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HOW DID LATIN AMERICA'S INFRASTRUCTURE FARE IN THE ERA OF MACROECONOMIC CRISES?

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Resumen

Un componente importante de los paquetes de ajuste fiscal en la mayoría de países en desarrollo es el recorte en la inversión pública, incluyendo los gastos en infraestructura (Roubini and Sachs, 1989; Hicks, 1991; De Haan et al. 1996). El objetivo del presente trabajo es proveer un panorama de la evolución del sector de infraestructura en América Latina (tanto el nivel del acervo como su calidad) para poder evaluar si el sector de infraestructura se vio afectado profundamente durante el prolongado periodo de estabilización macroeconómica en los 80s y 90s. Utilizando datos de 19 países de América Latina, procedemos a evaluar las tendencias del acervo de infraestructura y de la calidad de dichos acervos, comparando el desempeño de dicho sector con el mostrado por los siete países del Este Asiático que presentan un mayor desarrollo. Segundo, evaluamos las tendencias del gasto en infraestructura para las nueve (9) economías más importantes de América Latina. Específicamente, evaluamos en qué grado los cambios en el gasto público en infraestructura está asociado con reducciones en el déficit fiscal y/o determinados por la privatización de infraestructura y el creciente gasto privado en el sector. Finalmente, evaluamos la relación entre cantidad y calidad de la infraestructura con el nivel de gasto utilizando un análisis econométrico para datos de panel.

Abstract

There is a long-standing literature that shows that fiscal adjustment is often implemented through cuts in public investment, including infrastructure (Roubini and Sachs, 1989; Hicks, 1991; De Haan et al. 1996). In this respect, the present paper aims to provide a comprehensive overview of the evolution of infrastructure stocks, quality and spending in Latin America in order to assess whether the infrastructure sector suffer from the prolonged period of macroeconomic stabilization in the 1980s and 1990s. First, we assess trends in quantity and quality of infrastructure using data on 19 Latin American countries, and we compare them to the performance of the seven "East Asian miracle" countries. Second, we look at trends in infrastructure spending for 9 major Latin American countries on which we have country data. Here we examine to what extent changes in public infrastructure spending were linked to fiscal deficit reductions and driven by the privatization of infrastructure and increased private spending on infrastructure. Finally, we assess the relationship of infrastructure quantity and quality to the path of infrastructure spending in a panel data econometric analysis.

The views expressed in this paper are those of the authors and should not be taken as those of the World Bank or the Central Bank of Chile.

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1. Introduction

Did the quantity and quality of Latin America's infrastructure suffer from the prolonged period of macroeconomic stabilization and fiscal austerity in the 1980s and 1990s? To address that question, this paper provides a comprehensive overview of the evolution of Latin America's infrastructure stocks, quality, and spending over the past decades. The paper does not attempt to answer the question posed in a formal econometric manner that specifies the counterfactual of what would have happened if Latin America had not entered a period of macroeconomic crisis. Instead we give some illustrative facts that may be consistent with some answers to this question and not with others.

There is a long-standing literature that notes that fiscal adjustment is often implemented through cuts in public investment, including infrastructure. As Roubini and Sachs (1989) note, "in periods of restrictive fiscal policies … capital expenditures are the first to be reduced (often drastically)." During fiscal adjustment, the 1988 World Development Report (p. 113) of the World Bank found that governments cut capital spending by far more (about 35%) than other public sector categories like wages (about 10%). Likewise, Hicks (1991) found that in countries with declining government expenditure 70-84, governments cut capital expenditures by more (-27.8 percent) than current expenditures (-7.2 percent). Serven (1997) found that Latin American public investment fell 2.5 percentage points of GDP from the 70s to the 80s, when the region was adjusting. East Asia, which did not need to adjust in the 80s, had an increase of 3.7 percentage points. The World Bank (1994) found that when African countries lowered their budget deficits from 1981-86 to 1990-91, "most of the cuts were in capital spending" (p. 47). De Haan et al. (1996) find that public investment is reduced during times of fiscal stringency in OECD countries. Easterly (1999) argues that governments that do not really want to adjust engage in the "illusion" of adjustment by cutting both public debt and public assets (infrastructure).

First, we assess trends in quantity and quality of infrastructure using data on 19 Latin American and Caribbean countries, excluding the smaller Caribbean economies because their data availability is more limited and also to avoid influencing the region-wide statistics with too many observations from small island economies. We take the seven "East Asian miracle" countries as a comparator group against which we can judge the performance of Latin America.

We then look at trends in infrastructure spending for nine major Latin American economies on which we have country data. We examine to what extent fiscal deficit reductions and public infrastructure spending reductions went together. We also address the question of to what extent changes in public infrastructure spending were driven by the privatization of infrastructure and increased private spending on infrastructure. We then link the time path of infrastructure quantity and quality to the path of infrastructure spending in a panel data econometric analysis.

2. Comparative Trends in Latin American Infrastructure Quantity and Quality

We first present an overview of the evolution of Latin America's infrastructure indicators.[1] To place it in perspective, we compare the experience of Latin America with that of a set of 'successful' developing countries that did not need to undergo macroeconomic adjustment for most of the 80s and 90s – the East Asian Miracle 7 economies (as given in World Bank 1994). These are Hong Kong, Indonesia, Korea, Malaysia, Singapore, Taiwan, and Thailand. Further, we also assess the progress of these two developing regions vis-à-vis the industrial economies of the OECD[2] in terms of infrastructure indicators.

Of course, the East Asian economies were growing faster than Latin American economies, so faster growth in infrastructure could reflect demand as well as supply. But the arrow of causation mostly goes the other way, as fast growth in infrastructure contributed to the faster growth in East Asia. We present a rigorous analysis of the infrastructure-growth nexus in Calderón and Servén (2002).

We focus first on the comparative performance in terms of infrastructure stocks. Starting with telecommunications, Figure 1a shows the evolution of main telephone lines per worker (that is, relative to the labor force) over the last two decades across the three regions under consideration. In each case the regional median is shown. There has been a tremendous discrepancy in the growth in phone lines per worker between Latin America and East Asia. In 1980, Latin America trailed East Asia by a relatively small margin – 89 vs. 132 main lines per 1,000 workers --, with both regions far behind industrial economies. Since then, however, the number of phone lines has expanded much more rapidly in East Asia than in Latin America. As a result, by 1997 East Asia had over twice as many phone lines per 1,000 workers as Latin America – 500 vs. 232, respectively.

Figure 1a suggests an apparent stagnation in main phone lines in East Asia and industrial countries in the 1990s, but this turns out to be due to the substitution of cell phones for land mainlines. The graph including cell phones (Figure 1b) shows that in these two regions the expansion of total telephone lines has continued without interruption throughout the 1990s, making Latin America's lag relative to these two regions even greater than in the case of main phone lines. By 1997, the total number of phone lines per 1,000 workers was 718 in East Asia, compared with 289 in Latin America.

Other measures of the availability of telephone services portray a similar picture. Figure 1c reports regional medians of local connection capacity per worker. It confirms that a huge gap has opened between East Asia and Latin America since 1980, with few signs of abating in the 1990s. And the same pattern seems to emerge for newer telecommunications technologies. For example, Figure 1d shows that in the late 1990s

[1] The data are drawn from the Infrastructure Database assembled for this research. A summary description of the sources and coverage is given in Appendix A.
[2] OECD is defined here excluding Korea and Mexico.

East Asia acquired a considerable lead over Latin America in terms of the number of Internet hosts per worker.

[Figures 1a-1d here]

The regional indicators in the above figures conceal a wide range of variation across Latin American countries, however. Figure 1e shows that a few of them (Argentina, Chile, Costa Rica) were roughly on par with East Asia in terms of main phone lines per worker in 1997, with Uruguay even ahead of East Asia. At the other end, a number of smaller economies (Nicaragua, Honduras, Guatemala) lag far behind. But a number of economies, including major ones such as Brazil and Mexico, have lost considerable ground over time: they lagged way behind East Asia in 1997, even though in 1980 they had more phone lines per worker than the East Asia median.[3]

[Insert Figure 1e here]

Figure 2a shows the trends in electricity generating capacity per worker. Here too East Asia has acquired a sizable advantage over Latin America during the last two decades. In 1980, East Asia's power generating capacity per worker was only 70 percent of Latin America's; in 1997, it had risen to 165 percent.

[Insert Figure 2a here]

Like with telecommunications, there is considerable cross-country variation in power generation capacity in Latin America. Figure 2b reveals that three countries exceed the East Asia median in 1997 – Venezuela, Uruguay and Argentina. However, several major Latin American economies lag far behind – e.g., Brazil, Ecuador, Colombia and Peru – and have made little progress over the last two decades.

[Insert Figure 2b here]

Figure 3a shows the length of the road network per worker in Latin America and the East Asian NICs.[4] Here Latin America has remained ahead of East Asia throughout the period of analysis, although the gap between the two regions has narrowed considerably over time. Figure 3b presents similar information concerning overall transport routes, which include railways in addition to roads; the qualitative pattern is the same as in the preceding figure. Finally, Figure 3c offers a comparative perspective in terms of paved roads. Here the pattern is somewhat different. In 1980, Latin America was way ahead of East Asia in terms of the length of the paved road network, but by the second half of the 1990s East Asia had reached virtual parity – with both regions far behind industrial economies.

[3] The country detail is similar in the case of total phone lines and local connection capacity, and therefore for the sake of brevity it is not presented.

[4] Obviously, roads can vary greatly in quality, so that cross-country comparisons have to be taken with care, particularly in the case of unpaved roads. An indicator preferable to road length, used in the text, would be their length in terms of lane-kilometers equivalent. Unfortunately, such information is not widely available across countries and over time.

[Insert Figures 3a-3c here]

The country-wise detail in Figure 3d shows that in all but one of the Latin American economies listed the length of the road network relative to the number of workers has actually declined over the last two decades. The only exception is Uruguay, which experienced a significant expansion – even though in 1980 it was already the country with the largest road stock per worker. The picture in terms of paved roads is similar – the majority of the region's countries witnessed a decline in their paved road stock per worker, in contrast with the expansion that took place in East Asia over the lat two decades.

[Insert Figure 3d here]

Figure 4 shows the trends in safe water availability, in terms of the fraction of the total population with access to safe water in the two regions. The data are much more limited than for the earlier indicators, and span only the years 1988-93. Over that period, East Asia has shown a steady improvement in access to clean water, while the situation in Latin America deteriorated. As a result, by 1993 the initial advantage of Latin America over East Asia had been reversed.

[Insert Figure 4 here]

We next turn to indicators of infrastructure quality and excess demand. Unfortunately, the data are much more sparse on these indicators, and there are only three – telephone line waiting times, electrical power losses and percentage of roads paved – on which we have a continuous time series over several decades. Figure 5a shows the waiting time for a telephone line, calculated as the number on the waiting list for main lines divided by the change in main lines in that year. In the early 1980s, the median waiting time was 3 years in Latin America, versus 1.5 years in East Asia. Over the 1980s and 1990s the backlog declined steadily in East Asia (and disappeared in industrial countries). In contrast, the median waiting time rose sharply in Latin America over the 1980s, to decline later in the 1990s. However, by 1997 Latin America still had a median waiting time in excess of half a year, while in East Asia the typical country had virtually no main line waiting list from 1995 on. This provides an indication of excess demand for phone lines in Latin America in the era of macroeconomic crises in the 80s and 90s, and strongly suggests that the lag relative to East Asia was mainly due to supply constraints rather than to lower demand.

Figures 5b and 5c report two measures of the performance of the phone network: the number of telephone faults per 100 lines and the percentage of unsuccessful local calls. In both cases the country coverage of the information is severely limited, so that the regional comparisons have to be taken with caution because the regional aggregates include only a few countries. Furthermore, the available data refer to 1991-95 only.

The percent of unsuccessful local calls does not show much difference between Latin America and East Asia. In turn, the data on telephone faults per main line shows much

poorer quality of service in Latin America than in East Asia. Since we don't have data on earlier years, it's impossible to say whether Latin America's worse telephone service quality relative to East Asia's is due to the recent macroeconomic crisis of the past two decades or already existed prior to that. In any case, the obvious conclusion is that Latin America lags behind East Asia not only in the quantity of telecommunication services, but also in their quality.

[Insert Figures 5a-5c here]

Regarding power, the percentage of transmission losses relative to total output offers a crude measure of the efficiency of the power network. Figure 6a offers a cross-regional perspective on power losses. The figure shows a clear deterioration in the power system during the era of fiscal austerity in Latin America in the 1980s and 90s, with an incipient reversion only after 1995. In contrast, East Asia had roughly constant electrical power losses. Thus, while Latin America's service quantity indicator (generating capacity per worker) shown above displayed a modest upward trend during the last two decades, the quality of that service deteriorated sharply.

[Insert Figure 6a here]

Among Latin American countries, Figure 6b shows that only Paraguay and Costa Rica improved upon the East Asia norm for power losses in 1997. All other countries show higher power losses, strikingly large in some cases (the Dominican Republic, Nicaragua, Honduras). Moreover, only four countries (Paraguay, Chile, Jamaica and El Salvador) experienced an improvement between 1980 and 1997.

[Insert Figure 6b here]

Finally, a rough measure of the quality of the surface transportation network is given by the percentage of roads paved. This is shown in Figure 7a, which reveals a sharp increase in the road quality thus measured in East Asia, with the percentage of roads paved rising from 60 to 75 percent between 1980 and 1990. In contrast, Latin America made virtually no progress along this dimension over the last two decades. The country-specific data (Figure 7b) show a similarly bleak picture: all Latin American countries fall well short of the East Asia median, with Jamaica as the only country coming close to it.

[Insert Figures 7a and 7b here]

3. Trends in Infrastructure Spending in Latin America

On the whole, the comparative evidence just reviewed suggests that Latin America fell behind East Asia along most dimensions of infrastructure quantity and quality over the 1980s and 1990s. The next task is to assess how these trends relate to the observed performance of infrastructure spending in the region. To do this we use infrastructure investment data from major Latin American countries over the last two decades.[5]

Figure 8 depicts the trajectory of total infrastructure investment, as a ratio to GDP, in six major Latin American countries since 1980. The figure reveals three salient facts: First, the volume of infrastructure investment varies considerably across the countries shown. In the late 1990s, it ranged from 1 percent of GDP in Mexico, to over 7 percent in Colombia. Second, in most countries infrastructure investment experienced a substantial decline around the mid 1980s, which was reversed only partially, if at all, in the late 1990s. Third, Colombia and Chile are exceptions to this rule: they have witnessed an infrastructure investment expansion, particularly over the late 1990s.

[Insert Figure 8 here]

Investment performance varied also across infrastructure sectors. Figures 9a-9d depict the trajectory of total investment, relative to GDP, in each of four major sectors – telecommunications, power, transport and water. Investment in telecommunications actually displayed an upward trend in a number of countries, with Brazil and Mexico as main exceptions (Figure 9a). In power (Figure 9b), by contrast, most countries witnessed an investment decline, particularly sharp in the case of Brazil, who had been the leading investor in the early 1980s, and Peru, whose investment levels dropped to nothing in the early 1990s. The only exception was Colombia, which more than doubled its power investment in the late 1990s.

In transport (Figure 9c), investment also followed a declining trend after the mid 1980s, with Chile as the only country to display a sustained recovery at the end of the 1990s. In a few countries (Peru, Brazil, Argentina) investment remained at extremely low levels throughout the 1990s. Finally, in water and sanitation (Figure 9d) both investment levels and trends were fairly diverse across countries: investment fell to very low values in Peru, but rose to record highs in Colombia in the late 1990s.

[Insert Figure 9 here]

[5] The data sources are described in the appendix.

4. The behavior of public infrastructure investment

To what extent did this performance of total infrastructure investment reflect the performance of public investment? With the public sector as the main -- in many cases, the only – investor, the answer is that total and public investment moved closely together in most countries, at least until the mid 1990s. Figure 10 depicts the time path of public infrastructure investment as percent of GDP. Except for the late 1990s, the graph is strikingly similar to that for total investment (Figure 8 above). It shows that public infrastructure investment collapsed after the mid 1980s in five of the six countries considered. The exception once again was Colombia, who succeeded in maintaining her public investment levels roughly unchanged throughout the period.

[Insert Figure 10 here]

How was public infrastructure spending affected by fiscal austerity in the 80s and 90s in Latin America? It is unlikely that this expenditure reduction reflected increased efficiency of spending, as we have already seen that Latin America's infrastructure quality remained poor throughout the period. Instead, the contraction of infrastructure spending likely resulted from the fiscal retrenchment that the region underwent.

In fact, we can measure how much the change in infrastructure spending accounts for the observed change in the public sector surplus in each country. This is done in Table 1, which compares the contraction in public investment with the change in the public sector primary (i.e., non-interest) surplus, with both measured between the early 1980s and the late 1990s. The table shows that total public investment fell in all countries listed except for Bolivia. Public infrastructure investment, in turn, fell in seven out of the nine countries in the table. It rose in Ecuador and showed virtually no change in Colombia. Comparison of columns 1 and 2 in the table reveals that in Bolivia, Brazil and Chile public infrastructure investment fell by *more* than total public investment – implying that non-infrastructure capital spending actually rose. The third column shows that the primary fiscal surplus rose in eight of nine countries considered (all except Venezuela).

Columns 4 and 5 calculate the contribution of investment to the fiscal correction. Public investment contraction contributed significantly (i.e., half of the total correction or more) to the adjustment in five of the eight adjusting economies. Infrastructure investment compression did the same in five economies as well. This is more remarkable because infrastructure investment is typically a relatively small component of total public spending. The role of infrastructure compression was particularly large in Brazil, where the cut in infrastructure investment was almost twice as big as the fiscal correction. Venezuela is an extreme case because it reduced total and infrastructure investment without improving its primary surplus – so that in effect the investment compression financed a reduction in public saving. At the other extreme, Colombia and Ecuador managed to improve their fiscal balances without cutting public infrastructure (nor total) investment.

