.gov.br/>  
Agência Nacional de Telecomunicações. Relatório Anual 2005. See webpage:

<http://www.anatel.gov.br/>

Agência Nacional de Transportes Terrestres. Evolução do Transporte Ferroviário de Cargas. See webpage: <http://www.antt.gov.br/>

BNDES, 1999a. Concessões Rodoviárias no Brasil. Informe Infra-Estrutura No. 30, January

BNDES, 1999b. Ferrovias: Privatização e Regulação. Informe Infra-Estrutura No. 34, May

BNDES, 2000. O Setor Elétrico. Informe Infra-Estrutura No. 53, December

Da Costa Pinhel, A.C., 2000. Simulação de uma Usina Térmica a Gás no novo Contexto do Setor Elétrico Brasileiro: Uma Análise Risco X Retorno. Thesis submitted to Post-Graduate Program on Engineering at Universidade Federal do Rio de Janeiro

Departamento de Transportes Ferroviários. Anuário Estatístico das Ferrovias do Brasil, Various Years. See webpage: <http://www.transportes.gov.br>

Departamento de Transportes Ferroviários. Investimentos e outras Inversões e Previsões dos Planos Trienais. See webpage: <http://www.transportes.gov.br>

Instituto Brasileiro de Geografia e Gestão. Sistema de Contas Nacionais, Various Years. Brasília, Ministério de Planejamento, Orçamento e Gestão.

Lizardo de Araújo, J., 2001. A Questão do Investimento no Setor Elétrico Brasileiro: Reforma e Crise. Nova Economia, Belo Horizonte, 11(1), July

Ministério de Minas e Energia – Secretaria de Energia. Plano Decenal de Expansão: Sumário Executivo 2003-2012. See webpage: [www.ccpe.gov.br](http://www.ccpe.gov.br)

Ministério de Planejamento, Orçamento e Gestão. Estatísticas Orcamentárias, Various Years. See webpage: <http://www.planejamento.gov.br/>. Brasília, Brazil.

Ministério de Planejamento, Orçamento e Gestão. Estatísticas e Conjuntura, Various Years. Brasília, Brazil.

Pires, J.C.L., Giambiagi, F., Sales, A.F., 2002. As Perspectivas do Setor Elétrico Após Racionamento. BNDES Textos para Discussão 97.

Sistema Nacional de Informações sobre Saneamento (SNIS). Diagnóstico dos Serviços de Água e Esgotos, Several issues.

## **CHILE**

### **Public investment coverage**

General Government – including Central Government, State-Owned Enterprises and investment undertaken by the Regional Governments, specifically in Transportation (Roads, Railways) and Water consolidated by the Ministry of Public Works through its Sub-Secretariat of Transportation and the Dirección Nacional de Vialidad.

### **General Information**

Dirección de Presupuesto, 2007. Evaluación de la Gestión Financiera del Sector Público en 2006 y Actualización de Proyecciones para 2007. Santiago, Chile: Ministerio de Hacienda

- Ministerio de Obras Públicas, 2000. Inversión en Infraestructura: Rol sobre el crecimiento, Desarrollo Económico y la Globalización. Santiago, Chile: Gobierno de Chile.
- Ministerio de Obras Públicas, 2001. La Inversión en Infraestructura 1990-1999 y su Proyección 2000-2009. Santiago, Chile: Gobierno de Chile.
- Moguillansky, G.. 1999. La Inversión en Chile: ¿El Fin de un Ciclo en Expansión?, Santiago, Chile: Fondo de Cultura Económica Chile S.A.
- Moguillansky, G. and Bielschowsky, R., 2000. Inversión y Reformas Económicas en América Latina, Santiago, Chile: Fondo de Cultura Económica Chile S.A.

### **References on Infrastructure Sectors**

- Banco Central de Chile. Anuario de Cuentas Nacionales 2002. Santiago de Chile, Banco Central.
- Comision Nacional de Energia. Balance de Gestion Integral. Several issues. See webpage [www.cne.cl](http://www.cne.cl)
- Empresa de Ferrocarriles del Estado (EFE). Memoria, Various years. Santiago de Chile, Empresa de Ferrocarriles del Estado.
- Dirección de Vialidad. Memoria, Various years. Santiago de Chile, Ministerio de Obras Públicas .
- Instituto Nacional de Estadísticas (INE). Anuario Estadístico Sector Eléctrico, Various years
- Instituto Nacional de Estadísticas (INE). Transportes y Comunicaciones, Informe Anual, Various years
- Ministerio de Obras Públicas, 2003. Sistema de Concesiones en Chile, 1990-2003. Santiago, Chile: Gobierno de Chile.
- Ministerio de Obras Públicas, 2005. Sistema de Concesiones de Obras Públicas: Cartera de Proyectos 2005-2007. Santiago, Chile: Gobierno de Chile.
- Ministerio de Obras Públicas, 2006. Cuenta de Gestión 2006. Santiago, Chile: Gobierno de Chile.
- Ministerio de Obras Públicas, Transportes y Telecomunicaciones, 2005. Cuenta de Gestión 2005. Santiago, Chile: Gobierno de Chile.
- Subsecretaría de Telecomunicaciones. Estadísticas del Sector de las Telecomunicaciones en Chile, Various Issues. Santiago de Chile, Ministerio de Obras Públicas
- Subsecretaría de Telecomunicaciones. Informe de Gestión, various years. Santiago de Chile, Ministerio de Obras Públicas.
- Superintendencia de Servicios Sanitarios. Informe de Gestión del Sector Sanitario, Various years, Superintendencia de Servicios Sanitarios. Balance de Gestión Integral, Various years
- The World Bank, 2003. Water Services in Chile. Public Policy for the Private Sector Note No. 25, March.

## **COLOMBIA**

### **Public investment coverage**

General Government and State-Owned Enterprises. These figures include public investment at the national and regional level. They do not include investment by local governments, except for transport. Power figures are reported by agent participating in the National System of Transmission.<sup>16</sup> Recently, public investment in telecoms has been mostly undertaken by Empresa de Teléfonos de Bogotá (ETB) and the group of Empresas Públicas de Medellín (EPM) —around 80% of total public investment since 2000 (Comisión de Regulación de Telecomunicaciones, 2002).

<sup>16</sup> Among the main agents, we have: Interconexión Eléctrica S.A., Transelca, S.A. E.S.P., Empresas Públicas de Medellín, and Empresa de Energía de Bogotá.

### **General Information**

Departamento Administrativo Nacional de Estadística (DANE). Cuentas Nacionales: Gastos en FBKF por sector institucional según finalidad 1973-95. Bogotá, Colombia.<sup>17</sup>

Departamento Nacional de Planeación, 2003. Plan Colombia: Balance 1999-2003. Bogotá, Colombia.

Departamento Nacional de Planeación, 2007. Reporte de Inversión Privada en Infraestructura 1993-2006. Bogotá, Colombia.

Departamento Nacional de Planeación, 2007. Cifras de Inversión en Infraestructura 1987-2006. Bogotá, Colombia.

### **References on Infrastructure Sectors**

Cardenas, M., Gaviria, A., Melendez, M., 2005. La Infraestructura del Transporte en Colombia. Fedesarrollo, *manuscript*, August

Comisión de Regulación de Telecomunicaciones, 2000. El Sector de las Telecomunicaciones en Colombia en la Década de los 90's. Bogotá, Colombia: Ministerio de Comunicaciones. See webpage: <http://www.crt.gov.co/>

Comisión de Regulación de Telecomunicaciones, 2002. El Sector de las Telecomunicaciones en Colombia 1998-2001. Bogotá, Colombia: Ministerio de Comunicaciones.

Ministerio de Comunicaciones. Informe de Gestión Sector de las Telecomunicaciones. Bogotá, Colombia: Ministerio de Comunicaciones.

Ministerio de Transportes. El Transporte en Cifras 1970-96. Bogotá, Colombia: Ministerio de Transportes.

Ministerio de Transportes. El Transporte en Cifras 2000. Bogotá, Colombia: Ministerio de Transportes.

Ministerio de Transportes. Anuario Estadístico, Various years. Bogotá, Colombia: Ministerio de Transportes.

Unidad de Infraestructura y Energía. Sector de Energía: Competitividad del Sector. Bogotá, Colombia: Departamento Nacional de Planeación.

Unidad de Infraestructura y Energía. Sector de Energía: Documento Sectorial. Bogotá, Colombia: Departamento Nacional de Planeación.

Unidad de Infraestructura y Energía. Sector de Energía: Plan Colombia. Bogotá, Colombia: Departamento Nacional de Planeación.

## **MEXICO**

### **Public investment coverage**

Federal Government, States, State-Owned Enterprises, and para-State firms. For water, there is also a limited coverage of local government investment.

### **General Information**

Banco de México, 1995. La Encuesta de Acervos, Depreciación y Formación de Capital. México, DF: Banco de México.

Presidencia del Gobierno. IV Informe del Gobierno: México 1988-98. México, DF: Presidencia del Gobierno.

---

<sup>17</sup> Note that DANE data have been computed according to commitments and not to cash flow basis. Additionally, depreciation of the existing stock has also been considered.

Presidencia del Gobierno. V Informe del Gobierno: México 1989-99. México, DF: Presidencia del Gobierno.

Presidencia del Gobierno. Primer Informe del Gobierno: México 2006-7. México, DF: Presidencia del Gobierno.

Secretaría de Hacienda de México. Inversión Pública Federal por Entidad Federativa. México, DF: Secretaría de Hacienda.

World Bank, 2004. México: Public Expenditure Review. Washington, DC: The World Bank.

#### **References on Infrastructure Sectors**

Comisión Federal de Telecomunicaciones. Información sobre el Sector. México, DF: Secretaría de Comunicaciones y Transporte. See webpage: <http://www.cft.gob.mx/>

Comisión Nacional del Agua. Estadísticas del Agua en México. México, DF: Secretaría de Medio Ambiente y Recursos Naturales. See webpage: <http://www.cna.gob.mx/>

Comisión Reguladora de Energía. Estadísticas. México, DF: Secretaría de Energía. See webpage: <http://www.cre.gob.mx/>

Secretaría de Comunicaciones y Transportes. Anuario Estadístico, Various Years. México, DF: Secretaría de Comunicaciones y Transporte.

### **PERU**

#### **Public investment coverage**

General Government and State-Owned Enterprises. Reporting on all investment made by the public sector is centralized through the entities stated above. The figures do not include investment by local governments.

#### **General Information**

Banco Central de Reserva del Perú. Memoria Anual, Various Years. Lima, Perú: BCRP.

CUANTO S.A. Perú en Números, Varios Números. Lima, Perú.

Instituto Nacional de Estadística e Informática. Anuario Estadístico, Various Issues. Lima, Perú: INEI.

Instituto Peruano de Economía, 2003. La Brecha en Infraestructura: Servicios Públicos, Productividad y Crecimiento en el Perú. Lima, Perú: Asociación de Empresas Privadas de Servicios Públicos (ADEPSEP).

Pro-Inversión. Sectoral Foreign Direct Investment in Peru, various years.

#### **References on Infrastructure Sectors**

Ministerio de Energía y Minas, 2008. Evolución de indicadores del mercado eléctrico, 2002-2007. Lima, Peru: Ministerio de Energía y Minas

Organismo Supervisor de Inversión Privada en Telecomunicaciones, 2002. El Proceso de Apertura del Mercado de Telecomunicaciones. Estudios en Telecomunicaciones No. 10. Lima, Perú: OSIPTEL.

Organismo Supervisor de Inversión Privada en Telecomunicaciones, 2003. Compendio de Estadísticas de Telecomunicaciones en Perú, 1994-2002. Informe No. 025-GPR/2003. Lima, Perú: OSIPTEL.

Organismo Supervisor de la Inversión en Infraestructura de Transporte de Uso Público. Memoria Anual, Various Years. Lima, Perú: OSITRAN.