Table 1
The Contribution of Infrastructure Compression to Fiscal Adjustment
Average 1980-94 vs. Average 1995-98

	Reduction in Public Investment (as % GDP)		Change in Primary Surplus (% GDP) [3]	Contribution of Investment Reduction to Fiscal Adjustment (%)	
	Total [1]	Infrastructure [2]		Total [1] / [3]	Infrastructure [2] / [3]
Argentina	3.97	2.85	5.31	74.7	53.8
Bolivia	-0.91	3.10	6.15	...	50.3
Brazil	2.80	3.08	1.77	158.1	174.3
Chile	0.94	1.41	2.39	39.2	58.8
Colombia	0.45	-0.04	4.69	9.6	...
Ecuador	1.57	-0.68	1.81	87.0	...
Mexico	6.09	1.98	6.28	97.0	31.5
Peru	4.10	1.51	3.11	132.0	48.6
Venezuela	3.49	0.41	-1.88	...	...

Table 2
Regression of Public Infrastructure Investment to GDP ratio on the Primary Deficit to GDP ratio
Fixed-Effects SUR estimates, 1980-98

Variable	Coefficient	t-Statistic
Primary Deficit / GDP	-0.0242	-7.49
Argentina –trend	-0.0021	-8.01
Bolivia –trend	-0.0018	-6.27
Brazil –trend	-0.0023	-8.09
Chile –trend	-0.0011	-3.30
Colombia –trend	-0.0002	-0.88
Ecuador –trend	0.0005	2.08
Mexico –trend	-0.0013	-7.24
Peru –trend	-0.0011	-5.20
Venezuela –trend	-0.0004	-6.69
Adjusted R**2	0.842	
Number of Countries	9	
Observations	170	

This is just accounting without any imputing a causal role to fiscal adjustment, or even establishing a correlation between fiscal correction and infrastructure cuts. In fact, the (pooled) full-sample correlation between the primary deficit and the public infrastructure investment/GDP ratio is -.195, with a standard error of .077. This however, ignores the role of country-specific factors. A simple way to take them into account is to regress public infrastructure investment on the primary deficit, controlling for country-specific effects and time trends. This is done in Table 2, which shows a quantitatively small, but

highly significant, negative association between the fiscal primary balance and public infrastructure investment.[6] However, there are significant country-specific time trends in infrastructure spending – negative in all cases except Ecuador – which suggest that factors other than primary deficit adjustment may have been at work in the observed decline of public infrastructure investment.

As we saw above, only Colombia and Ecuador escape the general trend towards infrastructure investment compression. In fact, these are also the only two countries -- among those for which we have data -- where the composition of public investment did not shift against infrastructure over the period of analysis. Figure 11 illustrates the changes over time in the composition of public investment between infrastructure and non-infrastructure items. It is immediately apparent that public infrastructure investment lost ground relative to non-infrastructure investment in all but the two countries mentioned. In these two countries, infrastructure investment accounted for roughly 50 percent of total public investment in the late 1990s, while in other countries (Argentina, Mexico, Venezuela) it represented less than one-fourth of the total.

[Figure 11a-11i here
Insert 3 per page]

The decline in public infrastructure investment experienced by most countries was not evenly distributed across infrastructure sectors. Figure 12 breaks down public infrastructure investment into four major components – power, telecommunications, transport and water. In a number of instances, the sharpest investment decline corresponded to the power sector. This is the case in Argentina, Brazil, Chile and Peru. In other countries, however, the compression affected most severely transport investment – Mexico, Bolivia, Venezuela. Also, by the end of the 1990s public investment in telecom had practically disappeared in several countries.

[Figure 12a-12i here
Insert 3 per page]

In a few instances – most related precisely to the telecom sector – the declining public investment trend documented above reflected an increasingly important role of private infrastructure investment. But this was by no means a generalized phenomenon across countries and infrastructure sectors. We next document the observed pattern of private investment.

[6] The small magnitude of the regression coefficient is somewhat puzzling. Allowing for lagged effects of the primary deficit does not lead to significant changes.

5. Did private investment replace public investment?

Many Latin American countries opened their infrastructure sectors to private enterprise in the late 1980s and early 1990s. Table 3 shows the approximate date of effective opening up in different infrastructure sub-sectors in the countries under analysis. The opening up took a variety of forms, ranging from privatization of public enterprises, to management contracts and private concessions. Appendix B provides a full account of the reforms across countries and sectors (see also Estache, Foster and Wodon 2000).

Table 3
Infrastructure Sector Reform Dates

Country	Telecom	Electricity	Roads	Railways	Water
Argentina	1990	1992	1990	1990	1993
Bolivia	1987	1995	--	1996	1997
Brazil	1984	1984	1996	1996	1995
Chile	1986	1986	1994	--	1997
Colombia	1994	1992	1993	1995-97	1993
Ecuador	1994	1996	--	--	--
Mexico	1990	1998	1989	1996	1993
Peru	1990	1994	--	--	--
Venezuela	1991	1992	--	--	--

Source: Appendix B

The private sector response to this opening up showed considerable diversity across countries and sectors. Estache et al. (2002) and Pargal (2002) provide a detailed analysis of this response. Here we first give a descriptive account of the patterns of private infrastructure investment; in the next section we present some formal empirical experiments.

The evolution of private infrastructure investment relative to GDP in six major Latin American countries is depicted in Figure 13. In five of the six countries private investment took off in the late 1980s or early 1990s. The exception is Brazil, where infrastructure investment of the private sector hovered around 1 percent of GDP over the last two decades. Among the other countries, Chile exhibited the earliest rise in private investment, followed by a rising trend -- also apparent in Colombia. In contrast, Argentina and especially Mexico appear to have stagnated in the second half of 1990s. Also, in most countries – with Colombia and Chile as the exceptions -- the total volume of private infrastructure investment remains quantitatively modest, at 1.5 percent of GDP or less.

[Insert Figure 13 here]

In some countries, the rise in private infrastructure investment came along with an upward trend in overall private investment. Figure 14 shows that this was indeed the case in Argentina, Chile, and Peru and – to a more limited extent – Mexico and Ecuador as

well. In other cases, however, the increase in private infrastructure investment was not matched by a parallel rise in other types of private investment. Examples of this latter situation were Bolivia -- where non-infrastructure investment appears to have declined – as well as Colombia and Venezuela, where overall private investment displayed abrupt fluctuations over the period.

[Figures 14a-14i here
Insert 3 per page]

The rise in private infrastructure investment was uneven not only across countries, but also across infrastructure sectors. Figure 15 depicts the time pattern of private investment by sector of destination in the nine countries under analysis. In a majority of countries – Argentina, Chile, Ecuador, Peru, Venezuela -- the telecommunications sector became the prime destination of private infrastructure spending in the late 1990s. In contrast, the power sector took this role in Bolivia and Colombia. In Brazil there were no significant changes in the sectoral allocation of private infrastructure investment over the period under analysis. Finally, Mexico appears to have been the only country where the transport sector became a prime destination for private investment.

[Figures 15a-15i here
Insert 3 per page]

How did these sectoral patterns match the reforms introduced by most countries to open up their infrastructure sectors? It is easier to assess the response of private investment across countries and sectors to the reforms by switching to 'reform time'. To do this, we examine the path of private infrastructure spending in each sector before and after the year of reform identified in Table 3 above, which is shown as year 0 in the various panels of Figure 16.[7]

Figure 16a shows the path of private telecommunications spending in the nine Latin American economies considered. There has clearly been a surge of private investment in this sector in the wake of opening up to private initiative. The largest increases were in Argentina and Chile. Moreover, the increases are impressive compared to the average pre-reform public spending, which was around $12 per capita.[8]

Similarly, Figure 16b shows the path of private electricity spending before and after liberalization. In most countries, private spending in this sector rose sharply around the time of reform, although Ecuador is a conspicuous exception. In most cases, the increases fell short of the average pre-reform public spending per capita in the sector, which was around $32.

In roads (Figure 16c), Chile and Mexico show strong private spending increases, while in the other countries reforming this sector the results seem more modest. As a

[7] To smooth some large jumps in the data series, we use a centered 3-year moving average in the graphs.
[8] We calculate the pre-reform public spending per capita as the average over 1970-1989 for all countries that have data on the sector, in 1995 dollars.

consequence, only in these two countries did total per capita spending actually rise after the reform.

Likewise, in railways (Figure 16d) only Argentina displayed a sharp increase in private spending per capita after the reforms. Even in that case, however, the rise was sufficient only to keep total spending roughly at its pre-reform level (around $10). In the other countries, total spending per capita actually declined.

Finally, results are also uneven in the water sector (Figure 16e). In Bolivia, there was an increase in private water spending before liberalization, perhaps in anticipation of the reform. In Argentina, the liberalization clearly yielded significant increases in spending. In Chile, however, private spending in the water sector showed little change after reform. In spite of this diversity in private sector response, total per capita spending in the water sector rose in most countries. But the main reason is that, unlike in other sectors, public investment per capita in the water sector did not decline, but instead kept a rising trend in the majority of countries.

[Insert Figure 16a-16e]

In summary, these 'reform time' graphs of private investment, as well as similar graphs constructed for public investment (not shown here to save space) do not seem to provide strong support for the popular perception that the reform and liberalization of infrastructure sectors led to a surge in private investment to replace the declining public investment. The above graphs suggest that such perception might be roughly correct in the case of the telecommunications sector, but in the other sectors the picture appears to be much more mixed.

This conclusion from the 'reform time' graphs shown is corroborated by the correlations shown in Table 4. The overall correlation between public and private investment during the last two decades across the nine countries under study is statistically insignificant. Only two of the correlations by sector are significantly different from zero. They correspond to the telecom sector, in which public and private investment are negatively correlated, and the transport sector, where the correlation is strongly positive.

Table 4
Correlation between Sectoral Public and Private Infrastructure Investment (Investment as a ratio to GDP, 9 Countries, 1980-98)

Total Infrastructure Investment	-0.027
Power	-0.010
Telecommunications	-0.270**
Roads and Railways	0.383**
Water	-0.112

*Note: ** denotes statistical significance at the 5 percent level*

A more formal test of the hypothesis that private infrastructure spending replaced public spending can be performed by noting that, if such view is correct, we should see more of

a reduction in public infrastructure spending in the countries and sectors where private infrastructure spending increased the most. To verify this, we regress public infrastructure investment on private infrastructure investment, with both expressed as percent of GDP.

Table 5 reports the results from three sets of regressions. The first two use aggregate private and public infrastructure investment, and allow for country-specific constants and time trends, using a SUR setup. The first specification reported in the table imposes a common coefficient on private investment for all nine countries. The result is surprising. The coefficient estimate equals .10 and is strongly significant, implying a positive statistical association between private infrastructure spending and public infrastructure spending, which suggests that the two are complements rather than substitutes. The country-specific trends (not reported to save space) are negative and significant in seven of the nine countries, with Colombia and Ecuador as the only exceptions. In other words, the data assign the reduction in public infrastructure spending to the pre-existing trend rather than the increase in private infrastructure spending.

The second experiment in Table 5 reports results from a less restrictive empirical specification which permits the private investment / GDP ratio to carry different coefficients in each country. The estimated coefficients vary in sign and magnitude. Four are positive and five negative; their average equals 0.031. Four of the nine estimates are significant at the 5 percent level, and three of these (corresponding to Colombia, Peru and Bolivia) are positive, while the fourth (Brazil) is negative. On the whole, these results reveal a considerable degree of cross-country diversity in the relationship between private and public infrastructure investment. Indeed, the pooling restrictions implicit in the earlier empirical specification (which assumed equal coefficients across countries) are clearly invalid: a Wald test of equality of coefficients across countries yields a p-value of less than 0.0001, unambiguously rejecting the null of equal coefficients. As for the country-specific time trends, most (seven out of nine) are significantly negative; the exceptions now are Chile and Ecuador, whose time trends are insignificant.

In the last experiment reported in Table 5 we repeat the regression of public on private investment but allow for different regression coefficients for each country and sector, along with country-and-sector-specific time trends and intercepts using a fixed-effects specification. After dropping country-sectors with missing data, this yields a total of 32 regression estimates of the impact of private on public infrastructure investment.

Given the large number of parameters estimated, the table presents only a summary of the results. Again the coefficient estimates show a wide dispersion. Seventeen are positive and fifteen negative, and their mean equals 0.16. Of the sixteen estimates significantly different from zero at the 5 percent level, eight are positive and eight negative. In spite of this diversity, the sectoral distribution of the estimates (whose individual values are not shown in the table) is suggestive, however. The eight significantly negative estimates correspond to the power (four estimates), telecom and water (two each) sectors in various countries. Interestingly, none of the transport sector offset coefficients is significantly negative. In turn, the eight positive coefficients are found in transport (four), power

(two), telecom and water (one each). This pattern of coefficient signs would suggest some replacement of public by private investment in power, while in transport the relationship between public and private spending appears to be one of complementarity. As for the country and sector-specific time trends, the vast majority (twenty-five out of thirty-two) remains negative. Among those statistically significant, sixteen are negative and only two are positive.

Table 5
Regressions of Public Infrastructure Investment to GDP on Private Infrastructure Investment to GDP

(9 Countries, 1980-98)

I. Using aggregate investment by country (FE-SUR estimates with country-specific constants and trends)	
1.1 Pooled estimate	0.108**
Number of significantly positive trends	1
Number of significantly negative trends	7
Adjusted R-squared	0.838
1.2 Country-specific estimates (9 in total): Average	0.031
Number of significantly positive estimates	3
Number of significantly negative estimates	1
Number of significantly positive trends	0
Number of significantly negative trends	7
Adjusted R-squared	0.852
II. Using Sectoral Investment by country (FE-SUR estimates with country-specific constants and trends)	
Country-sector-specific estimates (32 total): Average	0.162
Number of significantly positive estimates	8
Number of significantly negative estimates	8
Number of significantly positive trends	2
Number of significantly negative trends	16
Adjusted R-squared	0.859

*Note: ** denotes statistical significance at the 5 percent level*

We conclude that in general the observed decline in public infrastructure spending was not closely matched with those sectors and countries where private infrastructure spending surged. There is a lot of diversity across countries and infrastructure sectors, and in some individual cases private infrastructure spending rises did offset public infrastructure spending cuts. But in a large number of instances the sectors where private spending increased the most were not those where public spending declined the most – or even those where it declined at all. On the whole, this suggests that private sector involvement did not lead to a generalized replacement of public spending with private spending. Hence, the opening up to private activity was not a panacea for Latin America's infrastructure woes.

6. Infrastructure Spending and the Quantity and Quality of Infrastructure

Finally, we examine the link between infrastructure investment trends and the evolution of standard indicators of infrastructure stocks and their quality. We first assess to what extent spending on infrastructure gets translated into actual quantity increases of infrastructure. It could be that public spending is mis-classified or is simply ineffective in creating new infrastructure. Pritchett (1999) reports many horror stories of public investment not translating into effective increases in capital. In this section, we examine the effect of total infrastructure spending, public and private, in the respective sectors on the growth of the corresponding infrastructure stocks for the nine Latin American countries where we have data.

We do this by estimating regressions with the growth in physical infrastructure stocks as dependent variable, and infrastructure investment (as a ratio to GDP) as explanatory variable.[9] We compute separate panel estimators for each of the infrastructure sectors under analysis. In each case, we use a dynamic specification for the relationship between growth in physical infrastructure stocks and infrastructure in investment, in order to capture lags in the capital accumulation process and investment decisions. Specifically, we include lags of both the dependent and independent variables in an autoregressive-distributive lag (ARDL) framework. The lag order of the ARDL is dictated by a compromise between the need to allow for time-to-build in the accumulation of stocks, and the length of the available time series. For telecommunications, four lags proved sufficient. For power and transport (roads and railways), we used up to six lags. While this specification might be insufficient given the long delays often involved in the construction of power plants and railway routes, the short data samples available prevented us from using longer lag specifications.

Table 6 summarizes the empirical results of this procedure. The table reports a variety of empirical specifications with and without country and/or time effects, which respectively intend to capture country-specific and common factors affecting infrastructure accumulation. In the case of transport routes, rather than fixed effects we use each country's total land area (in logs) as additional explanatory variable.[10] In view of the generous parameterization of the estimated equations, to save space the table only reports the long-run impact of investment on the rate of accumulation of the asset in question.

[10] Other experiments using instead the log of real infrastructure spending, or its ratio to the lagged stock, as explanatory variable yield qualitatively similar results, so we do not report them here. In the cases of telecom and transport routes, we also experimented with alternative definitions of the dependent variable – total phone lines, rather than main lines, in the case of telecommunications, and total and paved roads, rather than total roads plus railways, in the case of transport. The results were virtually indistinguishable from those reported in the table.

[10] The area variable typically carried a positive coefficient significant at the 5 percent level or better, so we opted for retaining this specification for the transport equation. We also experimented with population density as additional variable, but it turned always insignificant in the regressions. Finally, we also estimated specifications including land area in the accumulation equations for phone lines and power, but the estimated coefficient on the area variable was always very far from significance at conventional levels.

The top block of Table 6 reports pooled OLS estimates. For all three assets, the estimated long-run impact of total infrastructure investment on asset accumulation is positive and significant at the 5 percent level (6 percent in the case of transport). The long-run coefficient estimate reflects the percentage increase in the rate of asset accumulation associated with a permanent increase in investment by 1 percentage point of GDP. Thus, for example, the top left coefficient in the table indicates that the rate of growth of phone lines per worker rises by 8 percent when telecom investment increases permanently by 1 percent of GDP. The explanatory power of the estimated equations varies across assets. It is highest for telecom, where the simple ARDL specification chosen accounts for over three-fourths of the observed variation in asset growth rates, and lowest for power, where only 11 percent of the variation is captured by the estimates. This echoes the concerns stated above that asset accumulation may reflect investment performance with long and variable lags, perhaps longer than allowed for in our empirical specifications, due to the scarce number of observations available. Further, in the case of power the lag structure may vary considerably across countries, depending on the kind of power generation added to the system – hydroelectric, coal and so on.

Table 6
Relationship between Physical Stocks and Investment Spending in Infrastructure

Dependent Variable: Growth rate in physical infrastructure
Specification: Autoregressive Distributed Lag (ARDL) Model
Sample: 9 largest Latin American countries with annual data, 1970-98

Regression	**Telecom ARDL(4,4)**	**Power ARDL(6,6)**	**Total Roads ARDL(6,6)**	**Roads+Railways ARDL(6,6)**
I. Pooled OLS Regression				
Total Investment (p-value)	6.8922 (0.0006)	1.9650 (0.0380)	4.4286 (0.0770)	4.0704 (0.0532)
R**2	0.7674	0.1140	0.3762	0.3624
II. Fixed-Effects Estimator (F.E.)				
Total Investment (p-value)	8.7181 (0.0000)	3.4201 (0.0297)	4.6281 (0.0797)	4.6499 (0.0056)
ln (Area) (p-value)	…	…	0.0363 (0.0457)	0.0519 (0.0192)
F.E. (p-value)	(0.0320)	(0.0697)	-	-
R**2	0.7837	0.2435	0.3783	0.4889
III. Fixed- and Time-Effects Estimator (F.E. & T.E.)				
Total Investment (p-value)	7.9923 (0.0002)	6.3847 (0.0587)	5.2235 (0.0685)	6.0016 (0.0136)
ln (Area) (p-value)	…	…	0.0389 (0.0417)	0.0590 (0.0041)
F.E. (p-value)	(0.0403)	(0.0813)	…	…
T.E. (p-value)	(0.0043)	(0.0156)	(0.0064)	(0.0090)
R**2	0.8237	0.3244	0.5137	0.5319

The next block in Table 6 adds country fixed affects to the telecom and power regressions, and land area for roads. The long-run estimates do not change much in the case of telecom and roads, and the explanatory power of their empirical equations rises somewhat. For power, however, the estimated long-run effect of investment rises quite substantially, along with the R-squared. The land area and the country fixed effects are significant variables (although only at the 10 percent level in the case of power).

Finally, the bottom block in Table 6 adds time dummies in the empirical specification, to control for omitted common factors driving asset accumulation across countries. The set of dummies is highly significant in all three equations. The long-run coefficient estimates for telecom and roads show relatively modest changes, although the fit of the respective equations improves noticeably, especially in the case of roads, whose R-squared now exceeds 50 percent. As for power, the estimated long-run effect becomes much bigger, and the fit of the equation also improves substantially, with the R-squared now exceeding 30 percent.

In summary, we conclude that infrastructure investment is a robust predictor of subsequent changes in the physical infrastructure stock across countries and over time. The evidence is particularly strong in the case of telecommunications and transport routes. The simplicity of the empirical specifications employed, and the relatively short time span of the available data, suggest that the link between investment and infrastructure accumulation is probably much stronger in reality than the above experiments reveal. This broadly suggests that reductions in public, and hence total, infrastructure spending have negatively affected the quantity of infrastructure available in Latin America over the last two decades.

While earlier we found no systematic evidence that private investment had replaced declining public investment in infrastructure, it is nevertheless possible that private spending might have translated into faster stock accumulation than public spending. The former might have shown greater efficiency than the latter, by acquiring the same infrastructure stocks at a lower cost. In such case, we should see a greater contribution of private investment to stock accumulation than that of public investment.

This is investigated in Table 7, which reports similar experiments to those performed in the preceding table but disaggregating total investment between its public and private components. If the latter is more efficient than the former, private spending should carry a significantly larger coefficient than the former in the infrastructure stock accumulation regressions. The empirical results in the table only provide some evidence in favor of this hypothesis in the case of transport routes. In such sector, the coefficient of private investment is consistently much larger than that of public investment, although Wald tests show that the difference between the two is significant only when both time and country effects are added in the regression. In contrast, in telecommunications and power the coefficient of public investment is in most cases somewhat larger than that of public investment, but the tests of equality yield no strong evidence against the null hypothesis that the bang-per-buck of private and public investment is the same, regardless of whether country and time effects are added in the equation. These results, however, have

to be taken with some caution, since the projects falling under private initiative could be systematically different from those undertaken by the public sector.

Table 7
Relationship between Physical Stocks, Public and Private Investment Spending in Infrastructure

Dependent Variable: Growth rate in physical infrastructure
Specification: Autoregressive Distributed Lag (ARDL) Model
Sample: 9 largest Latin American countries with annual data, 1970-98

Regression	Telecom ARDL(4,4,4)	Power ARDL(6,6,6)	Total Roads ARDL(6,6,6)	Roads+Railways ARDL(6,6,6)
I. Pooled OLS Regression				
Private Invest.	3.8166	0.6099	14.6114	14.5679
(p-value)	(0.0006)	(0.5713)	(0.0364)	(0.0152)
Public Invest.	1.0705	0.9287	-0.2405	-0.8475
(p-value)	(0.1515)	(0.0375)	(0.0596)	(0.0306)
Equality Test *1/*	(0.6632)	(0.8289)	(0.0159)	(0.1527)
R**2	0.7844	0.1237	0.4383	0.4361
II. Fixed-Effects Estimator (F.E.)				
Private Invest.	5.9294	1.5760	14.2881	15.9247
(p-value)	(0.0000)	(0.0675)	(0.0370)	(0.0570)
Public Invest.	4.0754	1.2349	0.0652	0.1007
(p-value)	(0.1249)	(0.0757)	(0.0593)	(0.0281)
ln (Area)	…	…	0.0062	0.0103
(p-value)			(0.0568)	(0.0366)
F.E. (p-value)	(0.0697)	(0.0835)	…	…
Equality Test *1/*	(0.9243)	(0.8810)	(0.1592)	(0.0650)
R**2	0.7969	0.1708	0.4394	0.4953
III. Fixed- and Time-Effects Estimator (F.E. & T.E.)				
Private Invest.	5.9984	2.2758	12.6997	15.4697
(p-value)	(0.0003)	(0.0729)	(0.1078)	(0.0106)
Public Invest.	4.4666	1.7122	0.0772	0.0338
(p-value)	(0.0213)	(0.0902)	(0.0046)	(0.0434)
ln (Area)	…	…	0.0096	0.0096
(p-value)			(0.0257)	(0.0392)
F.E. (p-value)	(0.0285)	(0.1919)	…	…
T.E. (p-value)	(0.0059)	(0.0192)	(0.0473)	(0.0804)
Equality Test *1/*	(0.9487)	(0.3672)	(0.0319)	(0.0339)
R**2	0.8337	0.3964	0.5691	0.5965

1/ It tests the equality of the coefficients for public and private sector. We report the p-value for this test.

On the whole, then, we find only limited evidence that private investment was more effective than public investment in expanding infrastructure asset stocks. But what about their quality? Did enhanced private participation generally lead to an improvement in the quality of infrastructure stocks? In fact, where countries did privatize the infrastructure sector, there is some mixed evidence of quality improvements. Table 8 shows that all the telephone quality service indicators (telephone faults per line, percent of unsuccessful local calls, years spent on waiting list for phone service) get significantly better, the

higher is the share of the private sector in telecommunications spending. This result holds whether or not one controls for country fixed effects. On the other hand, there is a perverse result in the electricity sector, as power losses increase with increased private share of power spending. However, this could reflect reverse causality, as governments may have wanted to privatize inefficient enterprises in the power sector that were running high power losses, and/or heterogeneity among public and private power projects.

Table 8
Private Participation and Infrastructure Quality

Regression of Quality Indicators on Private Sector Investment Share
Sample: 9 largest Latin American countries

	Method	**Sample**	**Coefficient on Private Share**	**Total Observ.**	**R**2**
I. Telephones					
Faults per 100 main lines	SUR	1982-98	-52.89 (-3.2)	65	0.63
	FE-SUR	1982-98	-45.90 (-2.7)	65	0.78
% of Unsuccessful Calls	SUR	1990-98	-18.75 (-1.7)	26	0.63
	FE-SUR	1990-98	-8.34 (-0.8)	26	0.72
Years on Waiting List for Main Lines	SUR	1970-98	-0.16 (-5.2)	150	0.72
	FE-SUR	1970-98	-0.20 (-7.1)	150	0.84
II. Electricity					
Power Losses (% of Output)	SUR	1971-98	2.64 (3.3)	204	0.94
	FE-SUR	1971-98	3.95 (6.9)	204	0.98

Notes: SUR – Seemingly Unrelated Regressions, FE-SUR – Fixed Effects-Seemingly Unrelated Regressions. Numbers in parenthesis under the coefficients represent t-statistics.

Figure 17 explores the same issue in a different way. It presents scatter plots relating infrastructure quality indicators to the share of the private sector in total infrastructure investment, using ten-year averages instead of the annual data underlying the regressions in table 8; this should make it easier to detect the changes in quality if these only occur gradually over time, as the new private sector projects reach completion and become numerous enough to affect significantly overall infrastructure quality. Each point in the graphs represents one country-decade observation.

The verdict from the figure is similar to that emerging from the regressions: there is a clear association between improving quality of telecommunications service and private participation. In the case of the power sector, there is also some hint at declining power losses, although the evidence appears much weaker than for telecommunications.

[Insert Figure 17]

7. Conclusions

The 1980s and 1990s saw a widening of the infrastructure gap between Latin America and other successful developing economies like those in East Asia. A comparative review of a comprehensive set of infrastructure quantity and quality indicators reveals that during that period Latin America fell behind along most dimensions analyzed.

Latin American public infrastructure spending declined as a percent of GDP during the era of macroeconomic crises in the 80s and 90s. Part of this decline is associated with fiscal adjustment (reductions in budget deficits), but the magnitude of this association is small and there is still a downward trend in infrastructure spending even after controlling for budget balances. This suggests that some portion of the reductions in public expenditure took place aside from deficit reduction. Furthermore, there is only limited evidence to support the common perception that privatization (more generally, private sector entry in infrastructure industries) explains the observed downward trend in public infrastructure spending. While this seems to be true in a few cases, there are at least as many (or even more) instances in which higher private infrastructure spending is associated with *more* public infrastructure spending.

Private infrastructure spending did increase after the infrastructure sectors were opened up to private participation, but did so very unevenly. Opening up to the private sector was most successful in telecommunications and electricity, with water, roads, and railways showing more uneven results, and there were some laggards even in telecommunications and power. The levels of private infrastructure spending were generally below the pre-reform public infrastructure spending in each sector. Moreover, there was no universal tendency for public infrastructure spending to fall after liberalization.

Infrastructure spending is a good predictor of subsequent growth in infrastructure stocks, particularly robust in the cases of telephone lines and transport routes, but also for power generation capacity. If the quantity of infrastructure has an effect on output levels, as a growing literature has argued (Canning 1999, Calderón et al 2000), then fiscal retrenchment implemented through cuts in public infrastructure spending represents a myopic and potentially self-defeating adjustment strategy, as it lowers future output and thus the tax collection and debt servicing capacity of the economy (Easterly 2000). The evidence also suggests that under this kind of fiscal austerity, Latin America's increasing infrastructure lag behind East Asia is unlikely to get better soon.

There is no clear evidence that private sector participation has raised the efficiency of infrastructure investment – as reflected by the translation of spending into asset accumulation. On the other hand, there is some positive evidence on the effect of the increased private sector share of infrastructure on infrastructure quality. All of the telephone service quality indicators improve with an increased private sector share in telecommunications, while the evidence regarding the relationship between power sector efficiency and private participation is less strong.

The overall picture is that Latin America's infrastructure sector performed poorly during the era of macroeconomic crises in the 1980s and 1990s. Privatization has so far been no panacea, and a huge gap has opened relative to East Asian NICs. For Latin America to recover its long-run growth potential, increased emphasis on infrastructure policy is desirable.

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Appendix A: The Infrastructure Database

The data underlying the analysis in this paper come from the Infrastructure Database assembled for this work. The database includes both physical indicators of quantity and quality of infrastructure endowments and measures of public and private infrastructure investment expenditures. Here we give a brief description of both components of the dataset.

A1. Physical infrastructure data

1. Public Utilities

1.1 Telephones and Telephone Main Lines

Following Canning (1998), we use the number of telephone sets and the number of main lines connected to local telephone exchanges as our measure of the provision of telephone services. Although both measures are highly correlated, Canning suggests that the number of telephone main lines is a better measure of the capacity of the telephone system. Finally, the variables taken from Canning's database are:

Variables	**Period**	**Source**
Number of Telephone Lines	Annual, 1960-95	ITU, AT&T, United Nations Discontinued after 1995
Number of Telephone Main Lines	Annual, 1960-98	ITU, AT&T, United Nations

We extend Canning's data with more recent figures taken from the International Telecommunications Union (ITU) Annual Reports. Furthermore, ITU provides other indicators that could be used to measure the quantity and quality of telephone services. A summary of the coverage and availability of those indicators is presented in Table A1.

Table A1

Variables	**Frequency / Period**	**Cross Section and Time Dimensions**
I. System Capacity		
Connection capacity of local exchanges	Annual, 1975-98. Selected Years: 1960, 1965, 1970	1975-98: Between 55 and 175 countries. 1960-75: 10 countries. TS: Mean of 12 observations per country (opc) and median of 11 opc.
II. Operation and Access		
Main telephone lines in operation	Annual, 1975-97. Selected Years: 1960, 1965, 1970	1975-97: Between 158 and 209 countries. 1960,65,70: More than 100.
Percentage of main lines equipment for direct international dialing	Annual, 1985-97.	1985-97: Between 80 and 109 countries. TS: Mean of 5 opc and median of 4 opc.
Percentage of urban main lines	Annual, 1980-97. Selected Years: 1960,	1990-97: Between 27 and 98 countries. 1980-89: No more than

Variables	Frequency / Period	Cross Section and Time Dimensions
	1965, 1970, 1975.	10. 1960-75: Only 2 countries (HKG, SGP). TS: Mean of 3 opc and median of 1 opc
Percentage of residential main lines	Annual, 1975-97. Selected Years: 1960, 1965, 1970.	1975-97: Between 54 and 172 countries. 1960-75: No more than 6 countries. TS: Mean of 10 opc and median of 9 opc
Number of local telephone calls	Annual, 1975-97. Selected Years: 1960, 1965, 1970	1975-97: Between 12 and 52 countries. 1960,65,70: More than 7. TS: Mean of 3 opc and median of 0 opc.
Number of national long distance telephone calls	Annual, 1975-97. Selected Years: 1960, 1965, 1970	1975-97: Between 15 and 87 countries. 1960,65,70: 7. TS: Mean of 5 opc and median of 1 opc.
Percentage of households with a telephone (Limited Coverage)	Annual, 1975-97. Selected Years: 1960, 1965, 1970.	1975-97: Between 2 and 36 countries. 1960,65,70: Only 1 (CAN). TS: Mean of 1 opc and median of 0 opc.
III. Costs		
Cost of 3-minute local call (US$)	Annual, 1980-97	1990-97: Between 115 and 163 countries. 1980-89: 22 countries. TS: Mean and median of 6 opc.
Residential monthly telephone subscription (US$)	Annual, 1980-97	1990-97: Between 119 and 176 countries. 1980-89: 23 countries. TS: Mean of 6 and median of 7 opc.
Residential telephone connection charge (US$)	Annual, 1980-97	1990-97: Between 120 and 177 countries. 1980-89: 26 countries. TS: Mean of 6 and median of 7 opc.
IV. Quality		
Percentage of Unsuccessful local calls	Annual, 1980-97	1990-97: Between 45 and 98countries. 1980-89: 6 countries. TS: Mean and median of 2 opc, and a maximum of 14 (GBR).
Telephone faults per 100 main lines.	Annual, 1980-97	1990-97: Between 64 and 127 countries. 1980-89: 22 countries. TS: Mean and median of 4 opc.
Waiting list for main lines	Annual, 1975-97. Selected Years: 1960, 1965, 1970	1990-97: Between 76 and 175 countries. 1960-75: 55 countries. TS: Mean of 14 and median of 13 opc.

Regarding coverage across regions, we can summarize the time-series dimensions for some regions in the following table:

Region / Statistics	Main Lines (ML)	ML in Operation	Number of Telephones	Connection Capacity	Faults per 100 ML	Waiting List for ML
I. Latin America and the Caribbean [42 countries]						
Average	27	23	23	12	3	12
Median	28	24	33	12	3	13
Min / Max	0 / 38	14 / 26	0 / 36	0 / 23	0 / 14	0 / 24
II. East Asia and the Pacific [35 countries]						
Average	25	20	17	11	4	13
Median	26	24	20	9	4	13
Min / Max	0 / 38	0 / 26	0 / 36	0 / 25	0 / 9	0 / 26
III. Western Europe [25 countries]						
Average	28	23	20	13	5	17
Median	38	26	25	16	5	20
Min / Max	0 / 38	0 / 26	0 / 35	0 / 23	0 / 17	0 / 26

From the table, it is clearly that the quality indicators, faults per 100 main lines and waiting list for main lines, have a more limited coverage, especially the former.

1.2 Energy

The measure of infrastructure in electricity, as taken from Canning (1998), is the electricity generating capacity (in kilowatts). We have annual observations for the 1950-95 period. The main sources for these data was obtained from the United Nations' *Energy Statistics* and *Statistical Yearbook*. In Table 2 we report other variables that could be used as proxies for energy.