- Ponce, F., Begazo, T., Tovar, C., Ponce de León, O., 2003. Procesos de Privatización y Apertura de las Telecomunicaciones en América Latina: Un Análisis Comparativo. Informe No. 001-GPR/2003. Lima, Perú: OSIPTEL
- Subsector Eléctrico, 2002. Principales Indicadores del Año 2002. Lima, Perú: Dirección General de Electricidad, Ministerio de Energía y Minas
- Superintendencia Nacional de Servicios de Saneamiento. Memoria Anual, various years. Lima, Perú: SUNASS
- Superintendencia Nacional de Servicios de Saneamiento, 2006. Infraestructura de Agua Potable y Alcantarillado Urbano en el Peru: Un Reto Pendiente. Lima, Perú: SUNASS



**Table 1**  
**Infrastructure in Latin America: Basic Statistics**  
*Medians by group*

	Latin America (LAC)			East Asia non-LICs			Non-LAC MICs			Industrial Countries		
	1990	2000	2006	1990	2000	2006	1990	2000	2006	1990	2000	2006
Main lines in operation	136	257	313	145	337	427	176	324	388	929	1,156	1,048
Main lines and mobile subscribers	136	555	1,640	152	659	1,654	176	431	1,517	940	2,472	3,111
Power generation (Capacity installed, MW)	0.7705	0.9099	1.0753	0.8139	1.0346	1.3571	0.3340	1.3256	1.3130	3.1005	3.7802	3.9779
Length of road network (km. per sq.km. of area)	0.1326	0.1499	0.1499	0.3495	0.4405	0.4863	0.1521	0.2808	0.2994	1.1439	1.4739	1.5029
Quality of telecom services <sup>1/</sup>	0.9663	0.9956	0.9998	0.9878	0.9994	1.0000	0.9369	0.9865	0.9957	0.9999	1.0000	1.0000
Quality of electricity provision <sup>2/</sup>	0.1453	0.1699	0.1507	0.0709	0.0783	0.0634	0.0966	0.1498	0.1294	0.0684	0.0670	0.0676
Quality of road network <sup>3/</sup>	0.2087	0.2430	0.2520	0.7073	0.7591	0.8513	0.5455	0.6230	0.6445	0.9400	0.9029	0.9100
Other quality measures:												
- Telephone faults (per 100 main lines)	0.4330	0.9000	0.8717	0.8620	0.8395	0.9611	0.7450	0.9000	0.8520	0.7450	0.8925	0.9000
- Telephone faults cleared next day (%)	51.6000	14.5000	5.0500	57.7000	15.9600	1.9800	61.7100	28.3300	9.3750	61.7100	7.9600	1.3400

*Notes: The quantity indicators of telecommunications are expressed in number of lines per 1000 workers whereas the energy indicator is expressed in megawatts (MW) per 1000 workers.*

*1/ The quality of telecommunication services is a (0-1) variable based on the waiting time for main line installation. Higher values indicate higher quality of telecommunication services.*

*2/ The quality of electricity provision is calculated by the ratio of electricity transmission and distribution losses to electric energy output.*

*3/ The quality of the road network is measured as the share of paved roads in total road network.*

**Table 2**  
**Correlation among Infrastructure Measures**  
*Panel data correlations over the period 1981-2006 (annual data)*

Variables	Telephone Penetration		Power Generation	Total Roads	Quality			T. Faults cleared
	M.Lines & Cells	M.Lines			Telecom	Electricity	Roads	
Telephone main lines and mobile phones <i>(per 100 workers)</i>	1.0000							
Telephone main lines <i>(per 100 workers)</i>	0.8335 (0.000)	1.0000						
Power generation <i>(in MW per 1000 workers)</i>	0.6091 (0.000)	0.7402 (0.000)	1.0000					
Total road length <i>(in km. per sq. km. of arable land)</i>	0.5066 (0.000)	0.5853 (0.000)	0.3050 (0.000)	1.0000				
Quality of telecommunication services <i>(based on waiting time for main line installation)</i>	0.3694 (0.000)	0.4152 (0.000)	0.3694 (0.000)	0.2274 (0.000)	1.0000			
Quality of electricity <i>(based on technical losses of transmission and distrib.)</i>	-0.3373 (0.000)	-0.4258 (0.000)	-0.3766 (0.000)	-0.3009 (0.000)	-0.361 (0.000)	1.0000		
Quality of roads <i>(Share of paved in total roads)</i>	0.5425 (0.000)	0.6616 (0.000)	0.5019 (0.000)	0.5155 (0.000)	0.298 (0.000)	-0.305 (0.000)	1.0000	
Telephone faults cleared next day (%)	0.309 (0.000)	0.325 (0.000)	0.259 (0.000)	0.191 (0.000)	0.182 (0.000)	-0.244 (0.000)	0.276 (0.000)	1.0000
Telephone faults <i>(per 100 main lines)</i>	-0.355 (0.000)	-0.369 (0.000)	-0.280 (0.000)	-0.200 (0.000)	-0.187 (0.000)	0.228 (0.000)	-0.224 (0.000)	-0.246 (0.000)

*Numbers in parenthesis below the correlation coefficients represent their p-values.*

**Table 3**  
**Investment in Infrastructure in Latin America, 1981-2006**  
*(Percentage of GDP)*

Country	Period	Power Generation			Land Transportation 1/			Telecommunications			Total Infrastructure 2/		
		Total	Public	Private	Total	Public	Private	Total	Public	Private	Total	Public	Private
Argentina	1981-6	1.53%	1.53%	0.00%	0.81%	0.81%	0.00%	0.30%	0.30%	0.00%	2.76%	2.76%	0.00%
	2001-6	0.50%	0.06%	0.44%	0.68%	0.56%	0.13%	0.38%	0.00%	0.38%	1.67%	0.68%	0.98%
	Change	-1.02%	-1.47%	0.44%	-0.13%	-0.25%	0.13%	0.08%	-0.30%	0.38%	-1.09%	-2.08%	0.98%
Brazil	1981-6	3.30%	2.44%	0.86%	0.82%	0.51%	0.31%	0.72%	0.36%	0.37%	5.15%	3.60%	1.54%
	2001-6	0.63%	0.36%	0.28%	0.41%	0.24%	0.17%	0.78%	0.29%	0.50%	2.11%	1.15%	0.97%
	Change	-2.67%	-2.08%	-0.59%	-0.41%	-0.26%	-0.14%	0.06%	-0.07%	0.13%	-3.03%	-2.45%	-0.58%
Chile	1981-6	1.65%	1.65%	0.00%	1.04%	1.04%	0.00%	0.47%	0.47%	0.00%	3.44%	3.44%	0.00%
	2001-6	1.84%	0.32%	1.52%	1.69%	0.71%	0.97%	0.90%	0.00%	0.90%	5.21%	1.68%	3.53%
	Change	0.19%	-1.33%	1.52%	0.65%	-0.33%	0.97%	0.43%	-0.47%	0.90%	1.77%	-1.76%	3.53%
Colombia	1981-6	1.56%	1.56%	0.00%	0.94%	0.94%	0.00%	0.32%	0.32%	0.00%	3.13%	3.13%	0.00%
	2001-6	0.58%	0.45%	0.13%	0.67%	0.48%	0.20%	1.01%	0.36%	0.65%	2.77%	1.68%	1.08%
	Change	-0.98%	-1.11%	0.13%	-0.27%	-0.47%	0.20%	0.69%	0.04%	0.65%	-0.37%	-1.45%	1.08%
Mexico	1981-6	0.51%	0.51%	0.00%	1.50%	1.50%	0.00%	0.24%	0.24%	0.00%	2.44%	2.44%	0.00%
	2001-6	0.20%	0.20%	0.00%	0.37%	0.22%	0.15%	0.54%	0.01%	0.53%	1.23%	0.53%	0.69%
	Change	-0.31%	-0.31%	0.00%	-1.12%	-1.27%	0.15%	0.30%	-0.24%	0.53%	-1.21%	-1.91%	0.69%
Peru	1981-6	1.35%	1.34%	0.01%	0.36%	0.34%	0.02%	0.32%	0.32%	0.00%	2.11%	2.07%	0.04%
	2001-6	0.44%	0.16%	0.28%	0.37%	0.09%	0.28%	0.64%	0.26%	0.38%	1.49%	0.54%	0.96%
	Change	-0.92%	-1.18%	0.27%	0.01%	-0.25%	0.26%	0.32%	-0.06%	0.38%	-0.62%	-1.54%	0.92%
<b>Weighted Avg. (by GDP)</b>	<b>1981-6</b>	<b>1.91%</b>	<b>1.56%</b>	<b>0.35%</b>	<b>1.02%</b>	<b>0.90%</b>	<b>0.12%</b>	<b>0.46%</b>	<b>0.31%</b>	<b>0.15%</b>	<b>3.62%</b>	<b>3.00%</b>	<b>0.62%</b>
	<b>2001-6</b>	<b>0.51%</b>	<b>0.26%</b>	<b>0.24%</b>	<b>0.50%</b>	<b>0.29%</b>	<b>0.20%</b>	<b>0.66%</b>	<b>0.14%</b>	<b>0.52%</b>	<b>1.89%</b>	<b>0.89%</b>	<b>0.99%</b>
	<b>Change</b>	<b>-1.40%</b>	<b>-1.30%</b>	<b>-0.10%</b>	<b>-0.52%</b>	<b>-0.60%</b>	<b>0.08%</b>	<b>0.20%</b>	<b>-0.17%</b>	<b>0.37%</b>	<b>-1.73%</b>	<b>-2.11%</b>	<b>0.38%</b>

1/ Land transportation includes investment in roads and railways.

2/ Total infrastructure consists of power generation, land transportation, telecommunications, and water.

**Table 4**  
**Cyclicality of infrastructure investment**

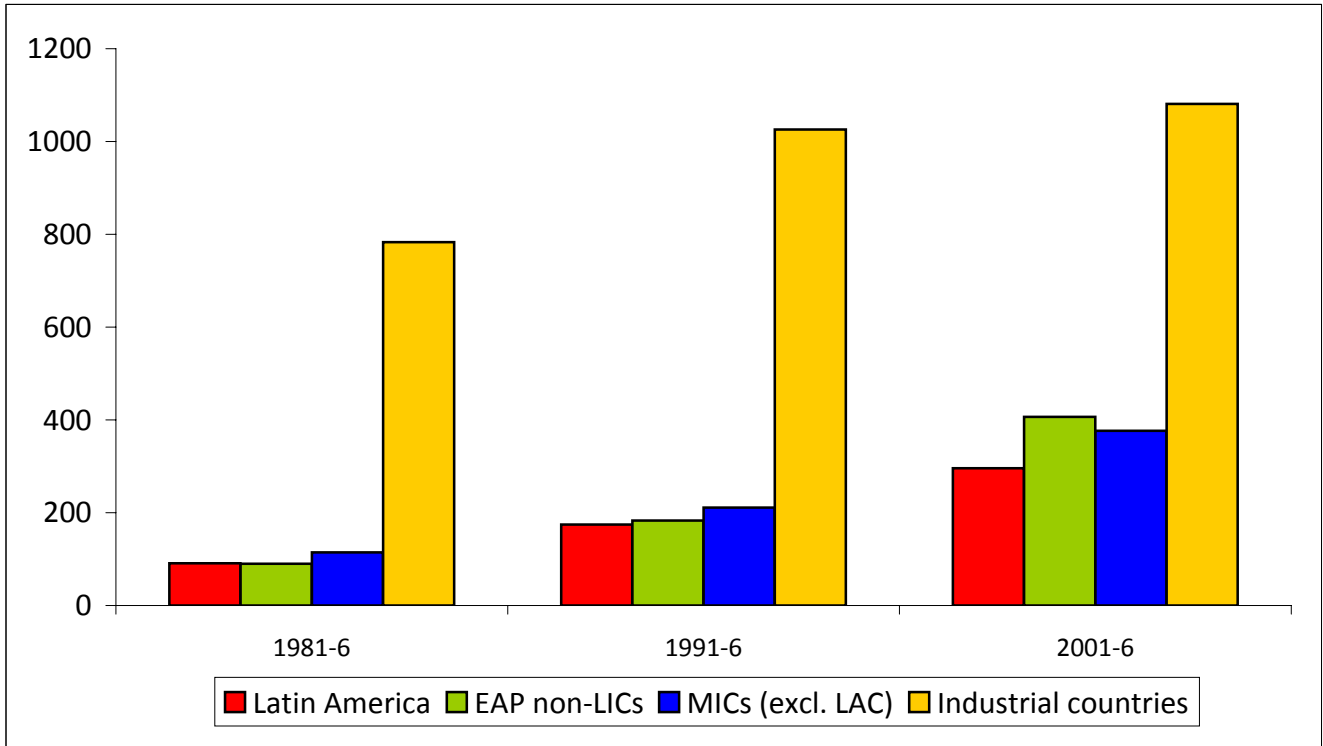
*Dependent Variable: Infrastructure investment (as ratio to GDP)*

*Sample: LAC6 countries, 1980-2006 (Annual data)*

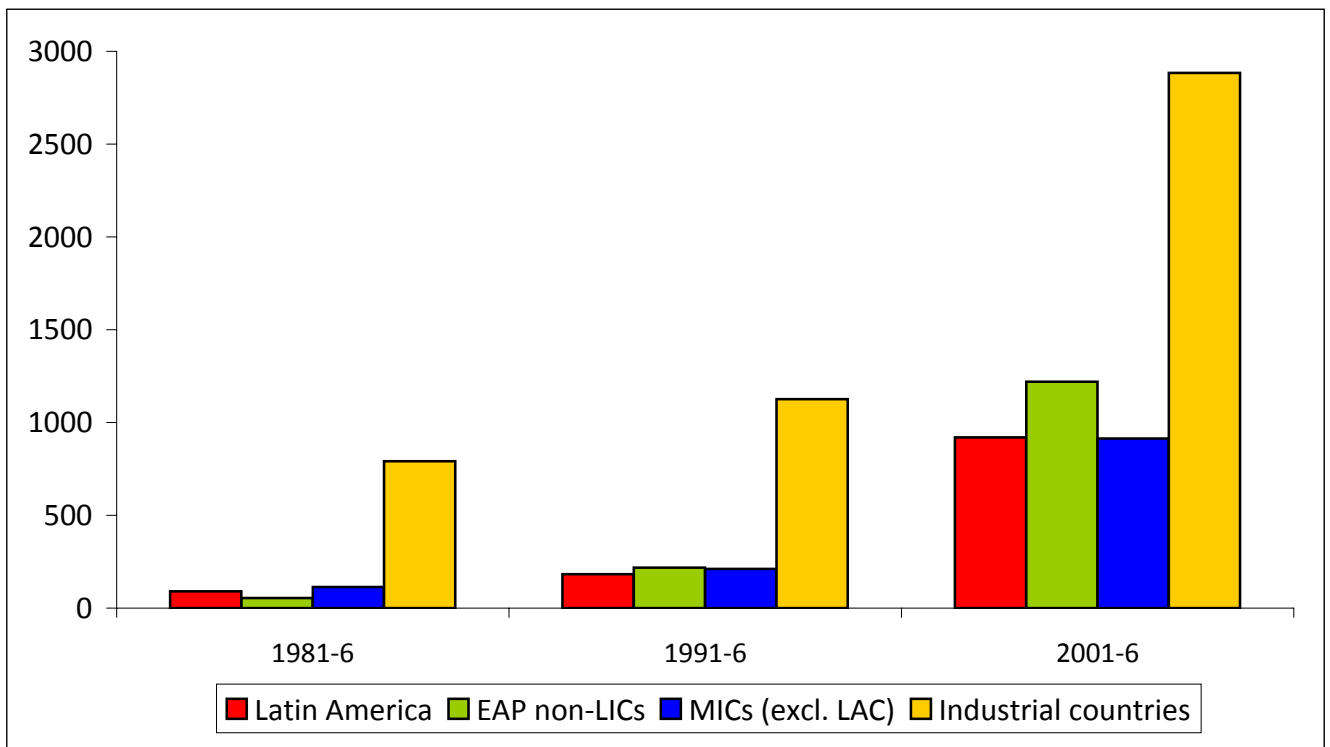
Dep. Variable	Total Infrastructure Investment			Public Infrastructure Investment			Private Infrastructure Investment		
	Lagged Investment	Real GDP Growth	Nobs. / R**2	Lagged Investment	Real GDP Growth	Nobs. / R**2	Lagged Investment	Real GDP Growth	Nobs. / R**2
Infrastructure investment (Total)	-0.0996 ** (0.035)	1.4432 * (0.888)	0.0661 156	-0.1042 ** (0.038)	0.4134 (0.790)	0.0619 156	-0.0683 ** (0.034)	0.9535 * (0.519)	0.0477 156
- Telecommunications	-0.2236 ** (0.063)	0.7126 ** (0.335)	0.1275 156	-0.2380 ** (0.107)	-0.1320 (0.297)	0.1173 156	-0.1447 ** (0.051)	0.7523 ** (0.268)	0.0984 156
- Power generation	-0.1333 ** (0.045)	-0.3356 (0.590)	0.0756 156	-0.1498 ** (0.055)	-0.4714 (0.550)	0.0888 156	-0.1281 ** (0.062)	0.1017 (0.363)	0.0607 156
- Roads	-0.0679 * (0.040)	0.7415 ** (0.259)	0.0851 156	-0.0794 ** (0.035)	0.5495 ** (0.173)	0.0951 156	-0.0628 (0.088)	0.1966 (0.144)	0.0371 156
- Roads and rails	-0.1057 ** (0.043)	1.0368 ** (0.392)	0.1078 156	-0.0897 ** (0.036)	0.8201 ** (0.293)	0.1088 156	-0.1254 (0.102)	0.2140 (0.220)	0.07 156

\* (\*\*) indicates that the coefficient estimate is statistically significant at the 10 (5) percent level.