Table A2

Variables	Frequency / Period	Cross-Section & Time Dimensions
I. Output and Consumption		
Electric Power Consumption (in kwh or kwh per capita)	Annual, 1960-97	1971-97: 130 countries. 1960-70: 27 countries. TS: Mean of 17 opc. Median: 26 opc, with a maximum of 37 observations for 27 countries
Electric Production	Annual, 1960-97	1971-97: 109-129 countries. 1960-70: 24 countries. TS: Mean of 16 opc. Median: 26 opc, with a maximum of 37 observations for 24 countries
II. Quality		
Electric Power Transmission and Distribution Losses (% of output)	Annual, 1960-97	1971-97: 100-129 countries. 1960-70: 24 countries. TS: Mean of 16 opc. Median of 18 opc, with a maximum of 37 observations for 24 countries

Source: World Bank. World Development Indicators. United Nations. Statistical Yearbook; Energy Statistics

We extend these data using mainly the United Nations Energy Statistics and Statistical Yearbook. Below we present some basic information on the time-series coverage of the indicators for infrastructure in the energy sector:

Region / Statistics	Electricity Generation Capacity	Electricity Power Consumption (kwh per capita)	Electricity Power Consumption (kwh)	Electricity Power (EP) Production (kwh)	EP Transmission and Dist. Losses (%Output)
I. Latin America and the Caribbean [42 countries]					
Average	27	15	15	14	14
Median	36	26	26	26	22
Min / Max	0 / 36	14 / 27	0 / 37	0 / 26	0 / 26
II. East Asia and the Pacific [35 countries]					
Average	20	13	13	13	13
Median	24	0	0	0	0
Min / Max	0 / 36	0 / 37	0 / 37	0 / 37	0 / 37
III. Western Europe [25 countries]					
Average	24	25	25	25	25
Median	36	37	37	37	37
Min / Max	0 / 36	0 / 37	0 / 37	0 / 37	0 / 37

1.3 Sanitation and Sewerage

For this category we have found observations only for selected years within the 1970-97 period. The main source is the World Bank's WDI. The variables are the percentage of population access to safe water and sanitation in all areas, as well as urban and rural areas. The limited coverage of the series could be observed in the following table that summarizes the time dimension in some selected regions:

Region / Statistics	Safe Water (% population with access)			Sanitation (% population with access)		
	Total	Rural	Urban	Total	Rural	Urban
I. Latin America and the Caribbean [42 countries]						
Average	3	3	3	2	2	2
Median	4	3	3	2	1	2
Min / Max	0 / 7	0 / 7	0 / 7	0 / 5	0 / 5	0 / 5
II. East Asia and the Pacific [35 countries]						
Average	3	3	3	2	2	2
Median	3	3	3	2	1	2
Min / Max	0 / 7	0 / 8	0 / 8	0 / 5	0 / 6	0 / 6
III. Western Europe [25 countries]						
Average	3	3	3	2	2	2
Median	3	2	2	2	1	1
Min / Max	0 / 7	0 / 7	0 / 7	0 / 5	0 / 5	0 / 5

2. Public Works

2.1 Roads

Canning (1998) presented two indicators for the stock of infrastructure in roads.

Variables	**Period**	**Problems**
Total Road length (in km)	Annual, 1950-97	Frequent Gaps and large changes. Differences in the definition of roads across countries and over time.
Paved Road length (in km)	Annual, 1950-97	Large variations in quality. Data do not reflect the width of the road and do not account for the age of the road.

Sources: International Road Federation, World Road Statistics. United Nations' Regional Commission, Statistical Yearbooks.

We extend these data using recent issues of the International Road Federation World Road Statistics. According to Canning (1998), the raw data on road length seem too unreliable to be useful, and even using national sources it appears impossible to construct data that are consistent either across countries or over time. On the other hand, Canning uses the percentage of the main paved and unpaved road network as a measure of quality.

Other available indicators are limited in coverage and only capture the transportation impact of these roads.

Table A3

Variables	Frequency / Period	Cross-Section & Time Dimensions
Road Traffic (vehicles per km)	Annual, 1990-97	1990-97: Between 13 and 60 countries. TS: Mean of 2 opc. Median of 0 opc, with a maximum of 9 observations for 8 countries
Roads, Goods Transported (million of tons per km)	Annual, 1990-97	1990-97: Between 23 and 57 countries. TS: Mean of 2 opc. Median of 0 opc, with a maximum of 10 observations for 4 countries

Source: World Bank. World Development Indicators.

2.2 Irrigation

The main source for measures in this category is the World Bank's World Development Indicators (WDI), and the variables are:

Table A4

Variables	Frequency / Period	Cross-Section & Time Dimensions
Irrigated Land (hectares)	Annual, 1960-97	1960-96: Between 143 and 164 countries. TS: Mean of 25 opc. Median of 36 opc, with a maximum of 36 observations for 134 countries
Irrigated Land (% of crop land)	Annual, 1960-97	1960-96: Between 136 and 156 countries. TS: Mean of 23 opc. Median of 36 opc, with a maximum of 36 observations for 122 countries

Source: World Bank. World Development Indicators

On the other hand, the time-series dimension for these indicators in some important regions are summarized in the following table:

	IRRIGATION	
Region and Statistics	As % of crop land	In hectares
I. Latin America and the Caribbean [42 countries]		
Average	27	27
Median	36	36
Min / Max	0 / 36	0 / 36
II. East Asia and the Pacific [35 countries]		
Average	18	18
Median	25	27
Min / Max	0 / 36	0 / 36
III. Western Europe [25 countries]		
Average	16	20
Median	0	36
Min / Max	0 / 36	0 / 36

3. Other Transport Sectors: Railways

The only measure provided by Canning (1998) is the rail route length. The main data sources for the length of railway lines are Mitchell's *International Historical Statistics* (1992, 1993, 1995) until 1980 and World Bank's Rail Statistics Database thereafter. Canning (1998) also used national sources to supplement these data.[11]

On the other hand, the World Bank has developed the *Railways Database* that comprises data for the period 1980-97. From this database, we have some variables that could be useful to measure capacity and quality of the railways: Stock of main diesel locomotives,

[11] However, Canning suggests that the data on the length of the line could have some problems. First, it does not take account for the number of tracks in the railway. Second, there are changes in the coverage due to the treatment of rail lines owned by companies for industrial use and not open to the public (e.g. railways owned by the sugar industry in Latin America).

Stock of main electric locomotives, Passenger - kilometer (in millions), Goods Transported, Freight ton - km (in millions), Goods Transported, Freight ton-km per Wagon (000), Diesel Locomotive Availability (in %), Operating Ratio with Normalization and without Normalization.

Finally, we summarize the time-series information across countries for some selected regions:

Region / Statistics	Roads		Railways
	Route Length (km)	Paved Route Length (km)	Route Length (km)
I. Latin America and the Caribbean [42 countries]			
Average	12	15	26
Median	9	12	34
Min / Max	0 / 34	0 / 34	0 / 38
II. East Asia and the Pacific [35 countries]			
Average	14	13	20
Median	9	0	32
Min / Max	0 / 36	0 / 36	0 / 38
III. Western Europe [25 countries]			
Average	21	17	24
Median	30	22	36
Min / Max	0 / 36	0 / 36	0 / 38

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International Telecommunications Union (1996) *World Telecommunications Indicators*. Geneva.

International Telecommunications Union. Various Years. *World Telecommunications Development Report*. Geneva.

A.2 Data on Investment in Infrastructure

The sample covers nine Latin American countries at annual frequency over the period 1970-98.

1. Definition of Public Sector

The following table presents the definition of public sector used in the figures of public investment in infrastructure.

Country	Telecom	Power	Transport	Water
Argentina	GG+SOE	GG+SOE	GG+SOE	GG+SOE
Bolivia	GG+SOE	GG+SOE	GG+SOE	GG+SOE
Brazil	GG+SOE	GG+SOE	GG+SOE	No Data
Chile	GG+SOE	GG+SOE	GG+SOE	No Data
Colombia	GG+SOE	GG+SOE	GG+SOE	GG+SOE
Ecuador	GG+SOE	GG+SOE	GG+SOE	GG+SOE
Mexico	GG+SOE	GG+SOE	GG+SOE	GG+SOE
Peru	GG+SOE	GG+SOE	GG+SOE	GG+SOE
Venezuela	GG+SOE	GG+SOE	GG+SOE	GG+SOE

where GG denotes General Government Spending on Infrastructure and SOE denotes State-Owned Enterprises Spending on Infrastructure. According to the table, we do not data on investment in Water for Brazil and Chile.

2. Definition of Transport Sector

The definition of the transport sector varies somewhat across countries, as shown in the table below.

Country	Transportation Sector
Argentina	We have data for both investment in roads and in railways (separately). We do not have data on investment in ports and airports
Bolivia	Same as in Argentina.
Brazil	Same as in Argentina
Chile	We only have aggregate data for investment in Transport. This includes all categories (roads, railways, ports & airports). There is no breakdown for any of these 4 categories.
Colombia	Same as in Chile
Ecuador	Same as in Argentina
Mexico	Same as in Argentina
Peru	Same as in Argentina
Venezuela	Same as in Argentina

Notes: Aggregate data on investment in the transport sector includes spending on roads, railways, ports and airports. However, we do not have the specific investment in each sub-sector. We lack of data on railways for Colombia.

3. Sources of Information

In order to obtain the data on infrastructure investment, we gather information mostly from national sources. Here is the list of documents used:

Argentina, 1970-98
General Information: [1] Fundacion de Investigaciones Economicas Latinoamericanas (1992). "Capital de Infraestructura en la Argentina: Gestión Pública, Privatización y Productividad." [2] Secretaria de Hacienda, "Cuenta de Inversion 1994-97," Sub-Secretaria del Presupuesto.

Telecommunications: [3] Celani, Marcelo (1998). "Determinantes de la Inversión en Telecomunicaciones en Argentina," CEPAL

Power: [4] Adrián Romero, Carlos (1998). "Regulación e Inversiones en el Sector Eléctrico Argentino," CEPAL Serie Reformas Económicas 5

Transport: [5] Delgado, Ricardo (1998). "Inversiones en Infraestructura Vial: La Experiencia Argentina," CEPAL Serie Reformas Económicas 6

Bolivia, 1980-98
General Information: [1] Antelo, Eduardo (2000) "Politicas de Estabilizacion y de Reformas Estructurales en Bolivia a partir de 1985". CEPAL Serie Reformas Economicas 62. [2] Barja Daza, Gover (1999c) "Las Reformas Estructurales Bolivianas y su Impacto sobre Inversiones". CEPAL Serie Reformas Economicas 42. [3] Instituto Nacional de Estadistica. "Bolivia en Cifras," Varios números. [4] The World Bank, "Bolivia: Public Expenditure Review," Washington, DC: The World Bank

Telecommunications: [5] Barja Daza, Gover (1999b) "Inversion y Productividad en la Industria Boliviana de Telecomunicaciones". CEPAL Serie Reformas Economicas 16.

Power: [6] Barja Daza, Gover (1999a) "Inversion y Productividad en la Industria Boliviana de la Electricidad". CEPAL Serie Reformas Economicas 15.

Brazil, 1970-98
General Information: [1] Cavalcanti Ferreira, Pedro (1996) "Investimento em Infra-estrutura no Brasil: Fatos Estilizados e Relacoes de Longo Prazo". Pesquisa e Planejamento Economico, 26(2), August. [2] Cavalcanti Ferreira, Pedro and Thomas Georges Malliagros, (1998) "Impactos Produtivos da Infra-estrutura no Brasil: 1950-95". Pesquisa e Planejamento Economico, 28(2), August. [3] Cavalcanti Ferreira, Pedro and Thomas Georges Malliagros, (1999) "Investimentos, Fontes de Financiamiento e Evolucao do Setor de Infra-estrutura no Brasil: 1950-96". FGV EPGE Ensaios Economicos No. 346. [4] Coes, Donald V. (1994) "Macroeconomic Crises, Policies and Growth in Brazil, 1964-90." Washington, DC: The World Bank Comparative Macroeconomic Studies. [5] Rigolon, Francisco J.Z. (1998). "O Investimento em Infra-estrutura e a retomada do crescimento economico sustentado". Pesquisa e Planejamento Economico, 28(1), April

Chile, 1980-98
General Information: [1] Ministerio de Obras Públicas, Transportes y Comunicaciones (2000). "Inversión en Infraestructura: Rol sobre el Crecimiento, Desarrollo Económico y la Globalización," Santiago, Chile: Gobierno de Chile. [2] Moguillansky, Graciela (1999) "La Inversión en Chile: ¿El Fin de un Ciclo en Expansión?," Santiago, Chile: Fondo de Cultura

Económica Chile S.A. [3] Moguillansky, Graciela; Bielschowsky, Ricardo (2000) "Inversión y Reformas Económicas en América Latina," Santiago, Chile: Fondo de Cultura Económica Chile S.A.

Colombia, 1973-98
General Information: [1] DANE. "Cuentas Nacionales: Gastos en FBKF por sector institucional segun finalidad 1973-95."[12]

Transport: [2] Ministry of Transport. "El Transporte en Cifras, 1970-94." [3] Ministry of Transport. "El Transporte en Cifras, 1970-96."

Ecuador, 1981-98
General Information: [1] Banco Central del Ecuador. Boletín – Anuario, Varios Números. [2] CEPAL/PNUD (1993). "La Política Fiscal en Ecuador, 1985-91". Serie Política Fiscal 35. [3] The World Bank (1991). "Reformas del Sector Público para lograr el crecimiento en una época de decreciente producción petrolera," Washington, DC: The World Bank. [5] The World Bank (1993). "Ecuador Public Expenditure Review: Changing the Role of the State," Washington, DC: The World Bank

Mexico, 1970-98

General Information: [1] Banco de México (1995). "La Encuesta de Acervos, Depreciacion y Formacion de Capital," México, DF: Banco de Mexico. [2] Presidencia del Gobierno. "IV Informe del Gobierno: Mexico 1988-98." México, DF: Presidencia del Gobierno. [3] Presidencia del Gobierno. "V Informe del Gobierno: Mexico 1989-99." México, DF: Presidencia del Gobierno. [4] Secretaría de Hacienda de México. "Inversion Pública Federal por Entidad Federativa."

Peru, 1970-98
General Information: [1] Banco Central de Reserva del Perú. "Memoria Annual," Varios Números. [2] CUANTO S.A. "Perú en Números," Varios Números. [3] INEI. "Anuario Estadístico," Varios Números.

Venezuela, 1980-98
General Information: [1] Oficina Central de Estadistica e Informatica, "Anuario Estadistico", Varios Números. [2] The World Bank, "Venezuela: Decentralization and Fiscal Issues", December 1992.

Telecommunications: [3] Comision Nacional de Telecomunicaciones (CONATEL). Website Info: www.conatel.gov.ve/indicadores.htm.

[12] We should notice 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.

Appendix B
The liberalization of infrastructure industries in Latin America[13]

This appendix provides a brief chronology of the opening up of Latin America's infrastructure sectors to private participation. The discussion focuses on the nine countries under consideration in the main text, and draws from national sources.

B.1. Overview

For each country and sector examined, we highlight the timing of (i) the sale and/or concession of public enterprises to the private sector; (ii) the opening up to private Greenfield projects, and (iii) the passage of reform legislation, which may precede or follow private sector entry into old or new infrastructure projects. In some cases reform legislation is passed in two waves: the first one aims at allowing private entry, while the second establishes the regulatory framework in the liberalized sector. Drawing from the country summaries that follow, it is possible to construct a comparative timetable for each of these three reform dimensions. This is done in the three tables that follow. On the basis of these tables, we construct Table 3 in the main text, which for each sector and country takes as relevant date the earliest one of the three dates in the tables below.

Some specific issues should be kept in mind. First, in the telecommunications sector there are typically two stages: privatization and liberalization (of access and/or tariffs), when the monopoly status disappears and competition is allowed. Second, in the power sector privatization and liberalization typically came together. Third, in the gas sector, whenever private participation is allowed, the private sector's main task is related to pipeline projects.

Table B1
Infrastructure Reform Laws
(Year of Enactment, by Sector)

	Energy		Transport			
Country	**Electricity**	**Gas**	**Roads**	**Railways**	**Telecom**	**Water**
Argentina	1989	1989	1989	1989	1989, 98	1989, 92
Bolivia	1994	...	1998[1]	1998[1]	1996	2000
Brazil	1995	...	1993[2]	1994-5	1995	...
Colombia	1991	...	1991	...	1991	...
Chile	1985	1986	1990	1990	1985, 94	1988-89
Ecuador	1994	..	...	...	(Pending)	...
Mexico	...	...	1989	1995	1989, 96	...
Peru	1992	...	...	...	1992, 98	...
Venezuela	(Pending)	...	...	...	1990, 97	...

Notes: (1) A concession law appeared in 1998, although 3 concessions had been granted to the private sector since 1996 until that date. (2) In early April 2000, the government announced a new format for the toll roads concessions to come.

[13] The material in this appendix is based on background work by Pilar Blanco.

Table B2
Sales and/or Concession of Public Enterprises in Infrastructure Sectors
(Starting Year)

Country	Energy		Transport		Telecom	Water
	Electricity	Gas	Roads	Railways		
Argentina	1992	1992	1990*	1990*	1990	1993*
Bolivia	1995	..	..	1996*	1996	1997*
Brazil	1996	1997[1]	1996*	1996*	1996	..
Colombia	1992	1996[2]	1994*	..	..	..
Chile	1986	1986*	1993*	1995-7	1986	1993*
Ecuador	pending	..	..	..	..	..
Mexico	..	1995-7[3]	1989*	1996*	1990	1994*
Peru	1994	..	..	..	1994	..
Venezuela	pending	..	..	..	1991	..

*Notes: (1) Some partial divestitures were carried out. The bulk of gas generation and distribution is in public hands. (2) Only one privatization was carried out (Promigas). (3) Repsol was partially privatized in two stages, 1995 and 1997. * M&O with Major Private Capital Expenditure (Concessions).*

Table B3
Greenfield Projects in Infrastructure Sectors
(Starting Year)

Country	Energy		Transport		Telecom	Water
	Electricity	Gas	Roads	Railways		
Argentina	1992	1996	...	...	1990	...
Bolivia	1997	...	...	...	...	...
Brazil	1984	1998	...	1996	1984	1995
Colombia	1993	1994	...	...	1994	1997
Chile	1990	1995	...	...	1986	1996
Ecuador	1996	...	...	...	1994	...
Mexico	1998	1996	...	...	1990	1993
Peru	1996	...	...	...	1990	...
Venezuela	1992	...	...	...	1991	...

B.2. Country summaries

Argentina

Argentina started its privatization program in 1989 after the approval of the Ley de Reforma del Estado (No. 23696) under the Menem presidency. That law authorised privatization of public enterprises. (PE). The comprehensive privatization program was launched jointly with an ambitious program of structural adjustment. Over 1990-92 twenty public enterprises were fully or partially privatized.

In the electricity sector, privatization of the three public enterprises (SEGBA, HYDRONOR S.A. and AYEE) started in 1992. Although Greenfield projects had been proposed since 1992, the bulk of them took place since 1995.

The publicly owned companies in the gas and petrol sectors were also privatized, Gas del Estado in 1992. Only one Greenfield project was proposed in 1996 with a total investment amount of 350 US$ million.

The Empresa Nacional de Telecomunicaciones (ENTEL) started its privatization procedure in 1990 and was divided into four new private companies (Telecom S.A., Telefonica de Argentina, Telinter and Startel). As it happened in Mexico and Venezuela, the publicly owned telecommunication companies were sold with a monopoly on basic service for a fixed exclusivity period, but with requirements to expand and improve basic service. Greenfield projects were also proposed since 1990, although most of them took place since 1995, basically due to the monopoly structure of the sector after privatization.

Additionally, since 1990 the private sector was awarded toll concessions of most transited roads. The concessionaires of toll road are responsible for maintenance, construction and re-construction operations. There are not Greenfield projects in the sector. In turn, concessions of railways (freight network, passenger and commuter urban railroad) started also in 1990. There are no Greenfield projects in the sector.

Finally, water supply and sewerage services were decentralised to the provinces in 1980, but the central government retained control over services in the capital city. In 1993, the operation of water and sanitation services in Buenos Aires was concessioned, through franchise bidding, to the private sector. Additionally, since 1995, some concessions (BROT) have been awarded to the private sector to operate potable water supply and sewerage services in the provinces of Santa Fe, Cordoba, Corrientes, and Tucuman. There are no Greenfield projects in the sector. Legal support for water and sanitation reforms comes from the Ley de Reforma del Estado in 1989, and the Decree 9999/92 to define the regulatory framework.

Bolivia

In the telecommunications sector, the government established a new legal and regulatory framework in 1996. The new law facilitated, among other things, the immediate entry by the private sector into such areas as leased lines, cellular phones and data transmission. To capitalise the sector, the national telecommunications company (ENTEL) became a mixed corporation comprised of the government's shares and the shares purchased by Entel workers. Although Greenfield projects existed since 1987, they were negligible in number and investment volume relative to other countries, however they started to have some importance since 1996 once the new telecommunication regulation was enacted.

The general electricity law, approved in December 1994, mandated vertical de-integration of the sector. Currently, in the electricity sector, a state owned, vertically integrated Empresa Nacional de Electricidad S.A. (ENDE) owns about 62% of the

installed capacity, supplies around 56% of the generation sold at the bulk power level. The investor-owned, vertically integrated Corporacion Boliviana de Energia Electrica (COBEE) owns about 19% of the total installed generating capacity. The privately-owned Cooperativa Rural de Electrificacion (CRE) provides distribution services in Sta Cruz. Only one Greenfield project was proposed in 1997 with an investment volume of 97 U$ millions.

Additionally, provision and distribution of gas is in public hands. Only one Greenfield project has been proposed in 1998 with an investment volume of 2200 US$ millions. The sector has not been liberalised.

Some railways concessions were provided to the private sector in 1996-7. No Greenfield projects have been proposed. A law for concessions was enacted in 1998.

Roads management, maintenance, construction and re-construction are under government control. No Greenfield projects have been proposed. A concessions Law was enacted in 1998.

Finally, only a few concessions were granted to the private sector in relation to water supply and sewerage services in 1997. No Greenfield projects have been proposed until now. A new Law has been presented recently (2000) to allow private participation in the sector.

Brazil

Brazil started its privatization process under the Collor de Melo presidency in October 1991. The process began with a reduced number of public enterprises in the tradable good sector (mining, manufactures).

Currently, in the electricity sector, Centrais Electricas Brasileiras S.A (Electrobras) is a federal utility holding company, with four regional integrated generating and transmission utility subsidiaries. The federal government owns, via Electrobras' newly created subsidiary (SINTREL), the two high voltage interconnected transmission systems. State government and municipalities own most of the distribution utilities. The state of Tocatins started the privatization of its distribution utility in 1990, and other state-owned (central and non central government) utilities were considered for privatization in 1995, with privatisation beginning in 1996. Although Greenfield projects started to appear in 1984, they were of negligible volume. The bulk of this type of projects in the power sector appeared in 1996, together with the privatization process.

Only some partial divestitures were carried out in the gas sector in 1997. The bulk of the generation and distribution of gas is in public hands. Only one important Greenfield project (BOT type) was proposed in the sector in 1998 with a total investment volume of 2,200 US$ millions. The sector cannot be considered as having been liberalised.

In the telecommunication sectors, full divestitures started in 1996. There have been Greenfield project since 1984, although of negligible size and number. Greenfield projects started to become significant in number and volume since 1997, together with the privatization process.

As for roads, a Federal Road Concession Program for toll roads was created in 1993, with a first wave of concessions taking place in 1996. The second wave of concessions was prepared in 1994-5. However, state and municipal governments manage the bulk of the road network. In early April 2000, the government announced a new format for the toll roads concessions to come. There are no Greenfield projects in the sector.

Concerning railways, initially they were under full control of the public sector through three public operators: Rede Ferroviaria Federal (RFFSA), Ferrovias Paulistas (FEPASA), Companhia Vale Rio Doce (CVRD). However, poor performance resulted in pressures to privatise the sector. The rail sector was concessioned in 1996-98. The bids (FEPASA, RFFSA) were for the operation and maintenance of each network for a period of 30 years. Only one Greenfield project was proposed in 1996 with a volume of 1256 US$ million.

Finally, no privatization program was carried out in the water and sewerage sectors. A negligible number of Greenfield projects were proposed since 1995. generally of very modest investment volume. The sector has not been liberalised.

Colombia

The Constitucion Politica of 1991 was established to put an end to the state monopoly in public services. After the Constitution, a significant amount of public enterprises were singled out for privatization, among them major mining, baking and tourism enterprises.

On the telecommunications side, Colombia chose to open the sector to new competition instead of privatization. In fact, several Greenfield projects were presented since 1994.

Reform of the power sector started in 1992 (including privatization of some public entities), and finished in 1998 having achieved a major degree of private participation in the sector. A number of Greenfield projects appeared since 1993.

In the gas industry only one privatization was carried out in 1996 (Promigas). Greenfield projects are negligible in the gas sector.

Some concessions of highways were approved in 1994. However, railways management remains under public sector control. There are no Greenfield projects in the transport sectors.

Finally, water supply and sewerage services were not privatised and only one Greenfield project was proposed in 1997.

Chile

Chile was a leader in privatization, having started its process in 1975. Two privatization waves can be distinguished: the first during 1975-82 and the second over 1985-89. In 1990, the new democratic government modified the privatization process, announcing that the sale of controlling stakes to the private sector would be limited to a few small public enterprises, while in other cases only a minority participation would become available to private investors. The government also announced its willingness to allow private participation in public infrastructure projects (water and sewerage, roads and railways). Concessions have been a main tool for promoting competition. Laws regulating the electric and telecommunications sectors in Chile guarantee all firms applying for a concession the right to receive it. Concessions have been provided to any private sector agent seeking them, even in industries or stages that are closer to being natural monopolies. The rationale is that the regulator, by increasing the number of producers, favours consumers by creating the conditions for more competition, but the result is that concessions frequently overlap.

In the telecommunications sector, the Corporacion de Fomento de la Produccion (CORFO), a state-owned corporation, owned 89.5% of CTC and 99% of ENTEL until 1986. The privatization of these two public telecommunication enterprises started in 1986 and was completed in 1990. In 1994, competition for national long-distance service was finally allowed and in 1997 seven firms joined CTC and ENTEL to compete in the domestic long-distance service. Also, competition in cellular mobile telephony increased and several mergers followed. Although sector Greenfield projects were already present since1984, they become important in number and weight only since 1993-4.

The second wave of privatization in the electricity sector ran from 1986 until 1990. The two public enterprises ENDESA (generation, distribution) and CHILECTRA (distribution) were privatised and split into different enterprises. Greenfield projects appeared in 1990, and started to be significant in volume (even if not in number) in 1994. Currently all power generation belongs to the private sector.

In the gas sector no privatization as such was carried out. The generation or exploitation is still in public hands, transportation of gas is done by public enterprises or by entities with concession, and gas distribution is developed only by entities with concessions since 1986, when the law for concessions was enacted. Greenfield projects in the sector are negligible.

In the road and rail sector, railways privatization started in 1995 with partial divestiture of FEPASA and it continued with the full divestiture of Ferronor in 1997. Since 1993 the government has been approving concessions to the private sector to manage the road network. There are no Greenfield projects in the transport sector.

Between 1988 and 1989, new legislation decentralised responsibility for publicly owned water and sewerage services in Chile, by creating autonomous regional service companies. The national government owns the majority of shares in these companies

through its Development Corporation. A national regulatory agency, the Superintendence of Sanitary Services, was created to regulate both public and private water and sewerage services. Under the Chilean law, all water service companies whether public or private are structured as stock corporations and operate by virtue of concessions granted by the Ministry of Public Works. Concessions are granted for an indefinite period of time and were awarded since 1993. No Greenfield projects are present in the sector.

Ecuador

In the telecommunications sector, the Instituto Ecuatoriano de Telecomunicaciones (IETEL) was owned entirely by the Ecuadorian state. IETEL also had the monopoly for local telephony, long-distance and international service. IETEL also had the authority to regulate the telecommunication sector until 1992, when a separate regulatory organisation was to perform this task. In 1992 a new regulatory body was created, the Superintendencia de Telecomunicaciones (SUPTEL), along with a new state owned corporation named EMETEL which took over the assets of IETEL and was granted monopoly status for the provision of local, long-distance and international telephony services. In preparing EMETEL for privatization, in June 1997, the government divided the firm into two limited liability companies. After rescheduling several times the auction for both companies, when the final date arrived (Nov 20, 1997) none of the interested investors submitted a bid. Additionally, only a few small Greenfield projects were carried out since 1994 (2 per year).

In the electricity sector, the main entities are: the state owned and vertically integrated Instituto Ecuatoriano de Electrificacion (INECEL), the investor-owned utility Empresa Electrica de Ecuador (EMELEC) which is subject to INECEL's technical and financial control since 1985, and several private and municipal entities. Legislation submitted to congress in 1994 proposed to restructure the sector, advocating deregulation and competition. The proposed law would divest all government-owned assets in generation, transmission and distribution after reorganising INECEL and consolidating distribution utilities into 4 or 5 enterprises. All new investment would be undertaken by the private sector. However, the privatization process is still pending. Only one Greenfield project was committed in 1996 with a total investment cost of 30 US$ million.

Mexico

In 1989, a law allowing privatization of the telecommunication state-owned enterprise was enacted. Before the privatization in 1990, TELMEX was a 66% state-owned corporation, with the rest in hands of local private shareholders. In 1990, TELMEX was granted a monopoly on fixed line telephone services until August 1996. After 1996 other firms offer long-distance services, but TELMEX will maintain the monopoly for local fixed telephony until 2026. Cellular telephony and value added services were opened to competition immediately. Since privatization several firms have been awarded licenses for cellular and long-distance telephony. In fact, Greenfield projects in the sector start to be significant since 1996.

In the electricity sector, the Comision Federal de Electricidad (CFE) is a state owned enterprise which currently owns and operates most generating plants serving the public power system, and provides all transmission and distribution service except in Mexico City. Since 1992, private power generators in the form of IPPs, self-generators, co-generators, and power importers are allowed to participate in the sector. Greenfield projects are almost negligible (only 1 in 1998). The liberalization of the sector is, then, still pending.

In the gas sector, Repsol was partially privatised in two stages, 1995 and 1997. Additionally, Greenfield projects started to have some weight in 1997.

Until early 1990's, publicly-owned Ferrocarriles Nacionales de Mexico (FNM) was the largest company in the railway sector. The process of reform took off with president Carlos Zedillo. In February 1995, the Mexican Congress approved an amendment to the Constitution opening opportunities for private sector investment. Privatization started in December 1996 with concessions of 50 years. These concessions allow to operate, exploit and build new lines. The second stage of the privatization process was the sale of the shares owned by the government in the concessionaire companies through a public bidding process open to private investors. By June 1999, the process of opening the main Mexican rail lines to private operators was almost finished and virtually the whole Mexican railroad system had been privatised.

During 1987-94, the government awarded 52 concessions of toll roads to the private sector. In April 1997 the government announced a new plan in the road sector and, in late 1997, assumed all bank liabilities along with temporary ownership of 23 toll roads.

In the water and sewerage sector, the Federal District Water Commission awarded general contracts for a ten-year period (with the possibility of extension) in 1993. Other concessions were awarded to the private sector since 1994 and a small number of Greenfield projects have been developed since 1993. Private operators are involved in distribution and commercial activities, but not in production. Additionally, most private participation in the sector has been carried out through PTOs (Plantas de Tratamiento), so that full liberalization of the sector is still pending.

Peru

In the telecommunications sector, the Peruvian government sold 35% of its shares in ENTEL and CPT to Telefonica Internacional of Spain in 1994. Telefonica took over the operation of both firms and within a year the firms merged into a newly formed firm called Telefonica del Peru. At the time of privatization the firms were licensed to provide local and long distance telephony services in the whole Peruvian territory. The license granted a 5 year monopoly in fixed and long distance service (finishing in 1999). Competition in public payphones, cellular (local), cable TV and value added service was allowed. Two firms, Telefonica and Tele2000-Bellsouth, provide cellular mobile telephony. However, competition in the cellular sector was allowed only in Lima until 1998 when Tele2000-Bellsouth won the concession for Band B for the rest of Peru. The

number of Greenfield projects in the telecommunications sector is almost negligible, with 3 projects in 1990 (150 US$ million) and 1 (30 US$ million) in 1995. The reason for this is the five-year monopoly status in fixed and long-distance service given to Telefonica del Peru. Thus, competition in the sector is still very low.

The power sector underwent restructuring and initiated a major privatization program in 1994, following enactment of a new Electric Concession Law in 1992. The law opened the sector to private participation in all areas; required the separation of generating, transmission and distribution functions and ownership and aimed at complete divestiture of all state-owned sector enterprises. Currently, 62% of Peru's generation capacity and 75% of country's distribution system is in private hands. Although the number of Greenfield projects in the sector has been negligible so far, additional competition being promoted.

No liberalization has taken place in the rest of infrastructure sectors.

Venezuela

Before privatization, the Venezuelan state owned 100% of the assets in the telecommunications sector. CANTV had full monopoly in local and long-distance service. Since 1988, it was also the sole provider of cellular phone services. In May 1991, a license for the provision of cellular telephony was awarded to Telcel Celular S.A., a Consortium of Venezuelan investors and BellSouth. Thus, Telcel Celular S.A. started competing with CANTV in the cellular phone business nation-wide. In November 1991, CANTV was privatised and received a 35 year concession contract. The license granted a monopoly status for a period of nine years in local and long-distance (national and international) telephony services. That is the reason for the narrow number of Greenfield Projects in Venezuela since 1991 (4 in 1998 and only 1 project from 1991 to 1996). The sector was not liberalised until more recently (1997).

In the electricity sector, there are five state-owned and 7 investor-owned utilities (IOU). The largest state-owned enterprises are Electrificacion de Caroni (EDELCA) and Compañia Anonima de Administracion y Fomento Electrico (CADAFE). Electricidad de Caracas (EdC) is the main IOU, supplying most of Caracas and holding part ownership in 3 other IOUs. Distribution systems were reorganised into regional enterprises before privatization. CADAFE is being reorganised into 4 regional distribution units, a separate transmission unit, and various separate hydro and thermal generating units, with privatization expected for many of these units. There have been a few Greenfield projects since 1992 (total of 5, one by year stopping in 1996). Liberalization of the sector is, then, pending.

No liberalization has taken place in the rest of infrastructure sectors.