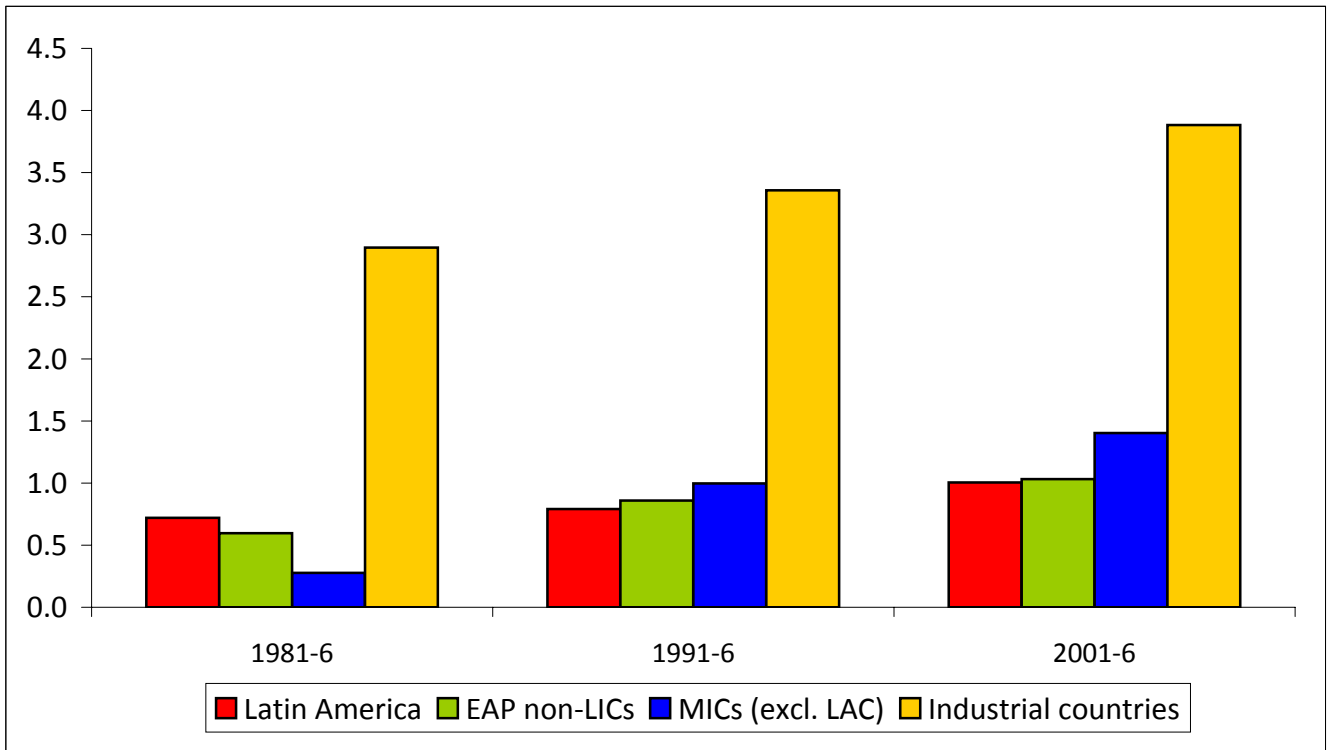
**Figure 1**  
**Telephone main lines in operation, medians by group**  
*(Lines per 1000 workers)*



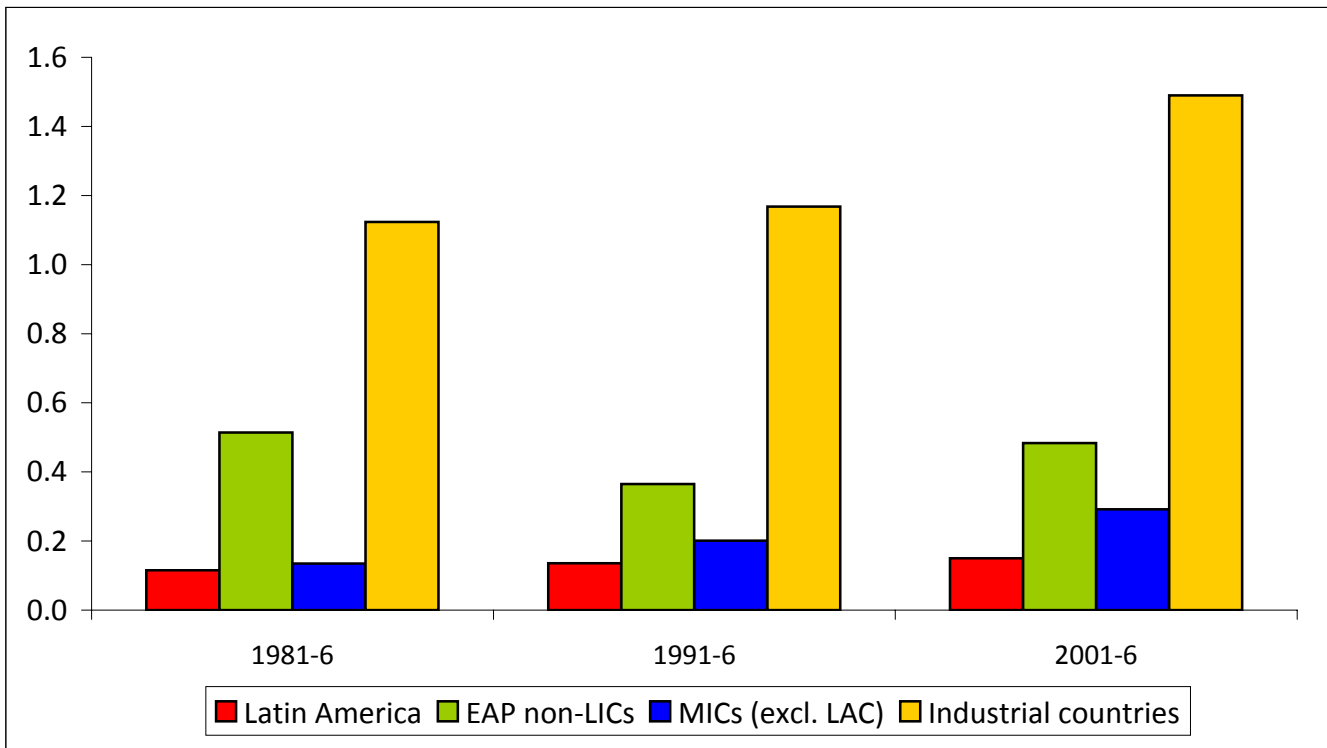
**Figure 2**  
**Total telephone lines (main lines and mobile cellular subscribers), medians by group**  
*(Lines per 1000 workers)*



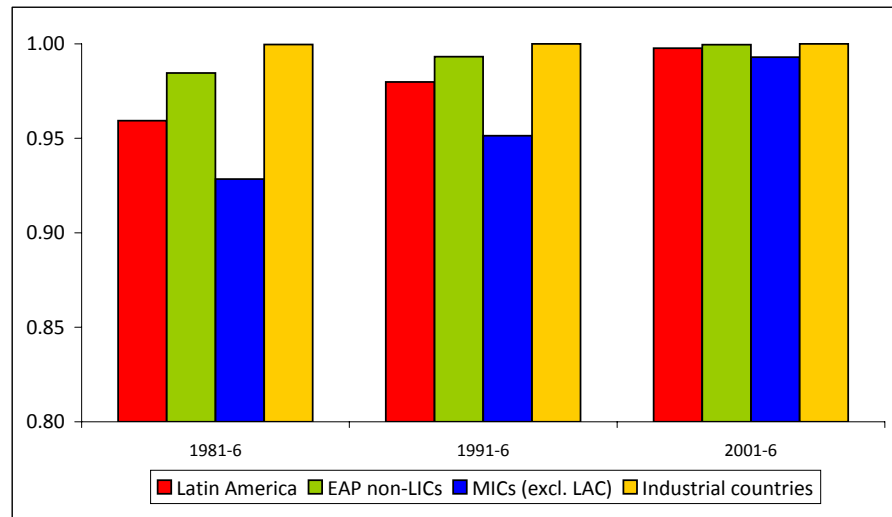
**Figure 3**  
**Electricity Installed Capacity, medians by group**  
*(MW per 1000 workers)*



**Figure 4**  
**Length of the road network, medians by group**  
*(km. per sq.km. of surface area)*

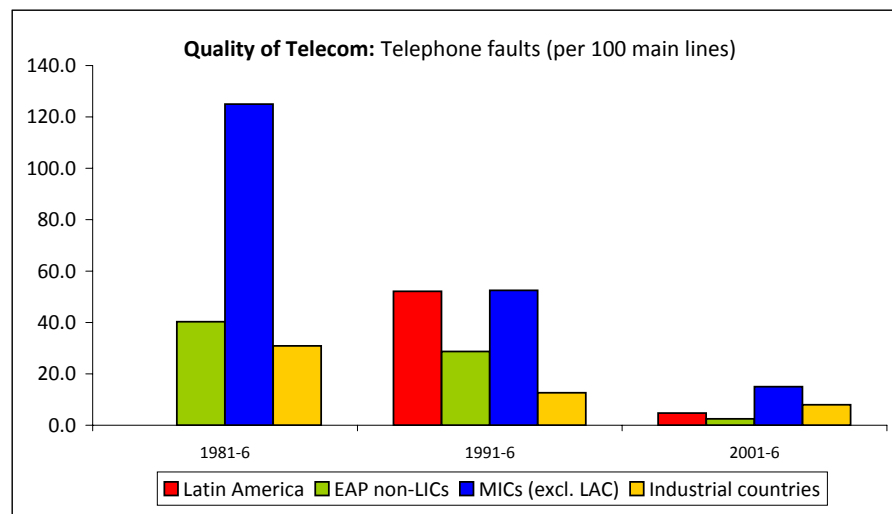


**Figure 5**  
**Quality of Telecommunication Services, medians by group 1/**  
*(0-1 Index, higher values indicate higher quality)*

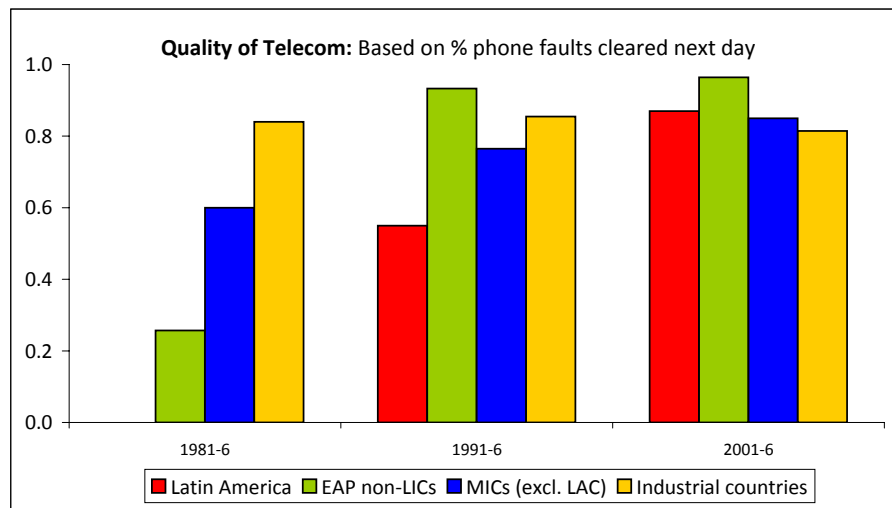


1/ It is the additive inverse of the waiting time for the installation of main lines.