Figure 1a
Telephone main lines
(medians by region, 1980-97)

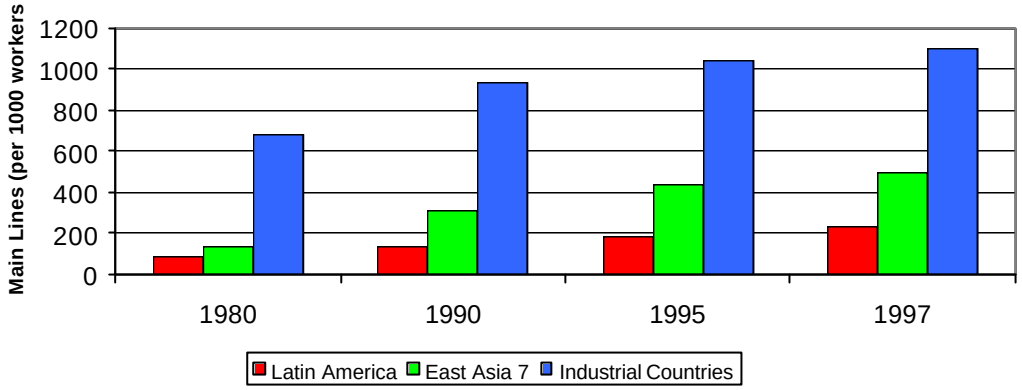


Figure 1b
Total phone lines
(medians by region, 1980-97)

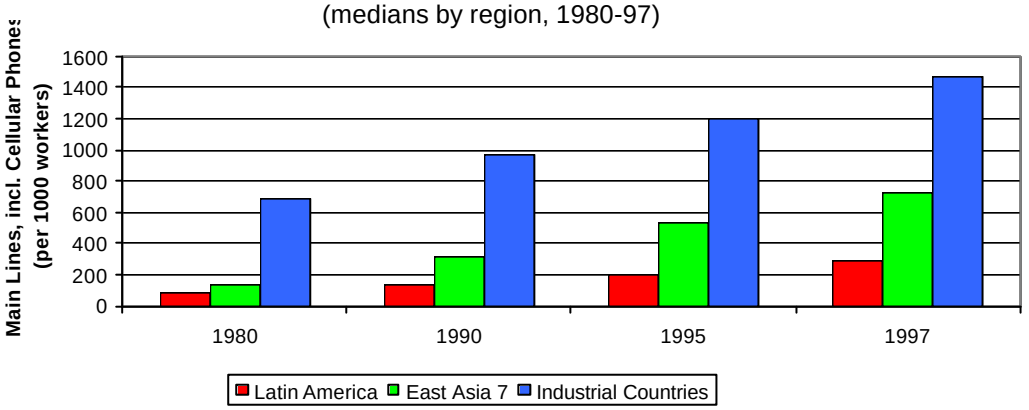


Figure 1c
Local connection capacity
(Medians by Region, 1980-97)

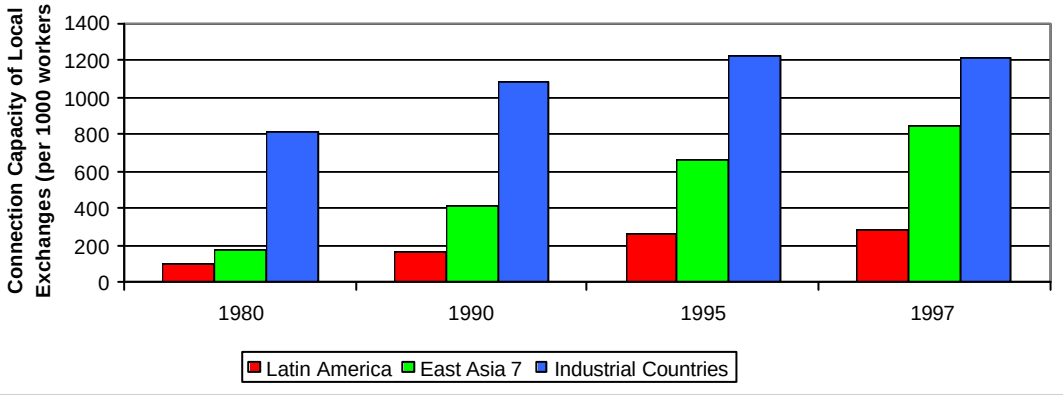


Figure 1d
Internet hosts
(Medians by Region, 1994-97)

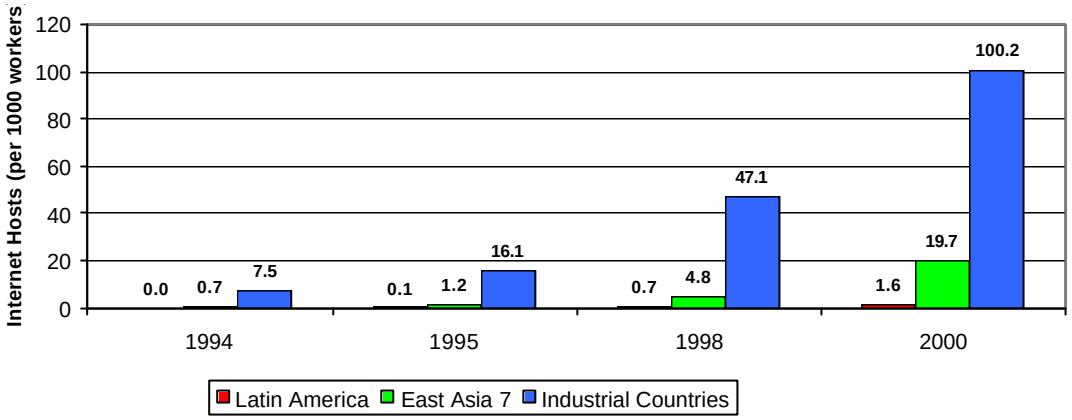


Figure 1e
Telephone lines per worker
(lines per thousand)

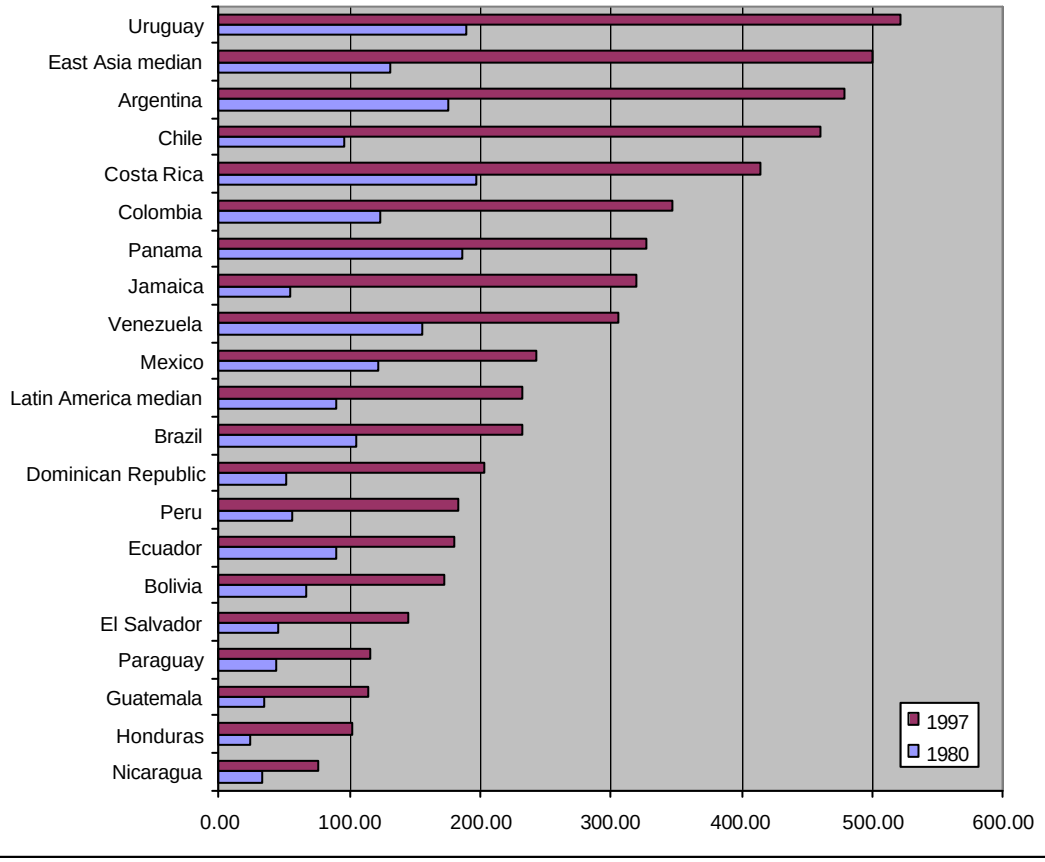


Figure 2a
Power generating capacity
(Medians by Region, 1980-97)

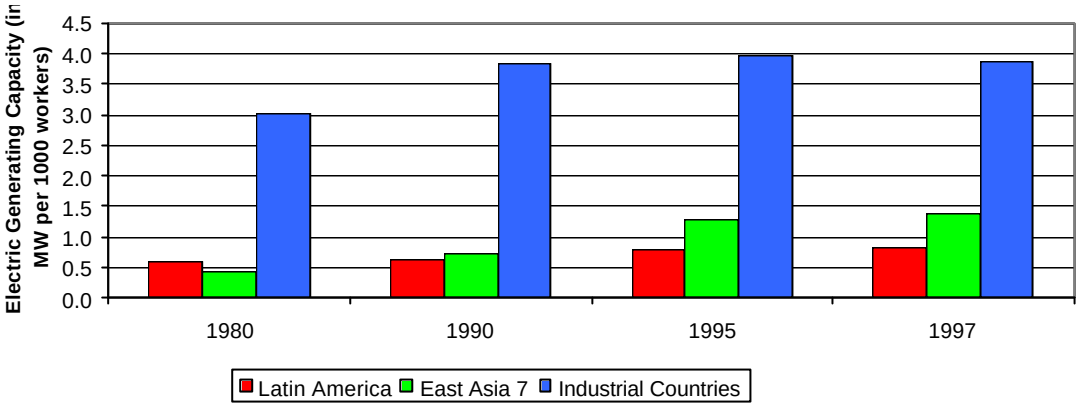


Figure 2b
Power generating capacity per worker
(MW per thousand)

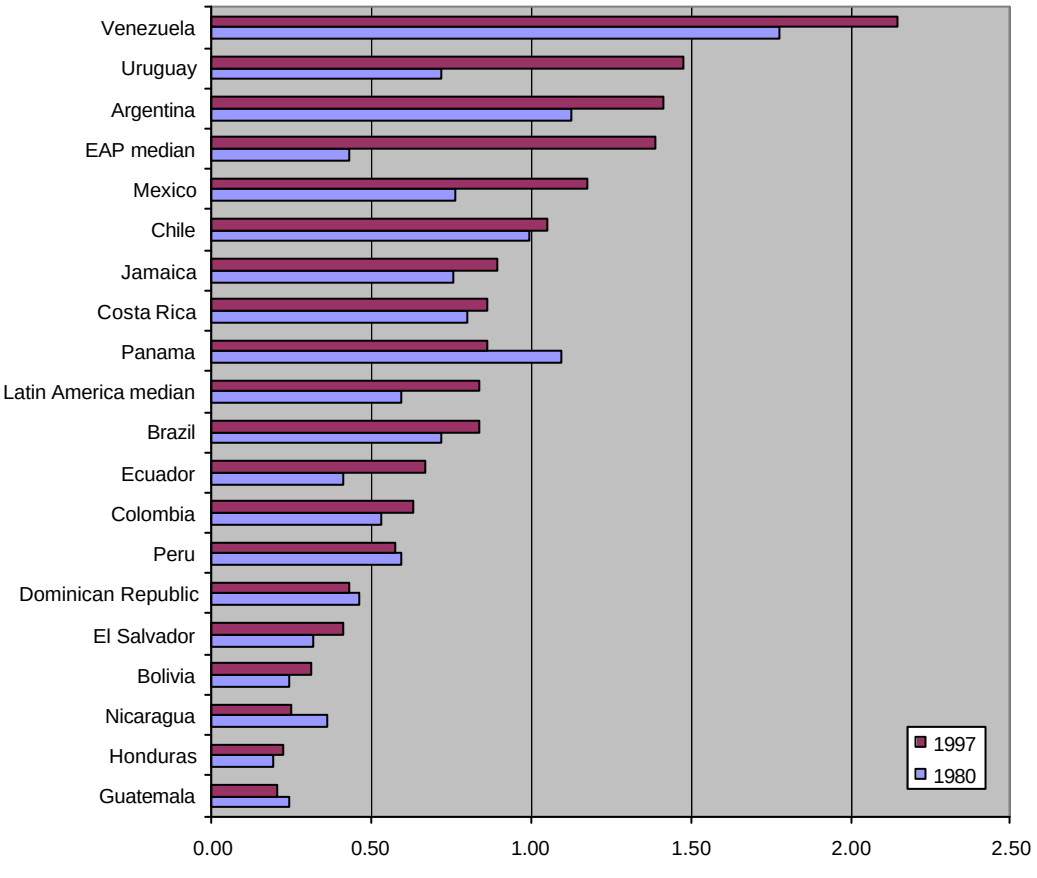


Figure 3a
Total roads
(Medians by Region, 1980-97)

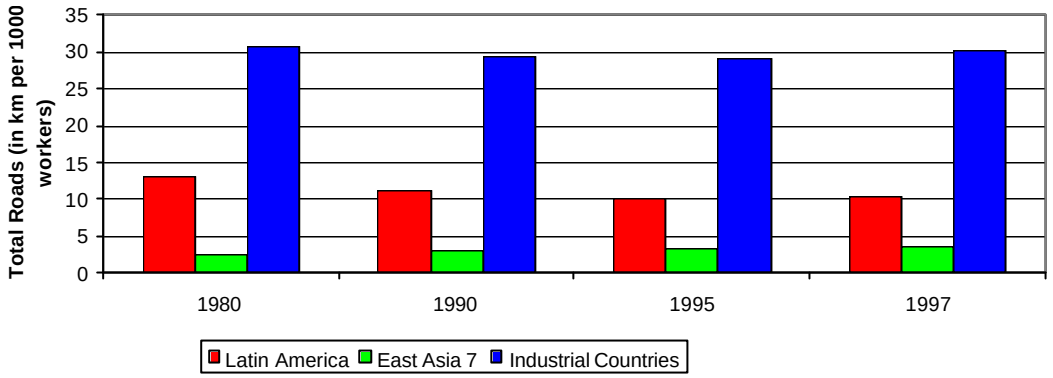


Figure 3b
Transport routes
(Medians by Region, 1980-97)

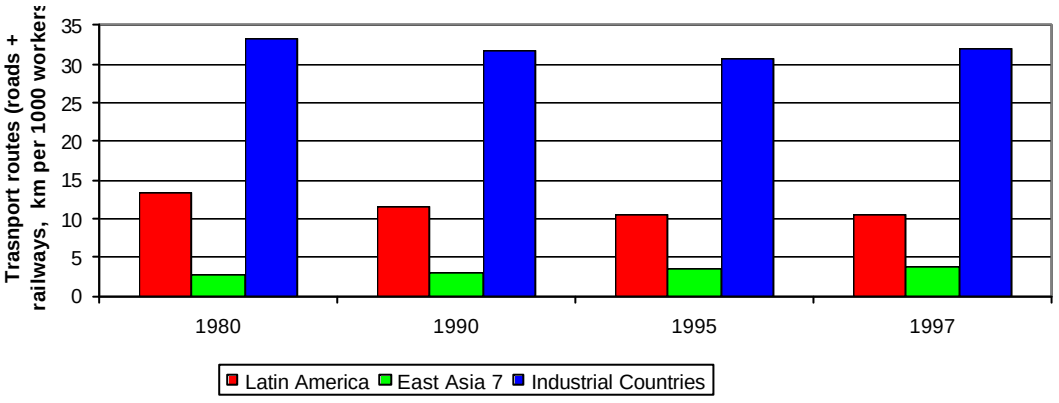


Figure 3c
Paved roads
(Medians by Region, 1980-97)

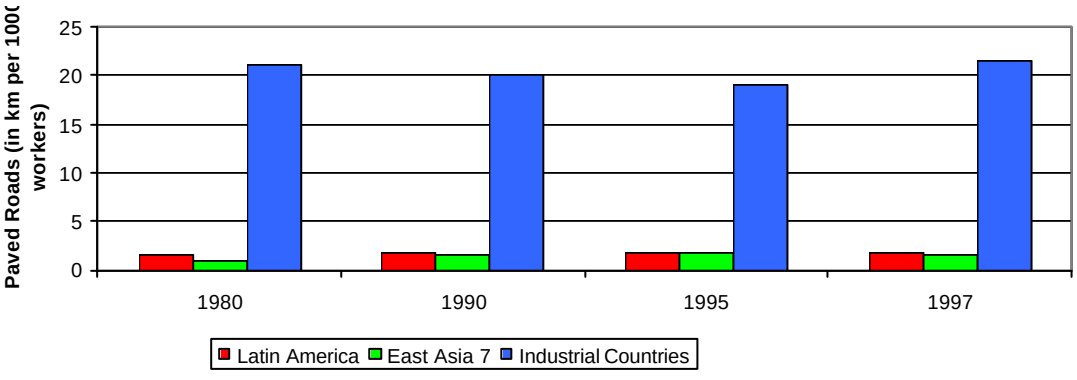


Figure 3d
Road length per worker
(km per thousand)