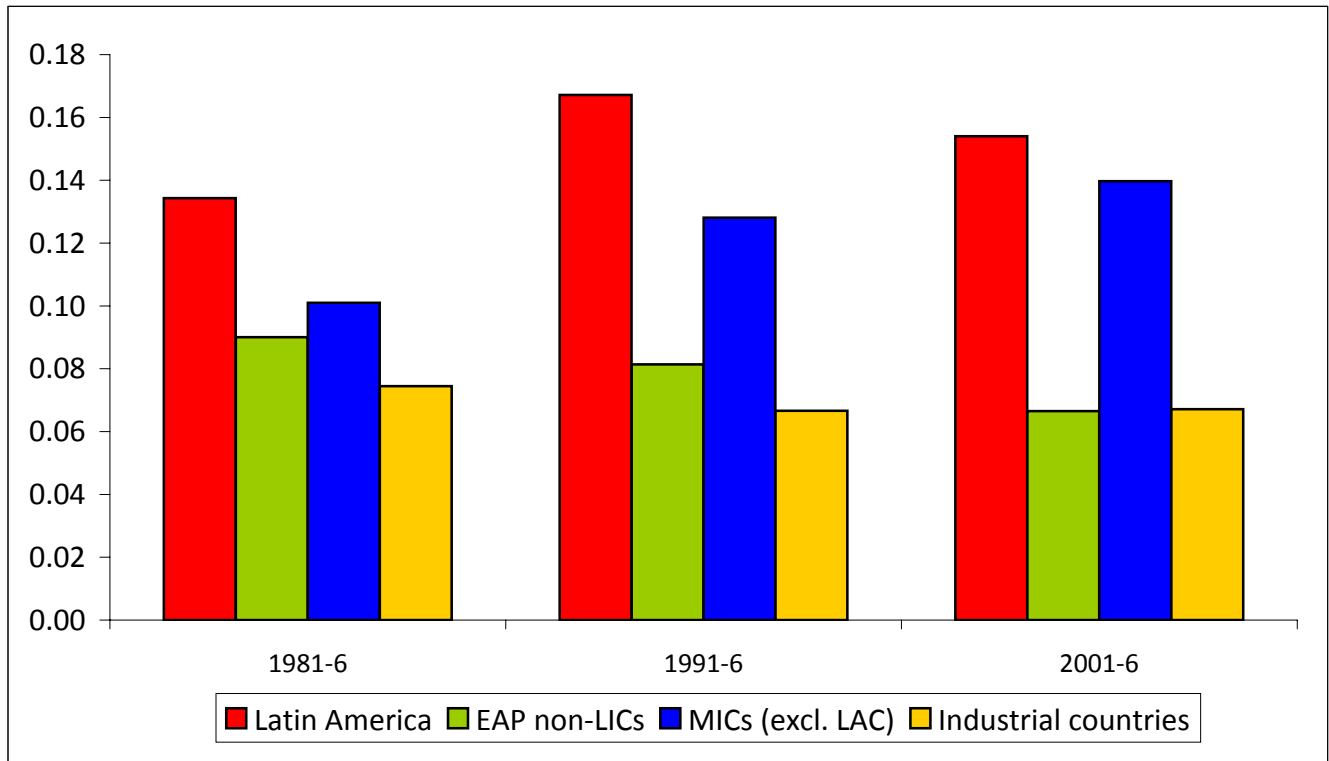
**Figure 6**  
**Quality of Telecommunication Services, medians by group**  
*(Telephone faults per 100 main lines)*



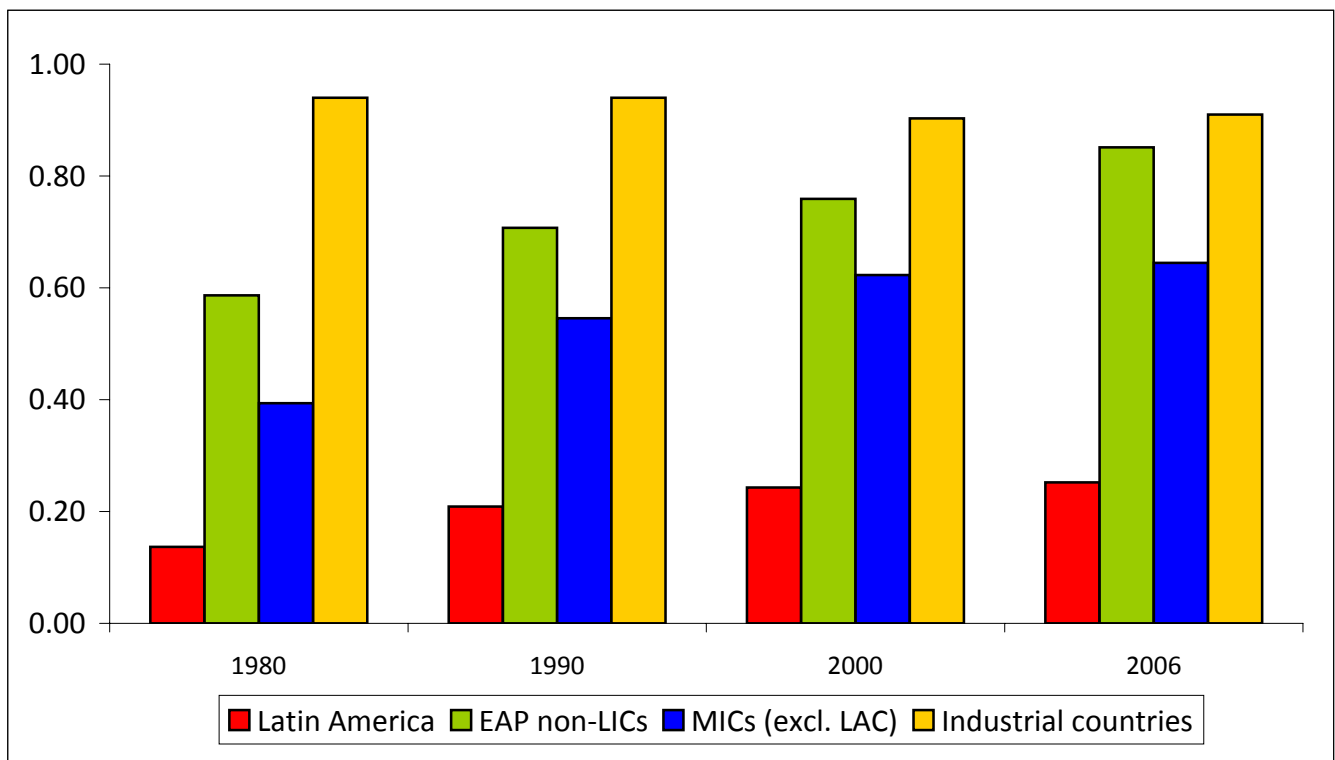
**Figure 7**  
**Quality of Telecommunication Services, medians by group**  
*(Percentage of phone faults cleared by next day)*



**Figure 8**  
**Quality of Electricity Provision, medians by group**  
*(Transmission and distribution losses as share of electric output)*

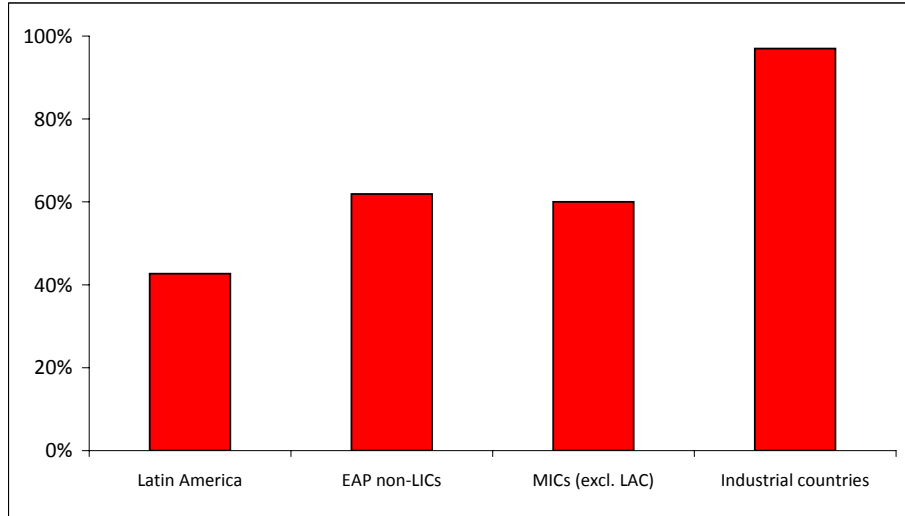


**Figure 9**  
**Quality of the road network, medians by group**  
*(Paved roads as a share of total road)*

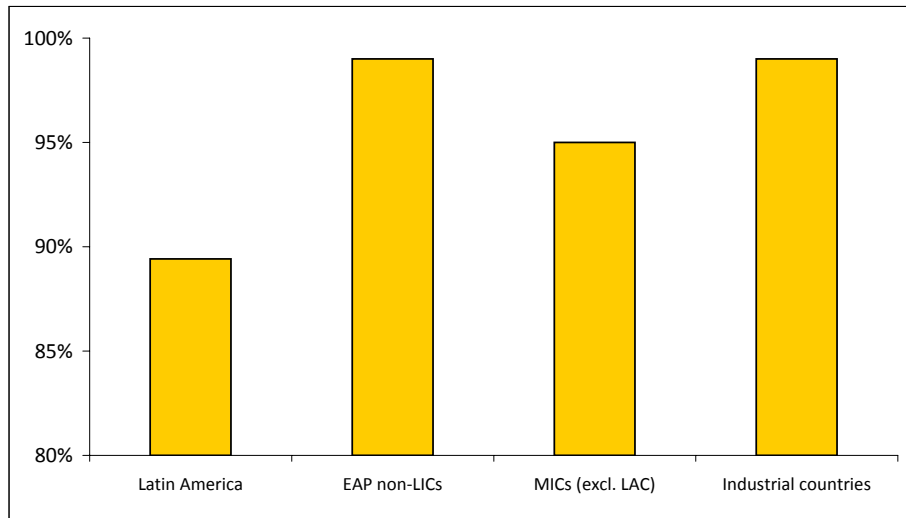




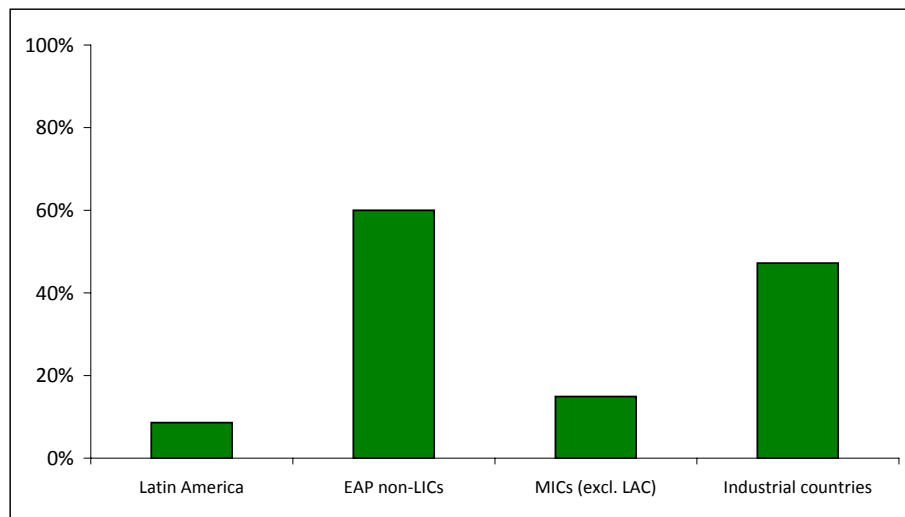
**Figure 10**  
**Access to Telecommunication Services, medians by group**  
*(Percentage of the population with telephone)*



**Figure 11**  
**Access to Telecommunication Services, medians by group**  
*(Coverage of cellular network, percentage of the population)*



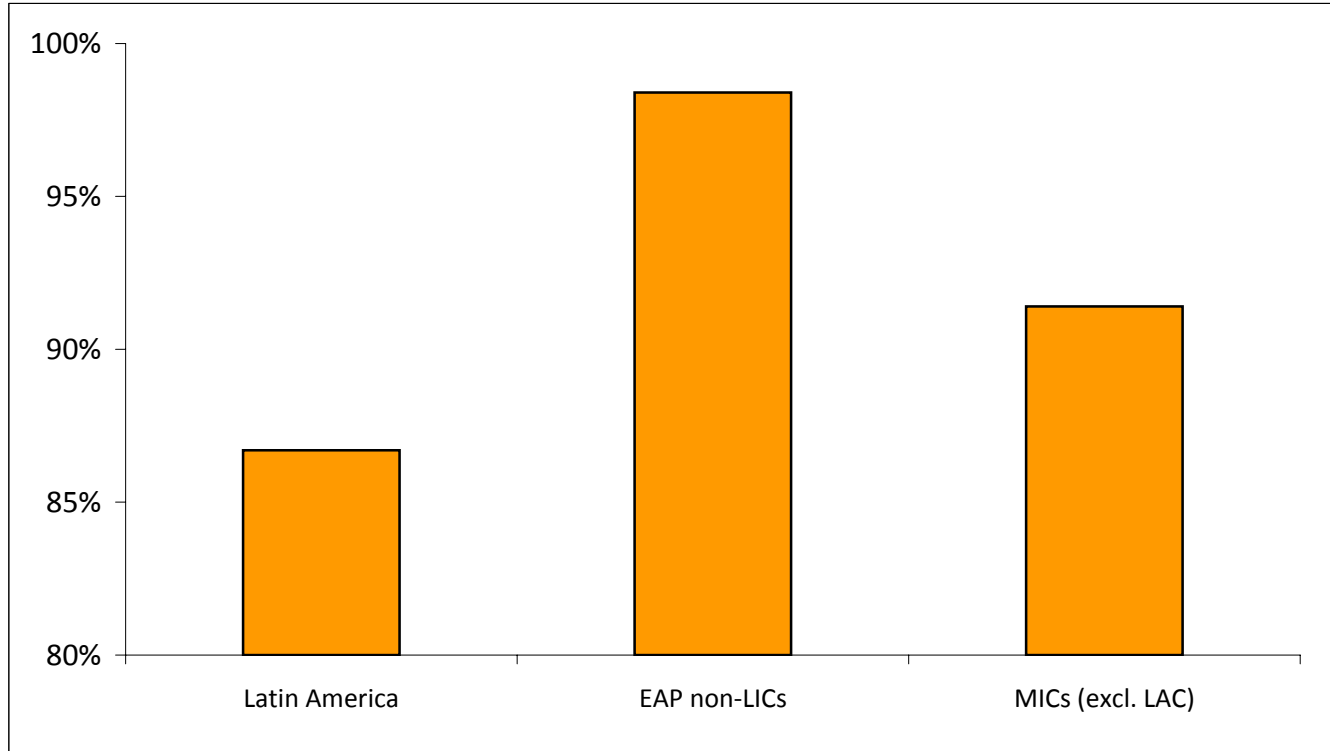
**Figure 12**  
**Access to Telecommunication Services, medians by group**  
*(Percentage of the population with internet)*



**Figure 13**

**Access to Electricity, medians by group**

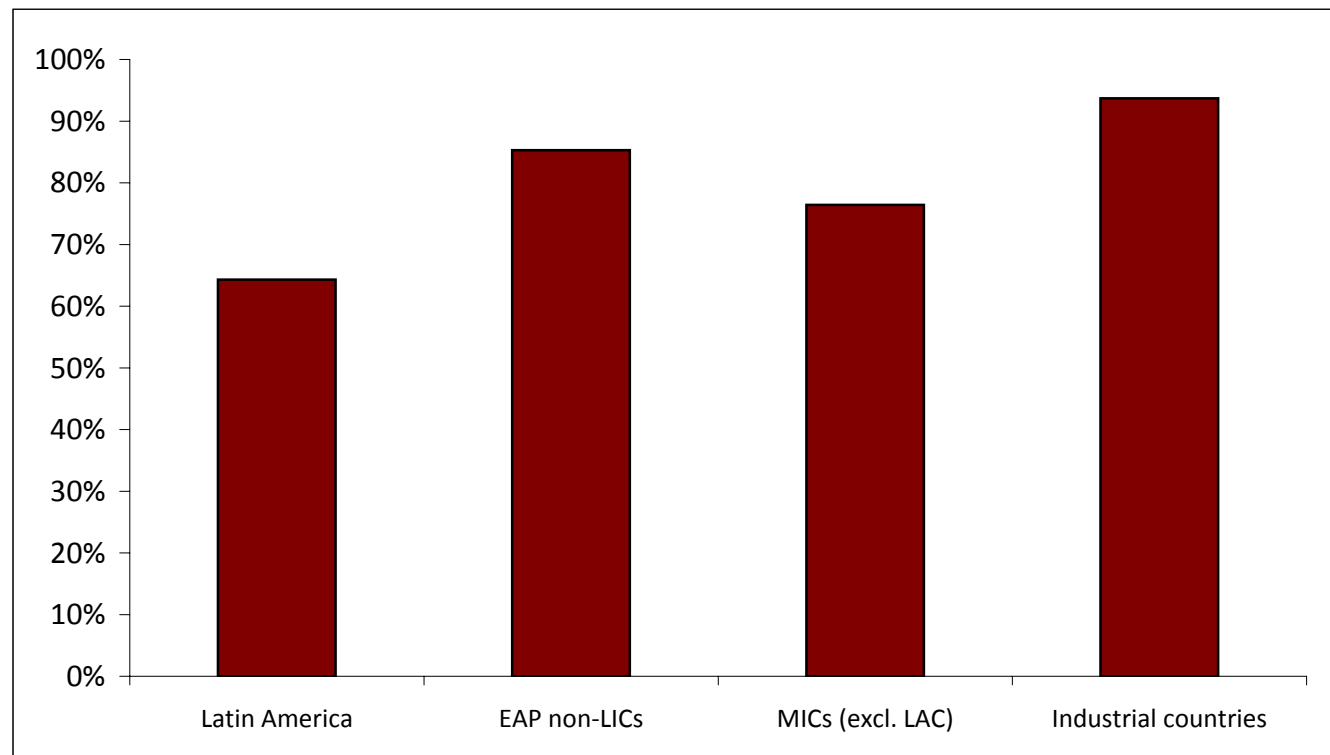
*(Percentage of the population with access to electricity)*



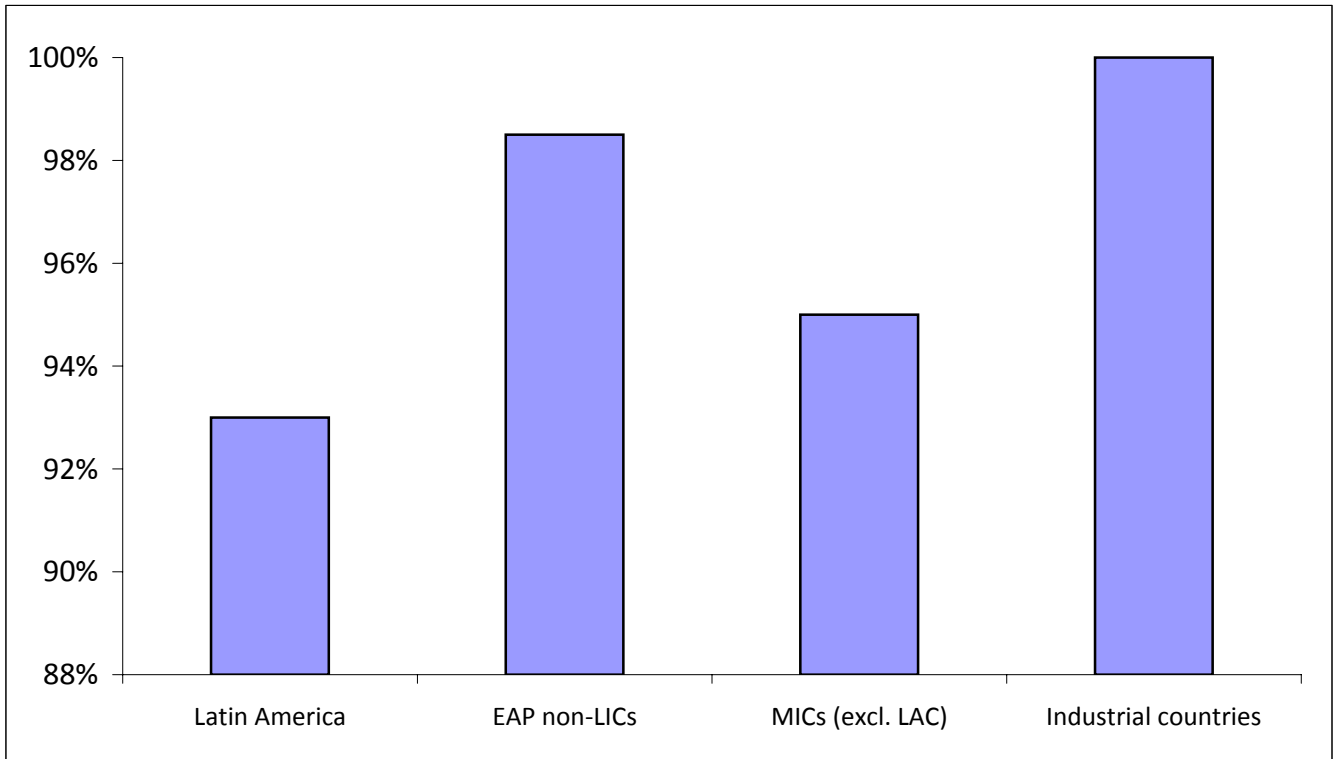
**Figure 14**

**Access to Transportation, medians by group**

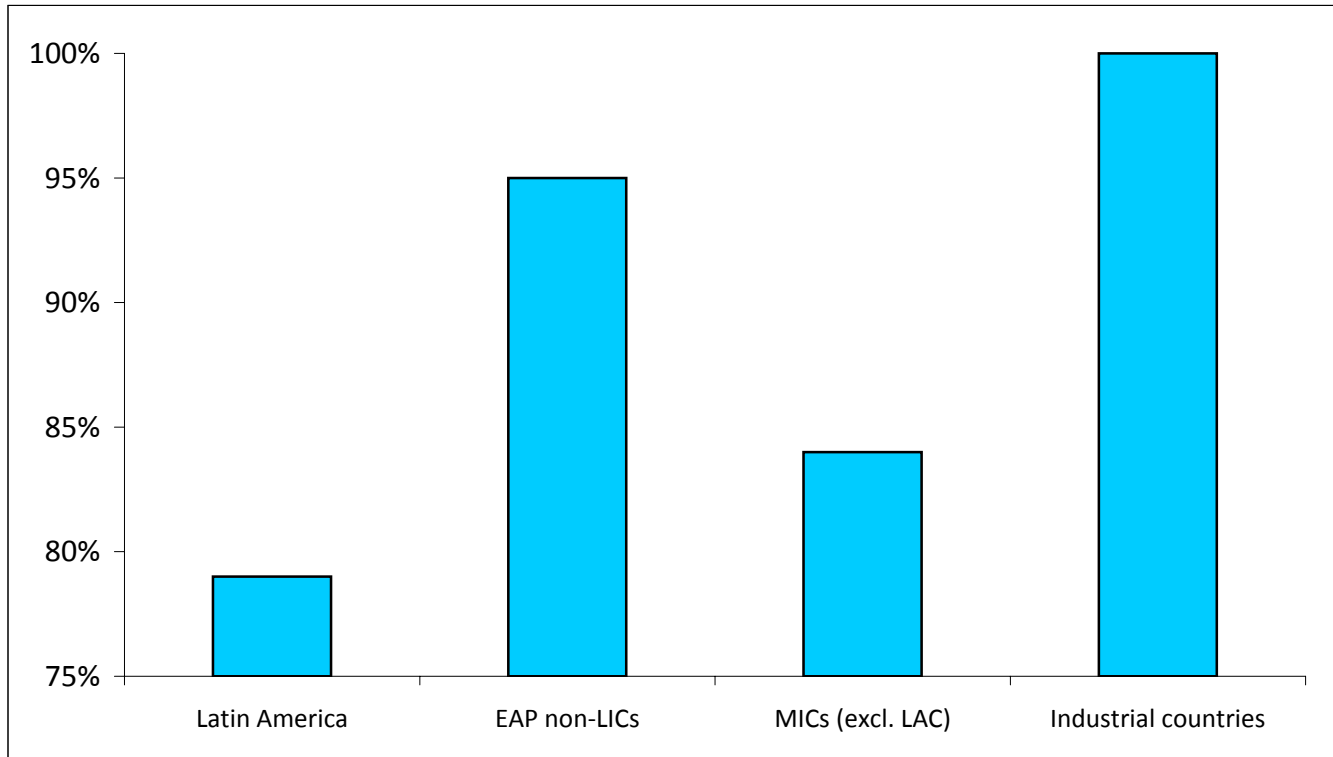
*Percentage of people who live within 2 km. of all seasonal road*



**Figure 15**  
**Access to Water and Sanitation, medians by group**  
*Percentage of people with access to improved water sources*

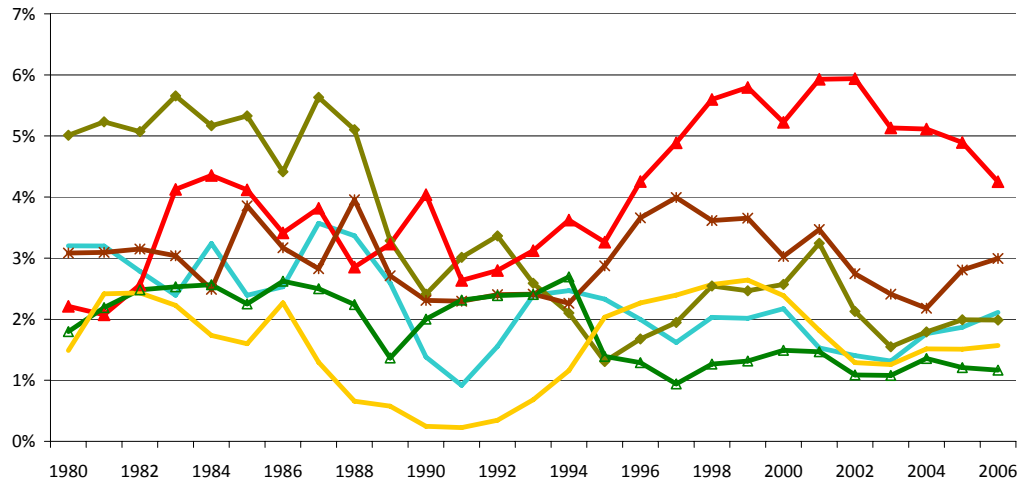


**Figure 16**  
**Access to Water and Sanitation, medians by group**  
*Percentage of people with access to improved sanitation facilities*