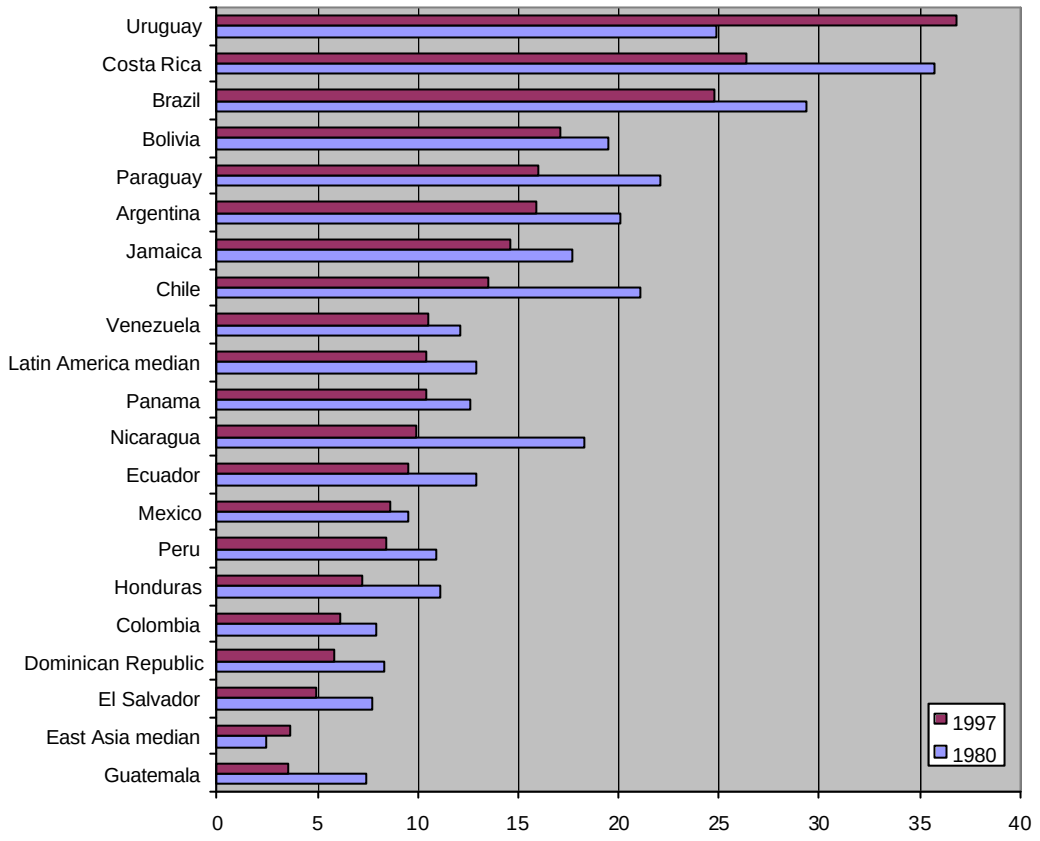


Figure 4
Access to water
(Medians by Region, 1985-93)

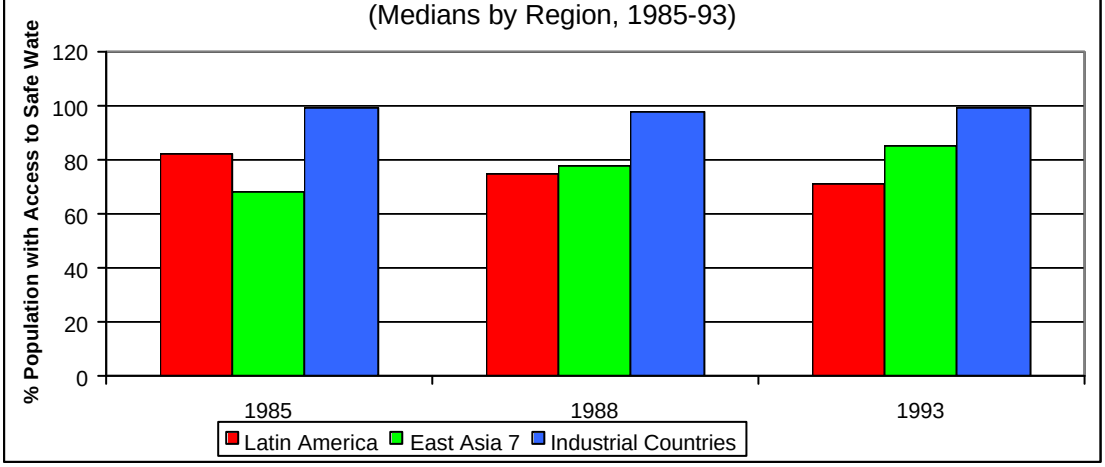


Figure 5a
Waiting time for main lines
(Medians by Region, 1980-97)

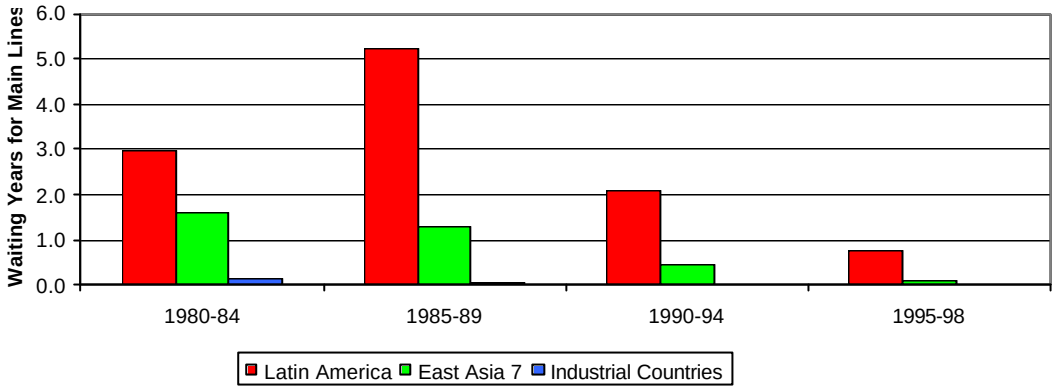


Figure 5b
Telephone faults
(Medians by Region, 1980-97)

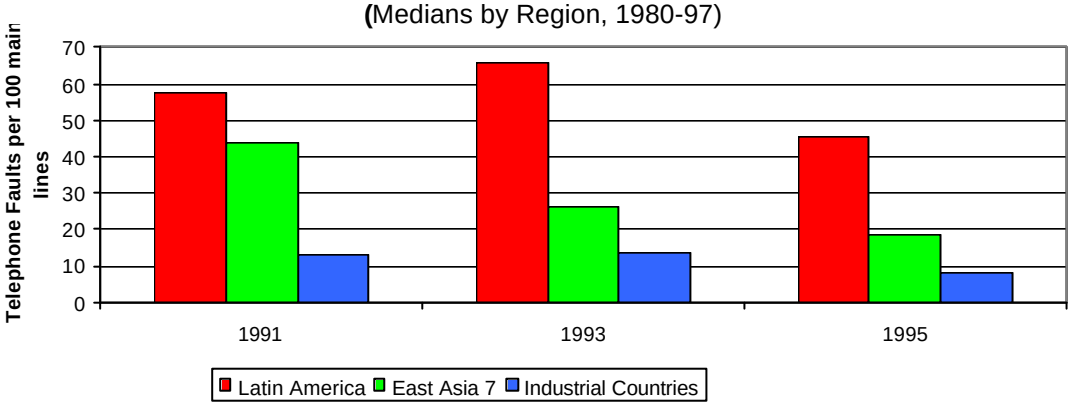


Figure 5c
Unsuccessfull local calls
(Medians by Region, 1980-97)

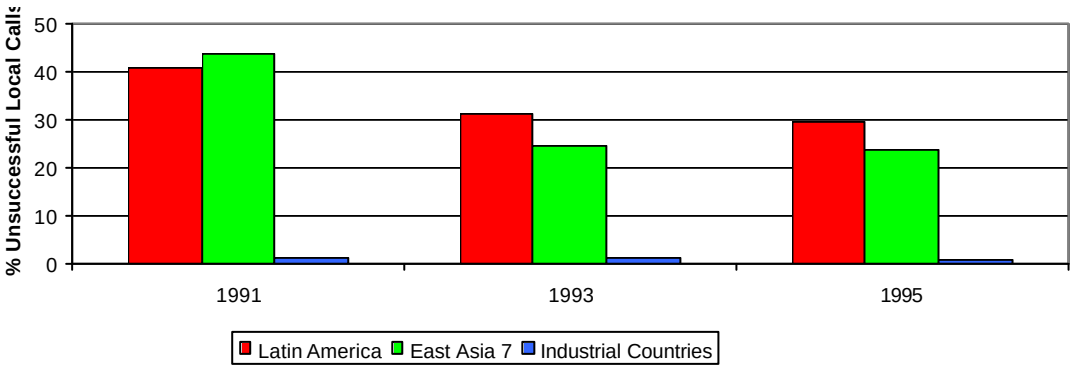


Figure 6a
Power losses
(Medians by Region, 1980-97)

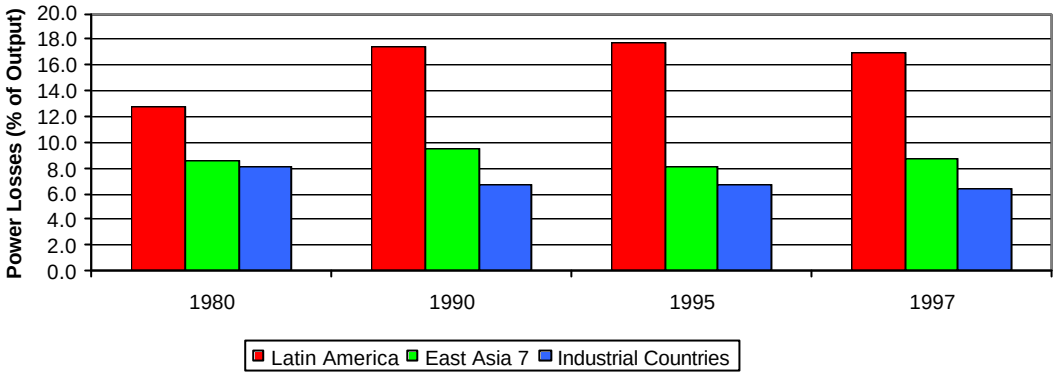


Figure 6b
Power losses
(percent of power output)

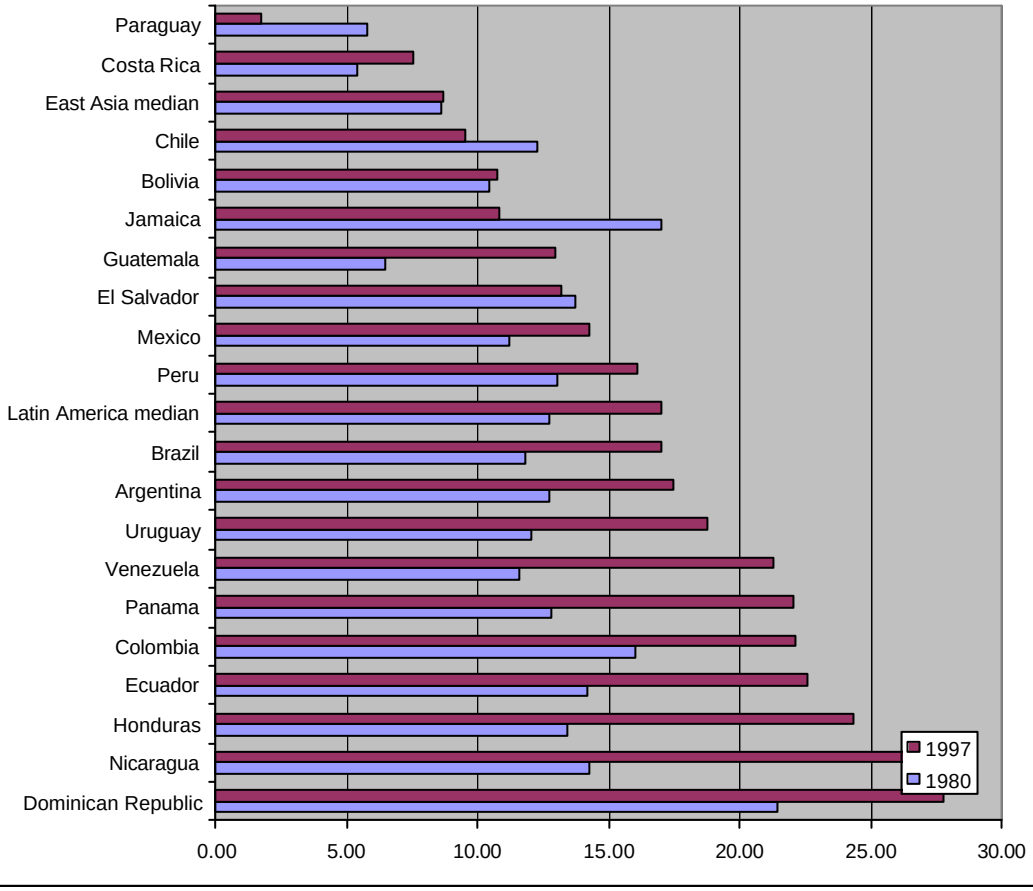


Figure 7a
Percentage of roads paved
(Medians by Region, 1980-97)

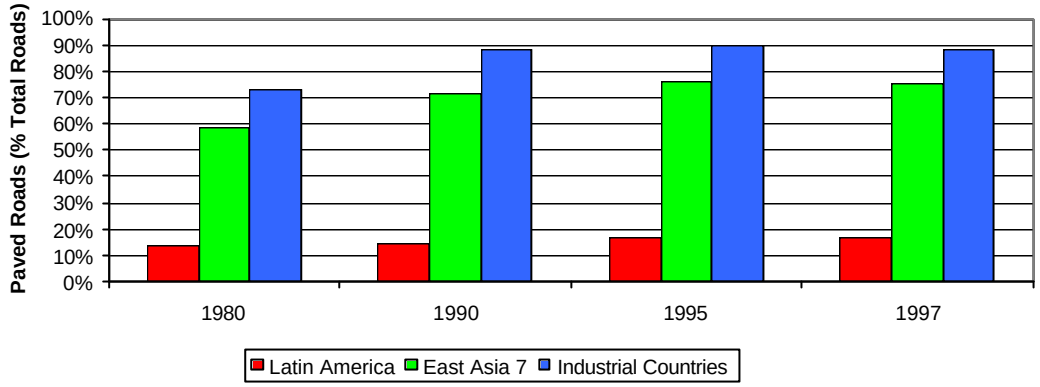


Figure 7b
Paved road length
(percent of total road length)

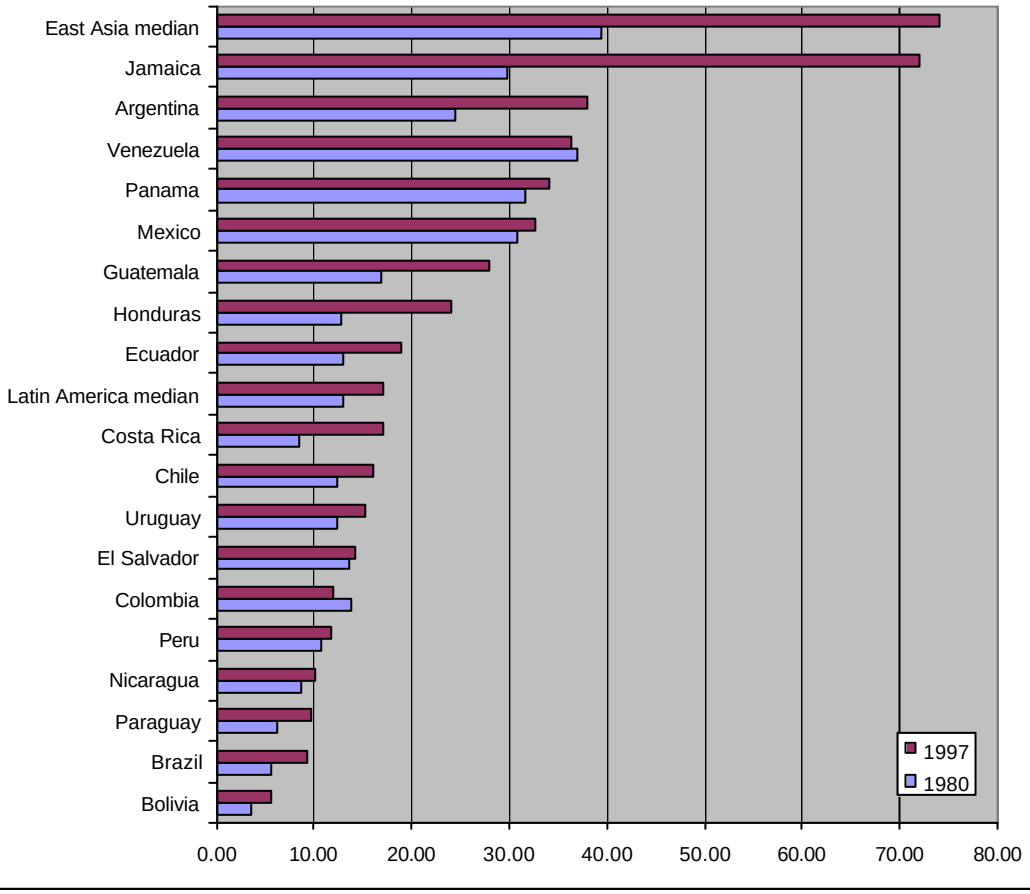


Figure 8: Total Investment in Infrastructure
Selected Latin American Countries, 1980-98