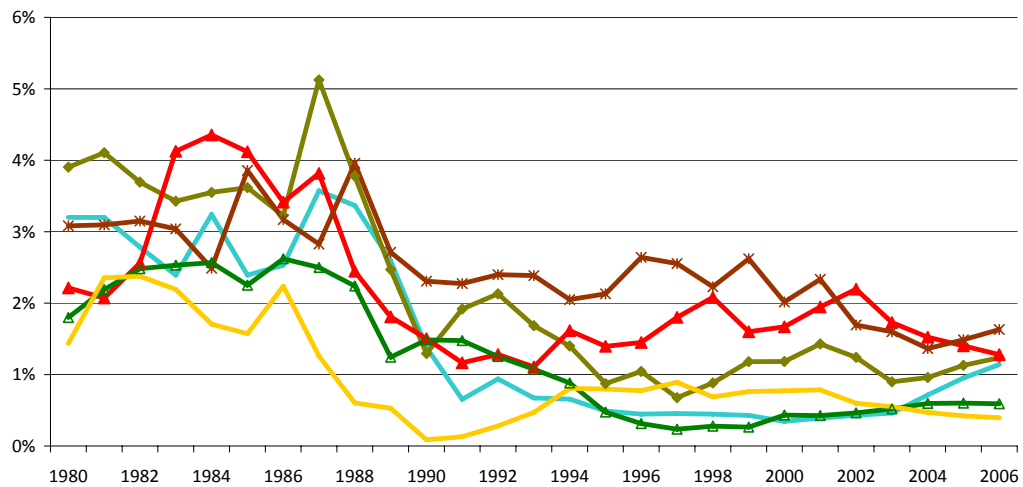


**Figure 17**  
**Infrastructure Investment in major LAC countries**  
*(Percent of GDP)*

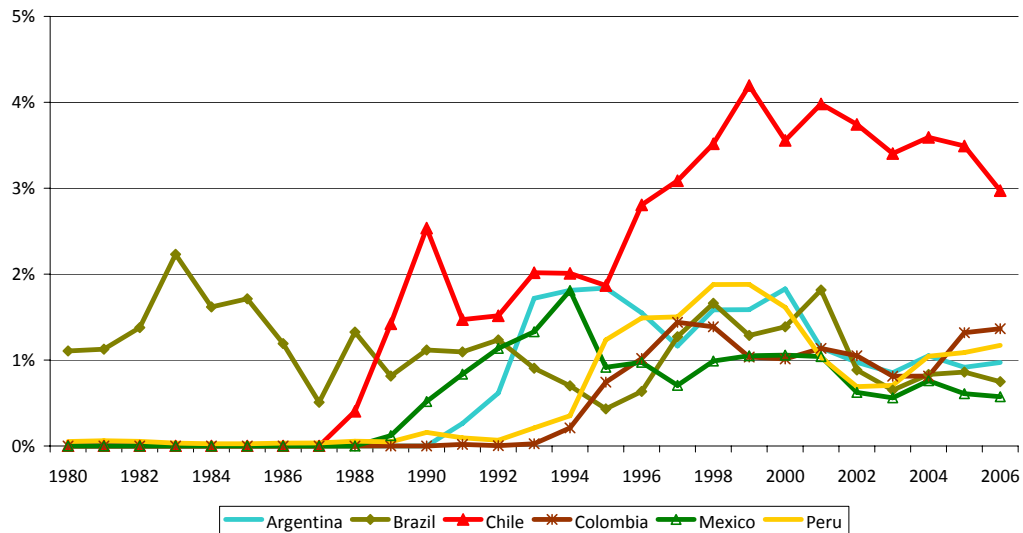
**17.1 Total infrastructure investment**



**17.2 Public infrastructure investment**



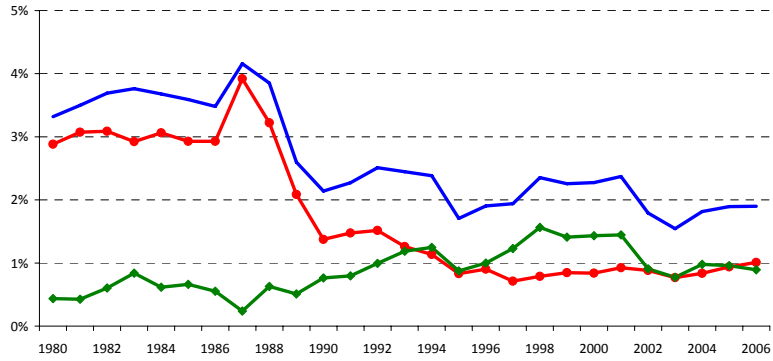
**17.3 Private infrastructure investment**



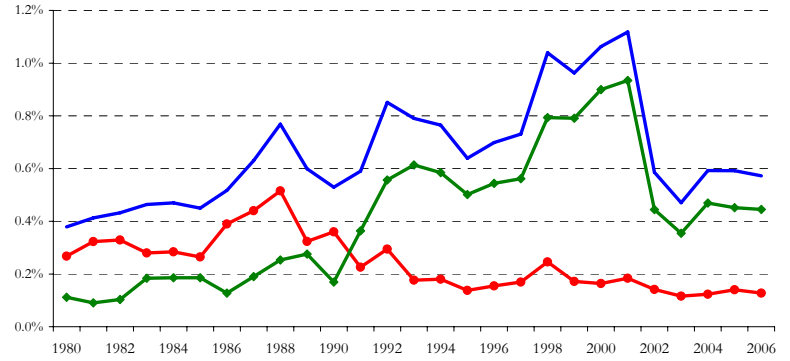
— Argentina — Brazil — Chile — Colombia — Mexico — Peru

**Figure 18**  
**Infrastructure Investment in Latin America**  
*(as a percentage of the GDP, GDP-weighted average)*

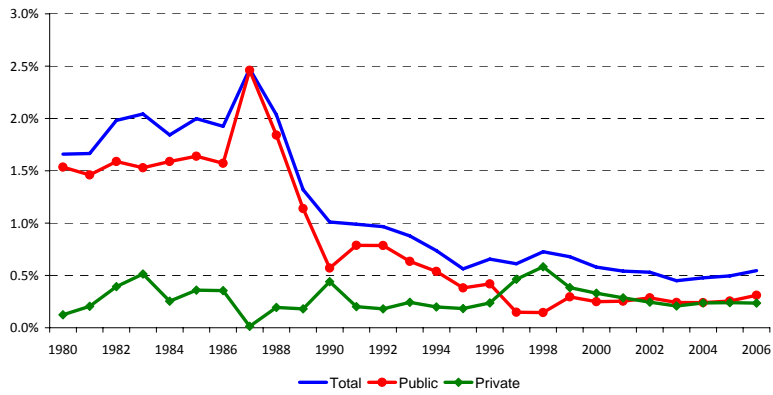
**18.1 Investment in Infrastructure, Total**



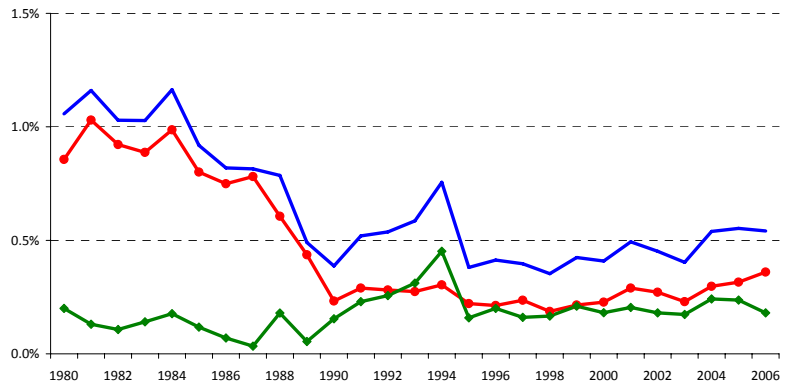
**18.2 Investment in Telecommunications**



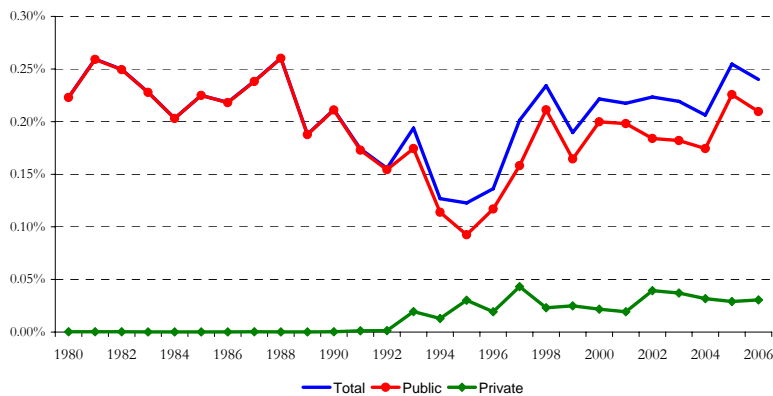
**18.3 Investment in Electric Energy**



**18.4 Investment in Land Transportation (Roads and railroads)**

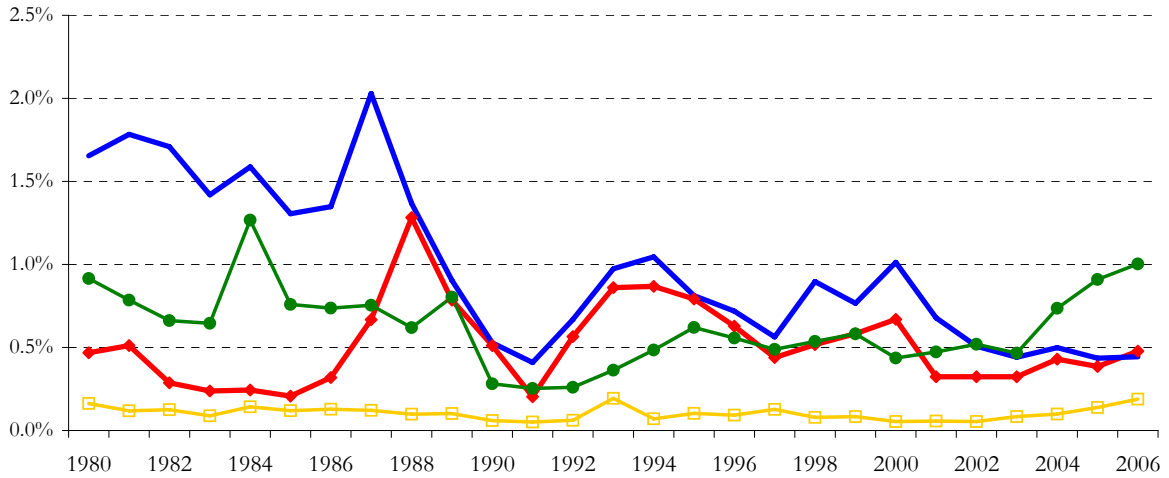


**18.5 Investment in Water and Sanitation**

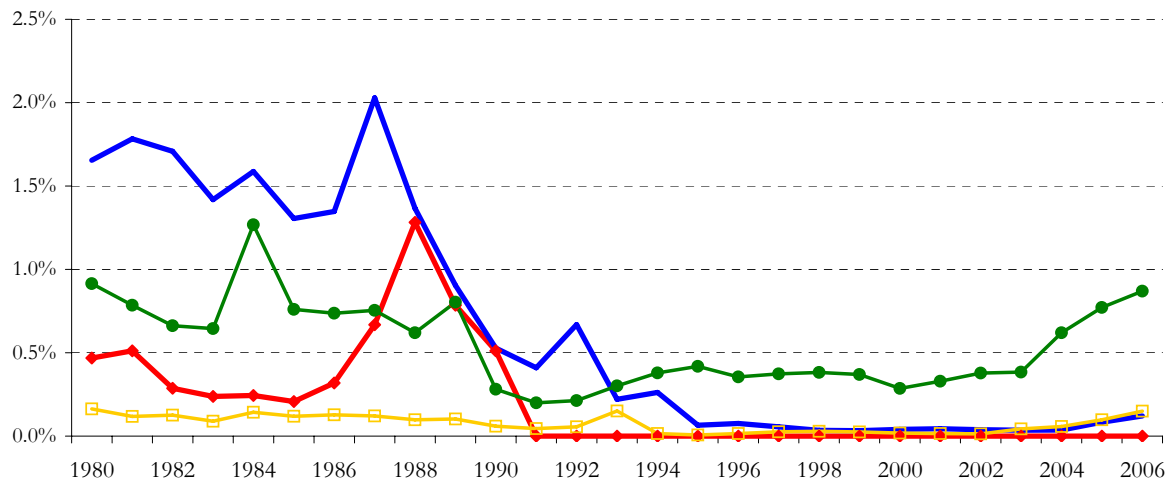


**Figure 19**  
**Infrastructure Investment in Argentina**  
*(as percentage of GDP)*

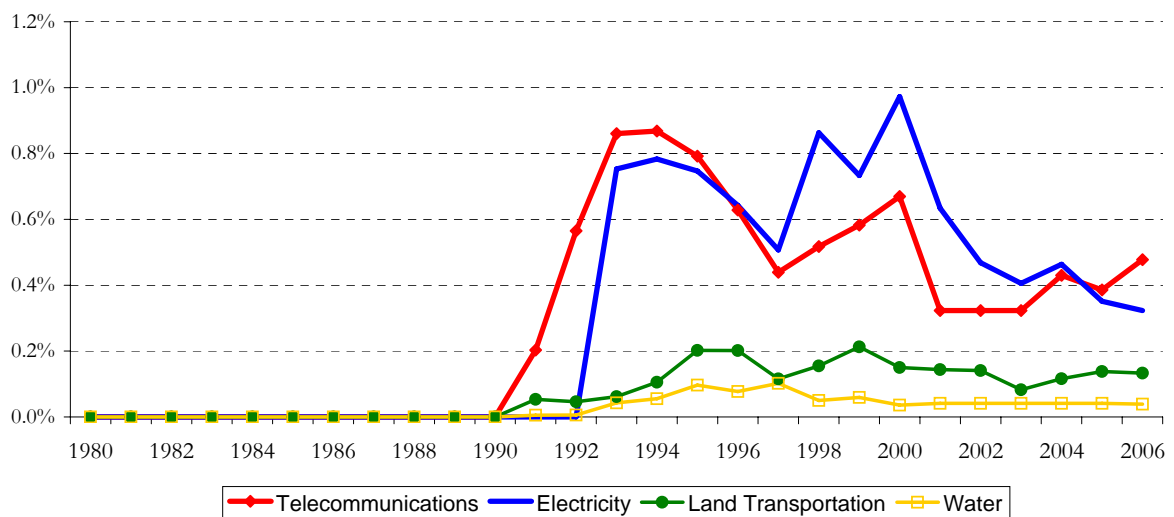
**19.1 Investment in Infrastructure, Total**



**19.2 Public Investment in Infrastructure**



**19.3 Private Investment in Infrastructure**



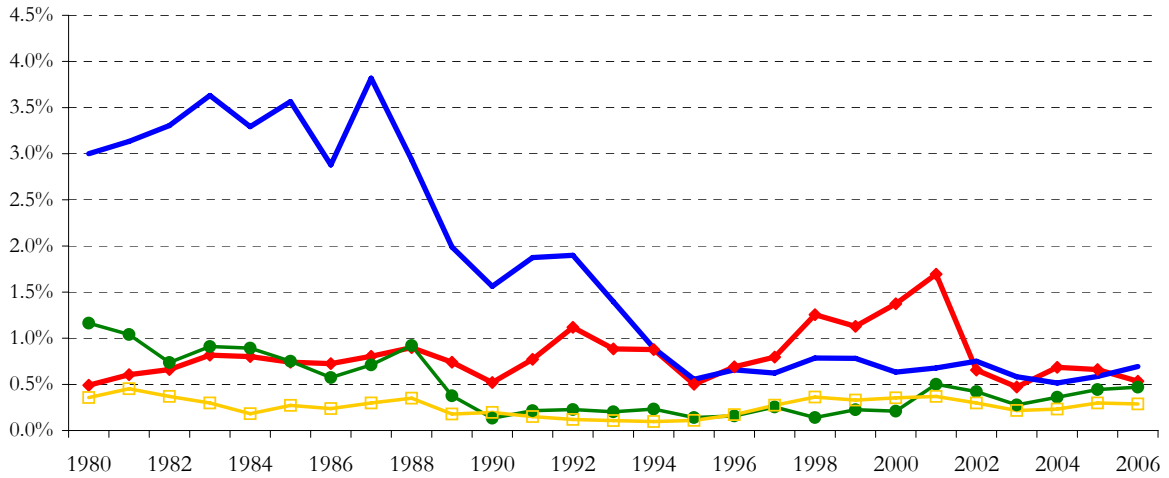
—◆— Telecommunications — Electricity —●— Land Transportation —□— Water

**Figure 20**

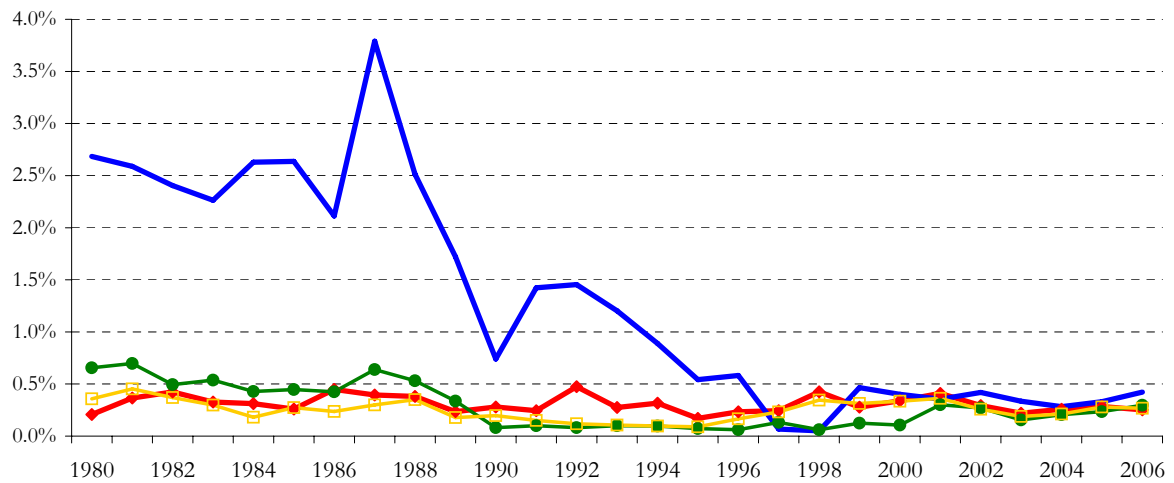
**Infrastructure Investment in Brazil**

(as percentage of GDP)

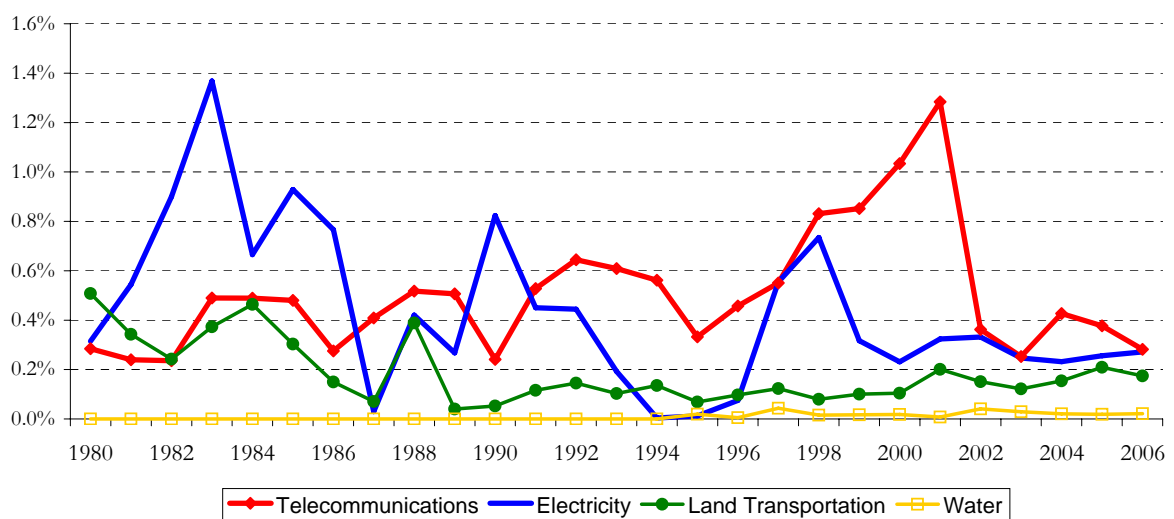
**20.1 Investment in Infrastructure, Total**



**20.2 Public Investment in Infrastructure**



**20.3 Private Investment in Infrastructure**

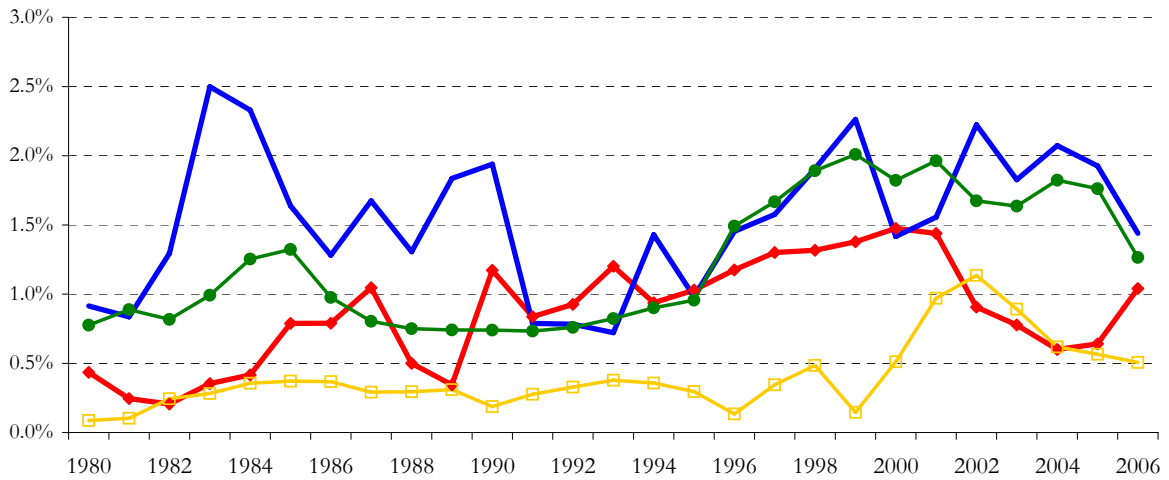


**Figure 21**

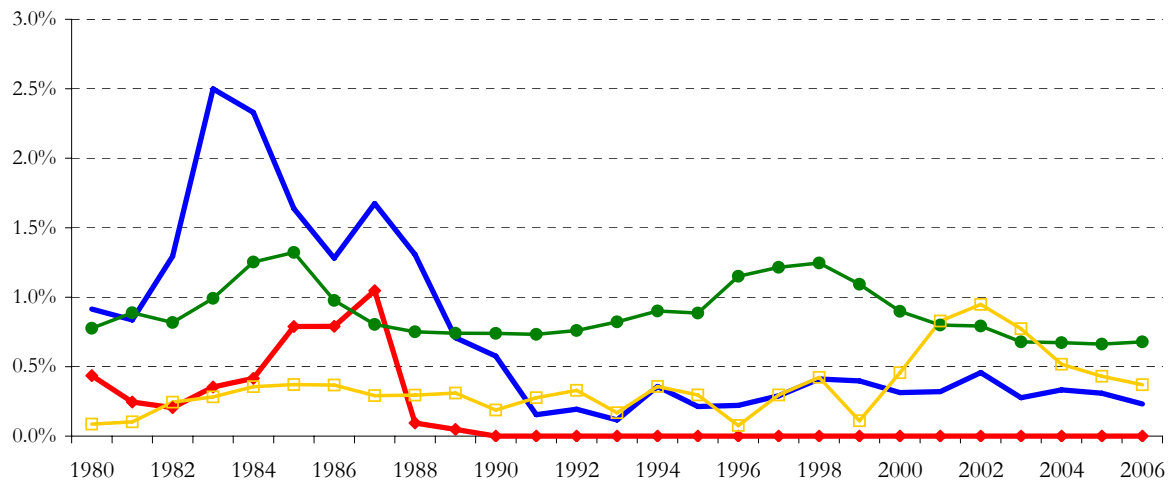
**Infrastructure Investment in Chile**

(as percentage of GDP)

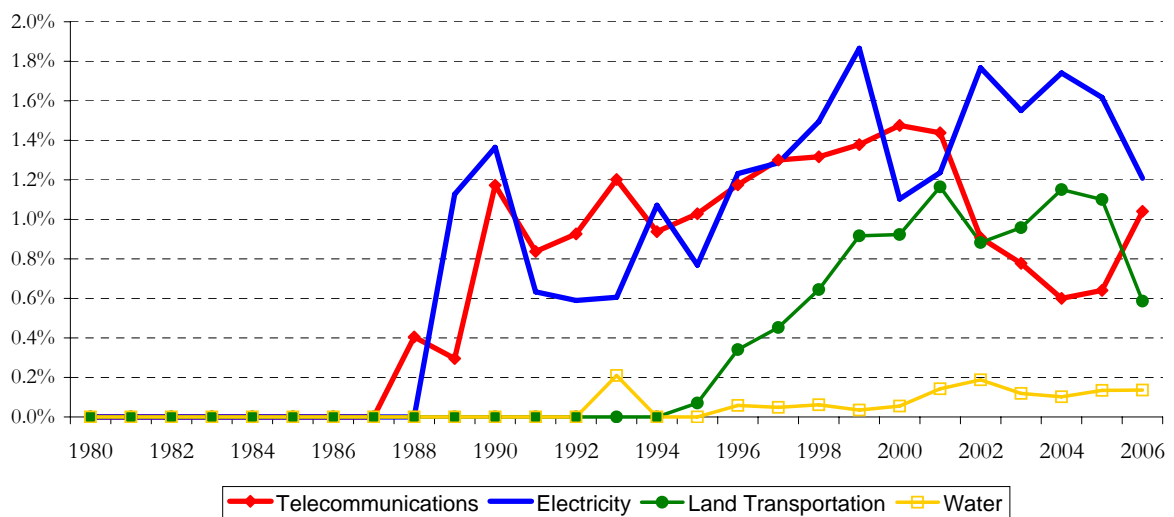
**21.1 Investment in Infrastructure, Total**



**21.2 Public Investment in Infrastructure**



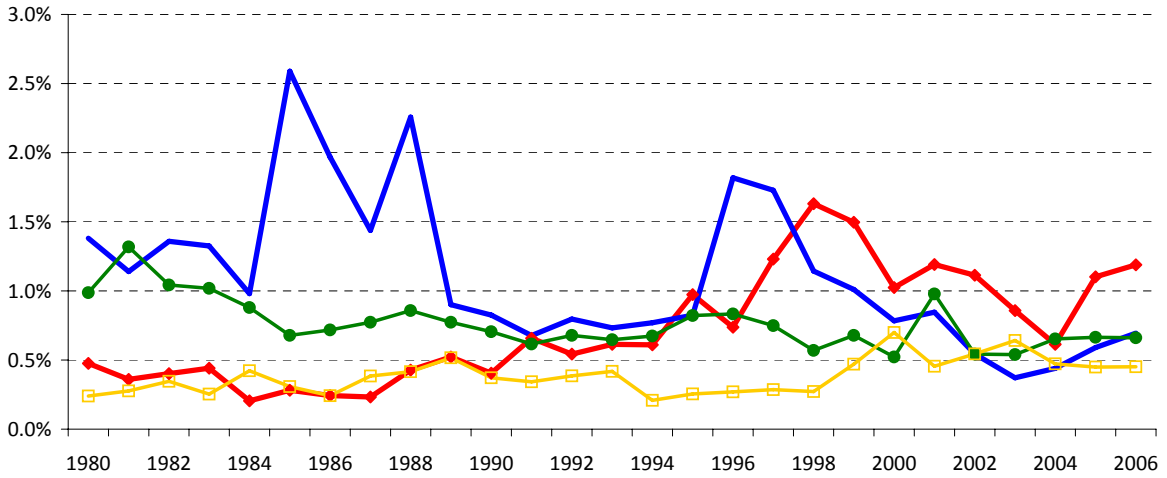
**21.3 Private Investment in Infrastructure**



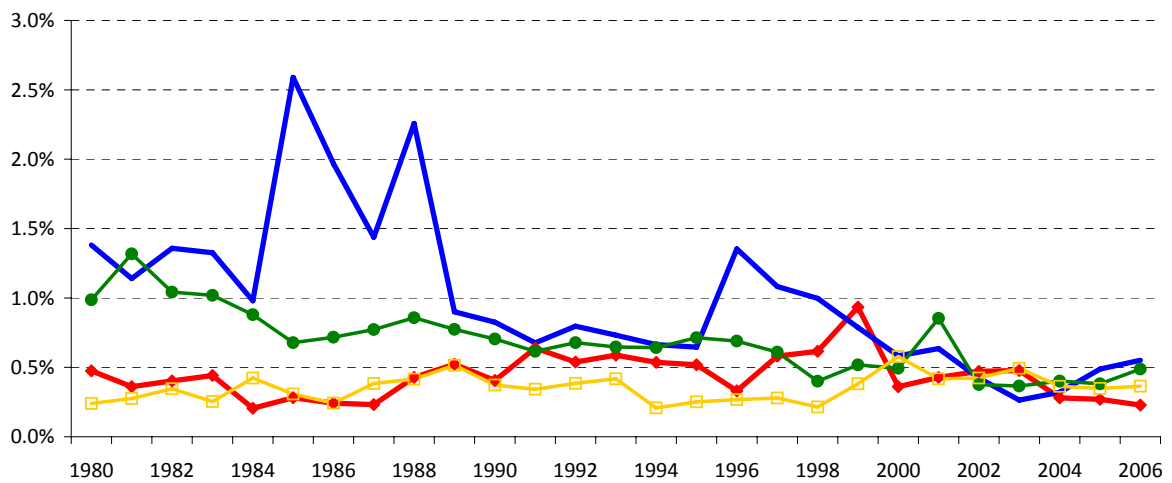


**Figure 22**  
**Infrastructure Investment in Colombia**  
*(as percentage of GDP)*

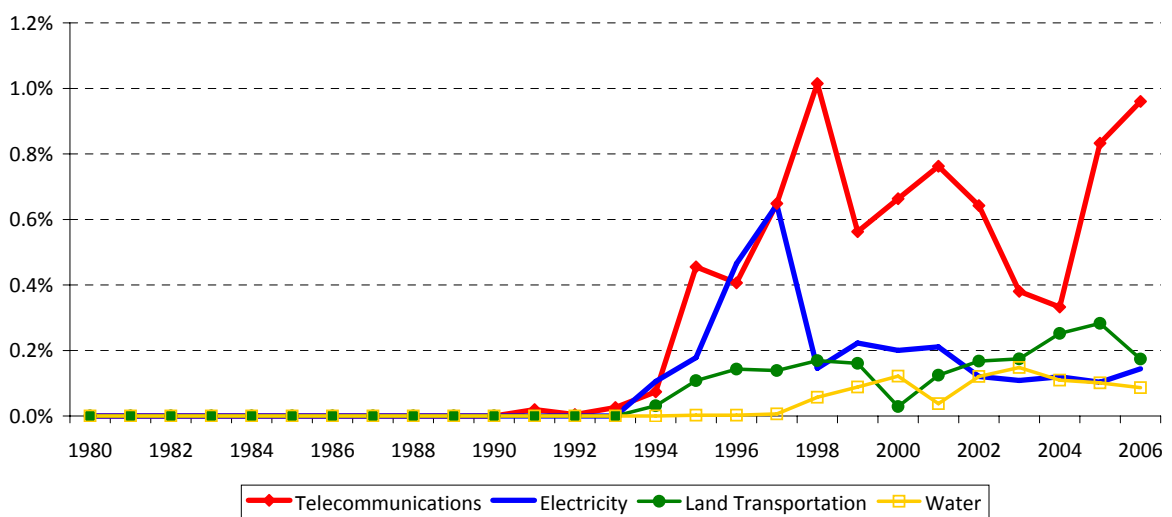
**22.1 Investment in Infrastructure, Total**



**22.2 Public Investment in Infrastructure**



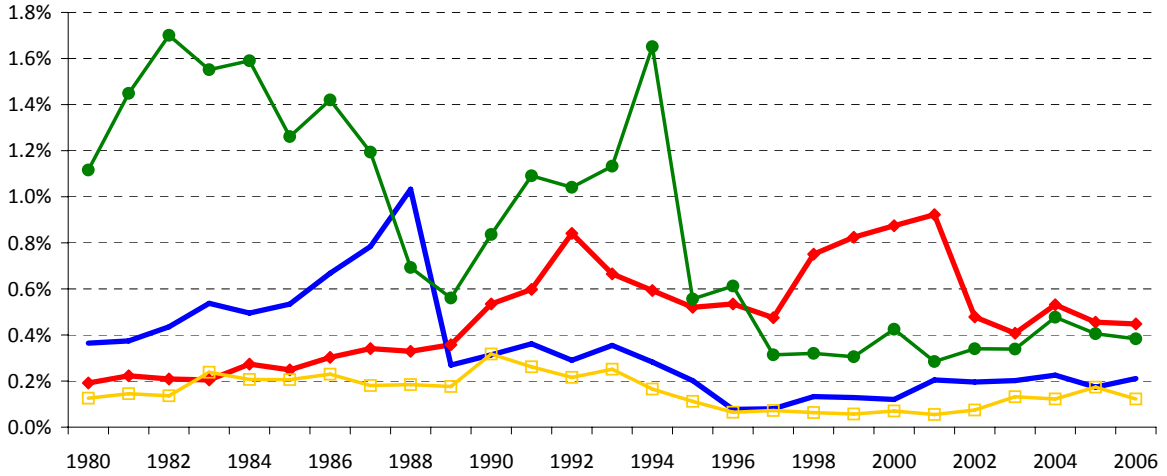
**22.3 Private Investment in Infrastructure**



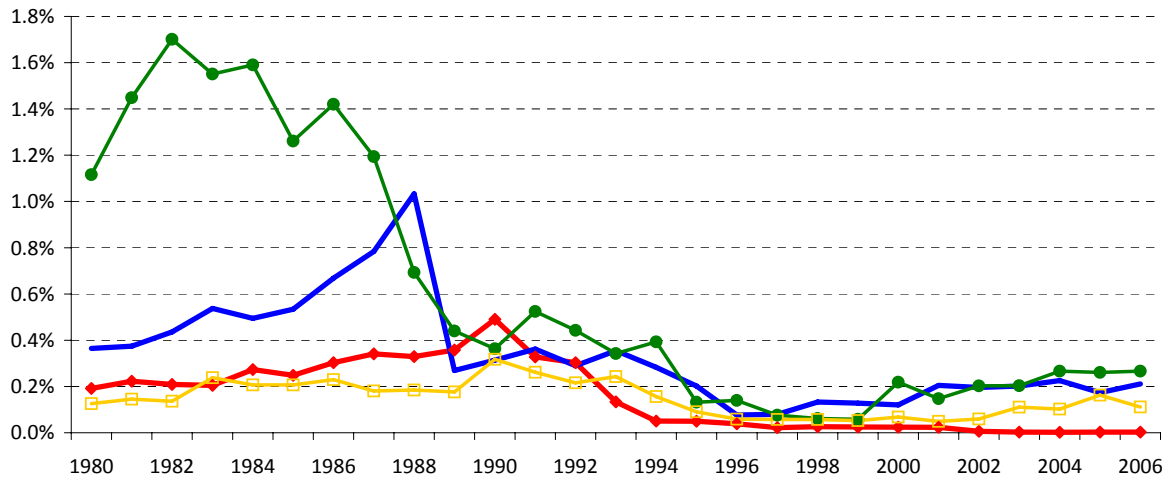
—◆— Telecommunications —▲— Electricity —●— Land Transportation —□— Water

**Figure 23**  
**Infrastructure Investment in Mexico**  
*(as percentage of GDP)*

**23.1 Investment in Infrastructure, Total**



**23.2 Public Investment in Infrastructure**



**23.3 Private Investment in Infrastructure**

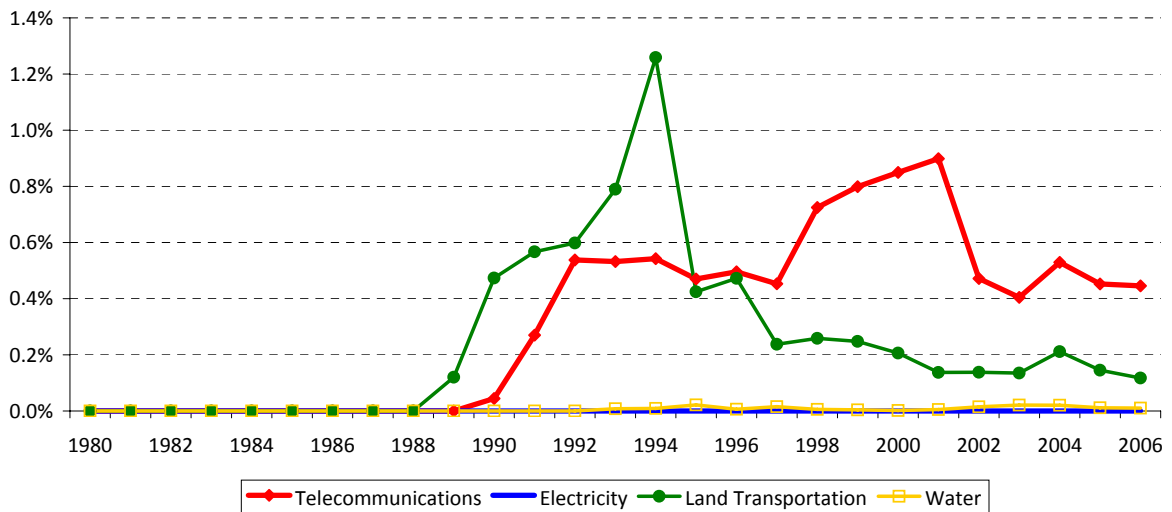
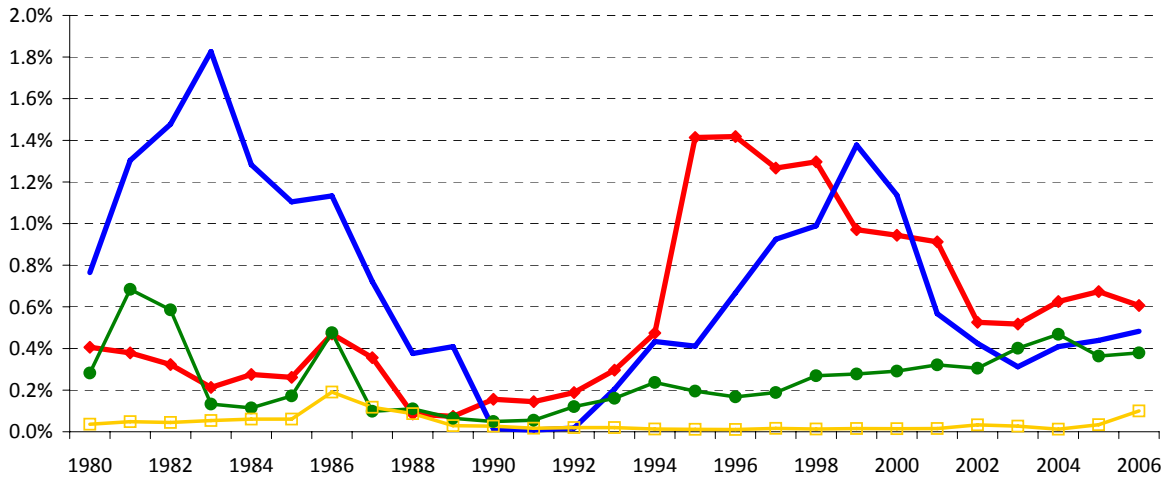


Figure 24

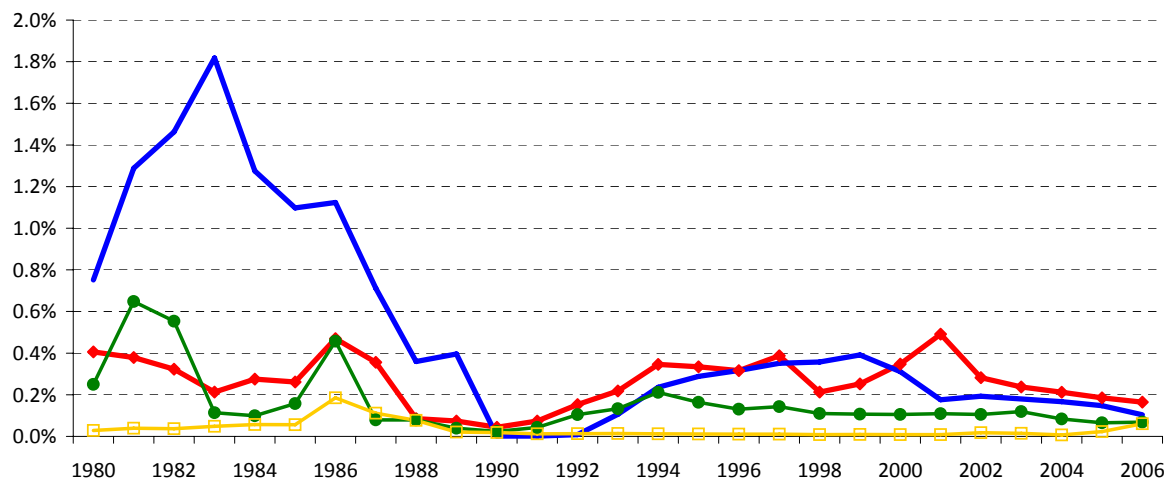
Infrastructure Investment in Peru

(as percentage of GDP)

24.1 Investment in Infrastructure, Total



24.2 Public Investment in Infrastructure



24.3 Private Investment in Infrastructure