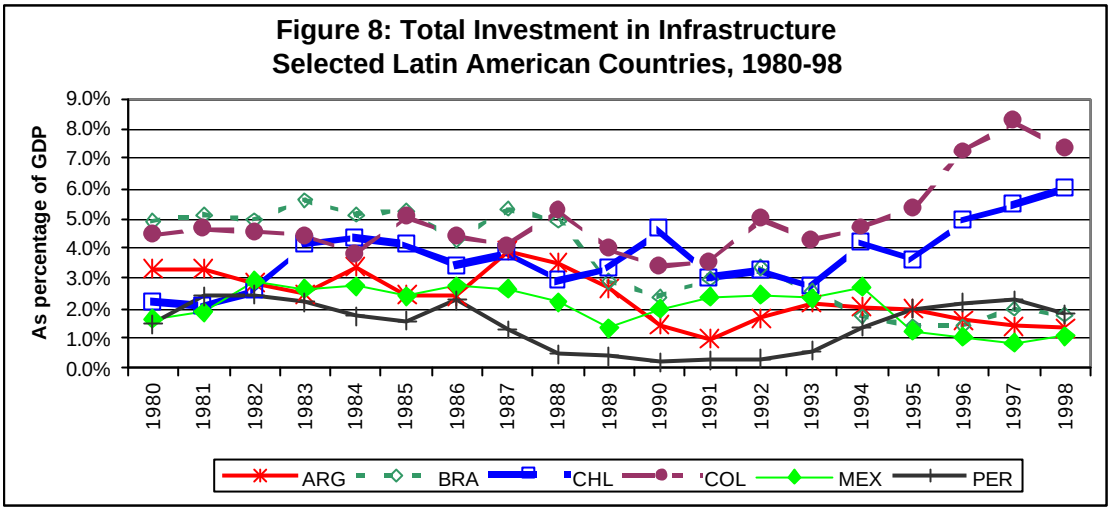


Figure 9a: Investment in Telecommunications
Selected Latin American Countries, 1980-98

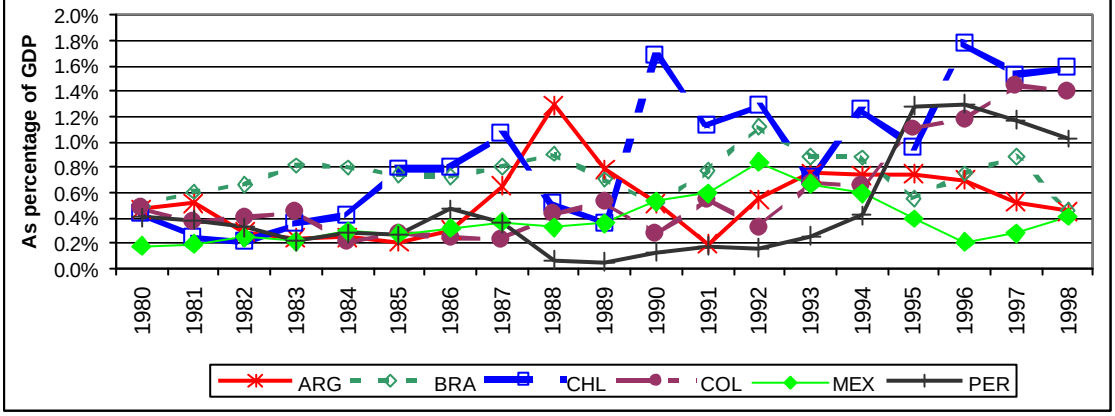


Figure 9b: Investment in Power
Selected Latin American Countries, 1980-98

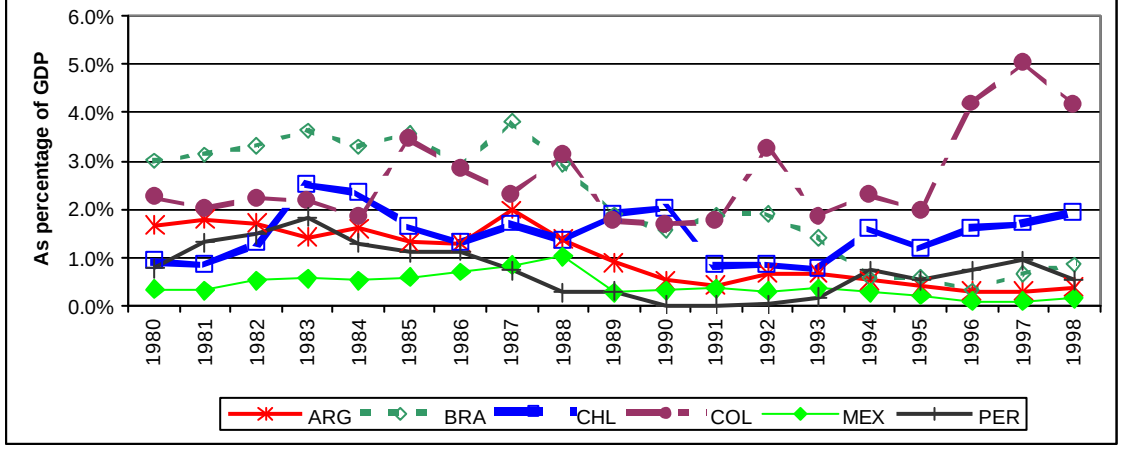


Figure 9c: Investment in Roads and Railways
Selected Latin American Countries, 1980-98

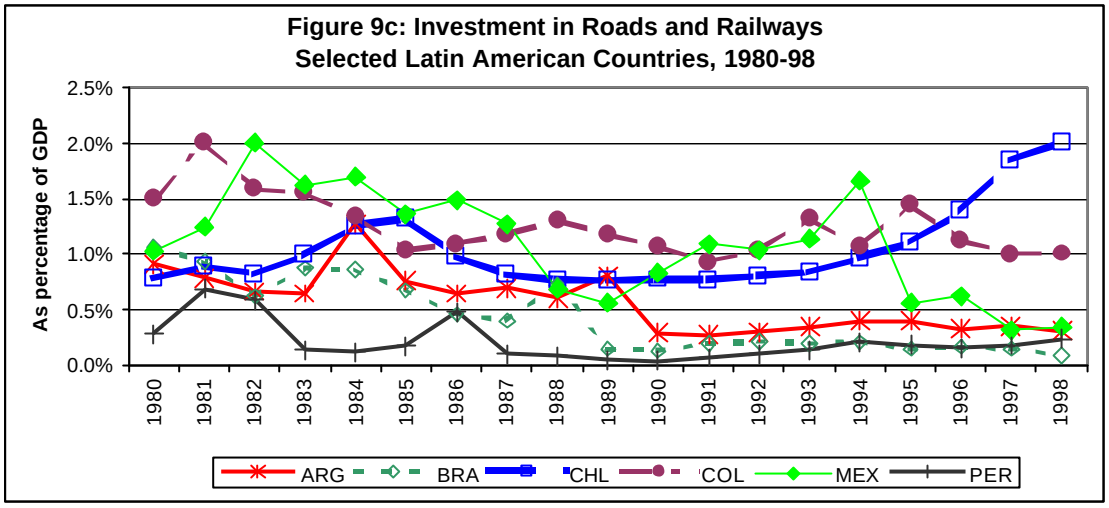


Figure 9d: Investment in Water
Selected Latin American Countries, 1980-98

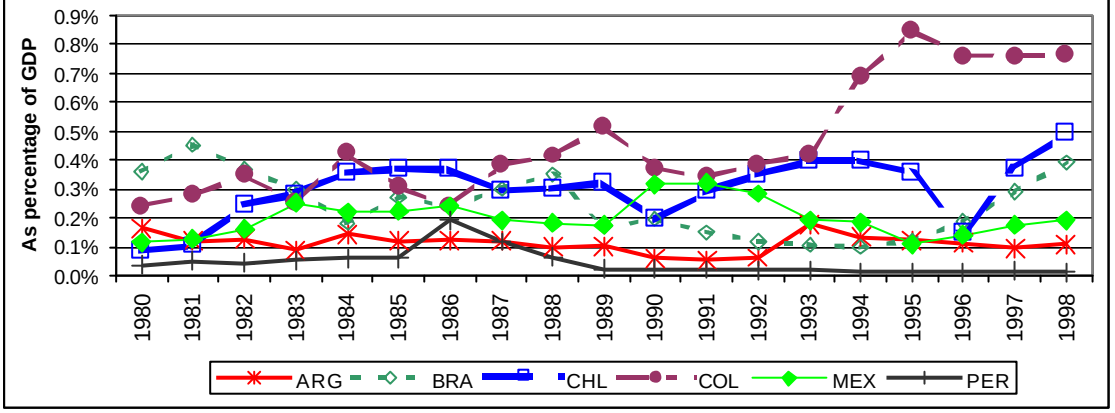


Figure 10: Public Investment in Infrastructure
Selected Latin American Countries, 1980-98

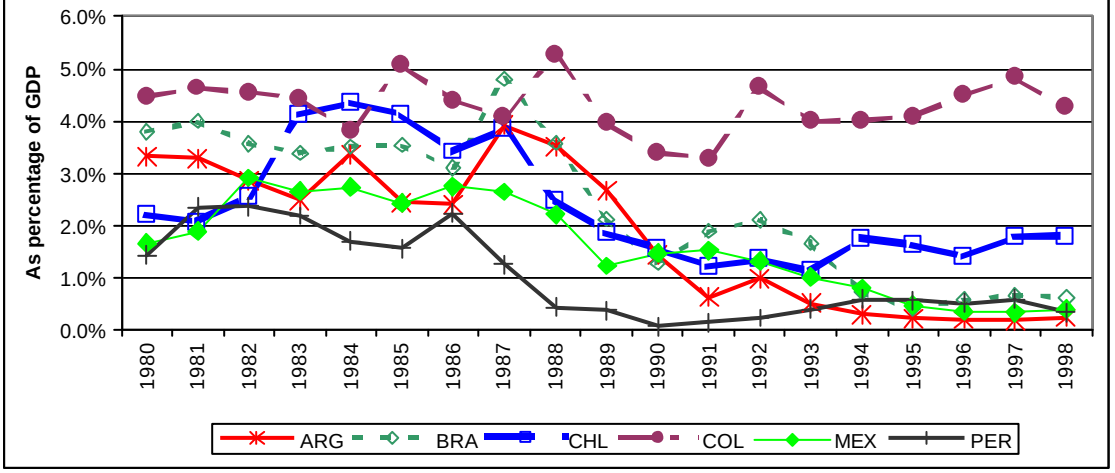


Figure 11a: Public Investment in Argentina, 1980-98

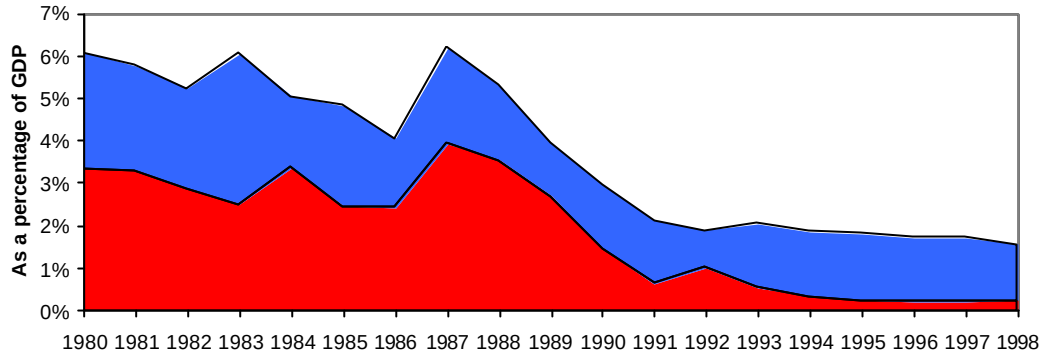


Figure 11b: Public Investment in Bolivia, 1980-98

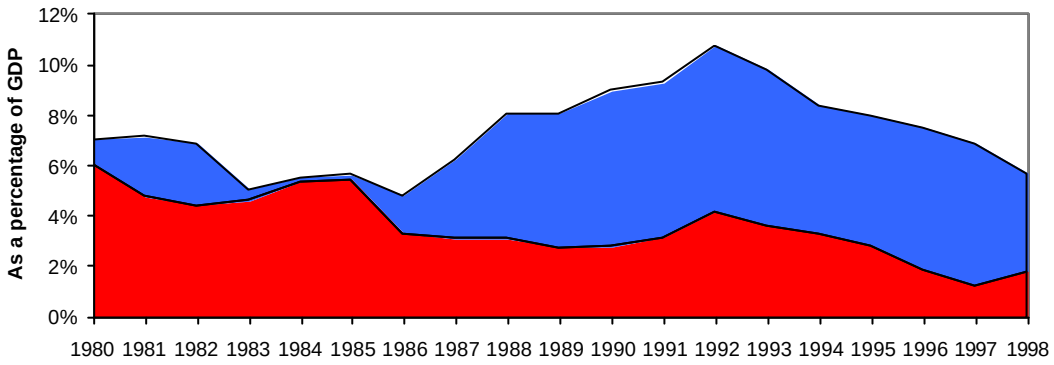
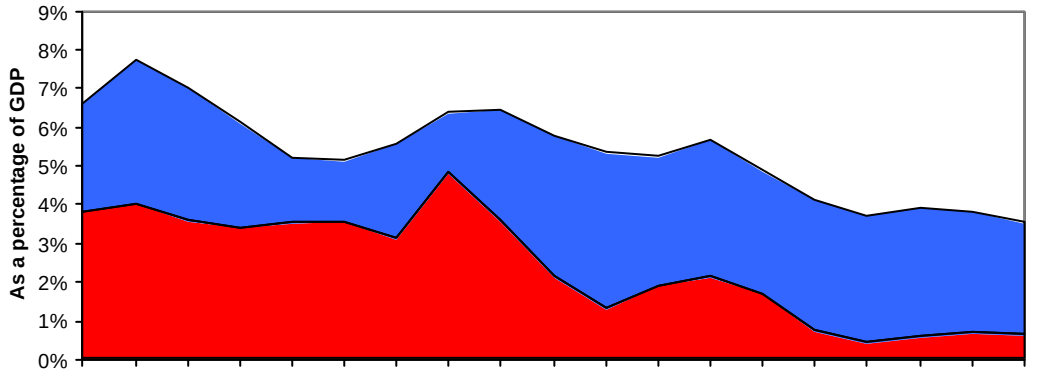


Figure 11c: Public Investment in Brazil, 1980-98



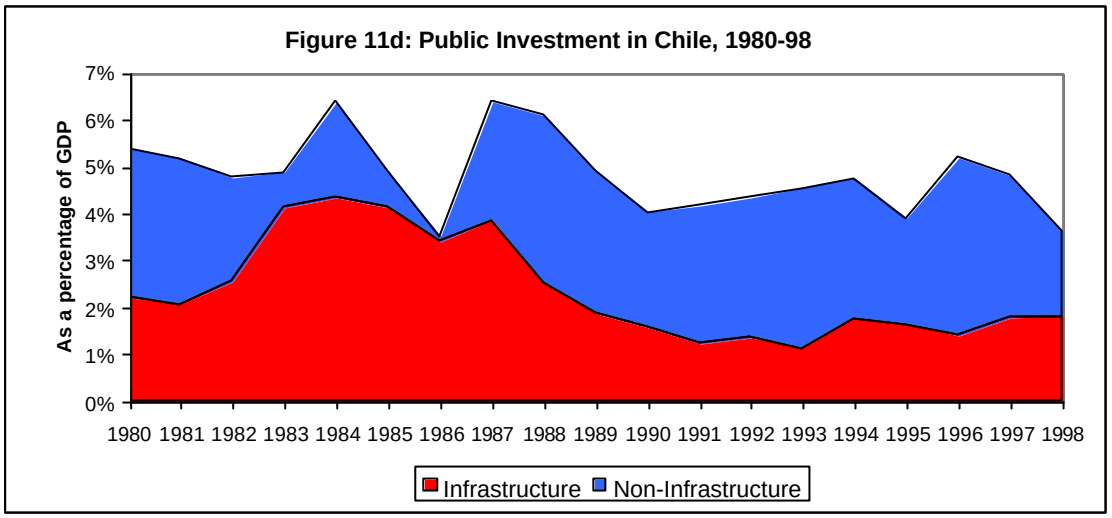


Figure 11d: Public Investment in Chile, 1980-98
As a percentage of GDP
7%
6%
5%
4%
3%
2%
1%
0%
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Infrastructure
Non-Infrastructure

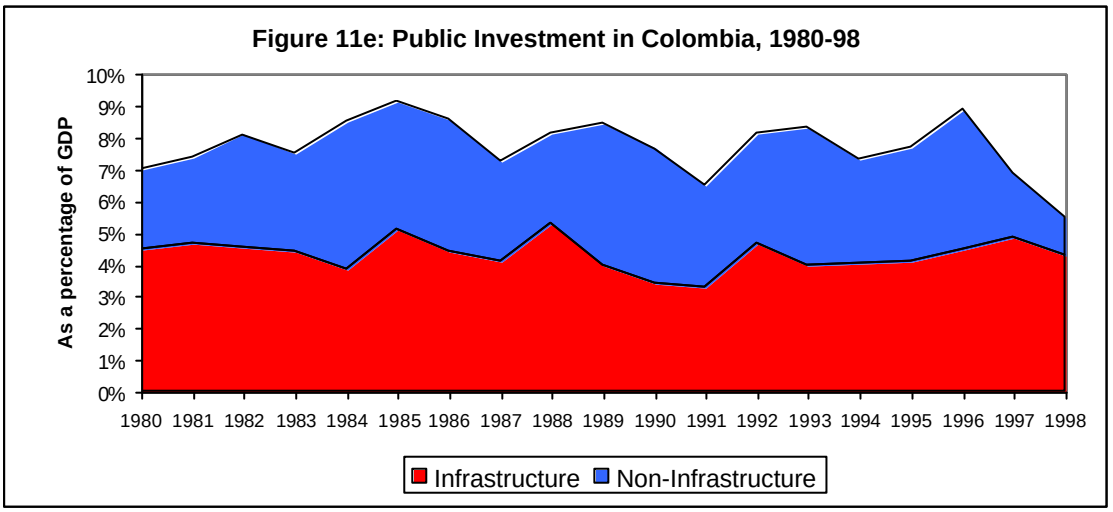


Figure 11e: Public Investment in Colombia, 1980-98
As a percentage of GDP
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Infrastructure
Non-Infrastructure

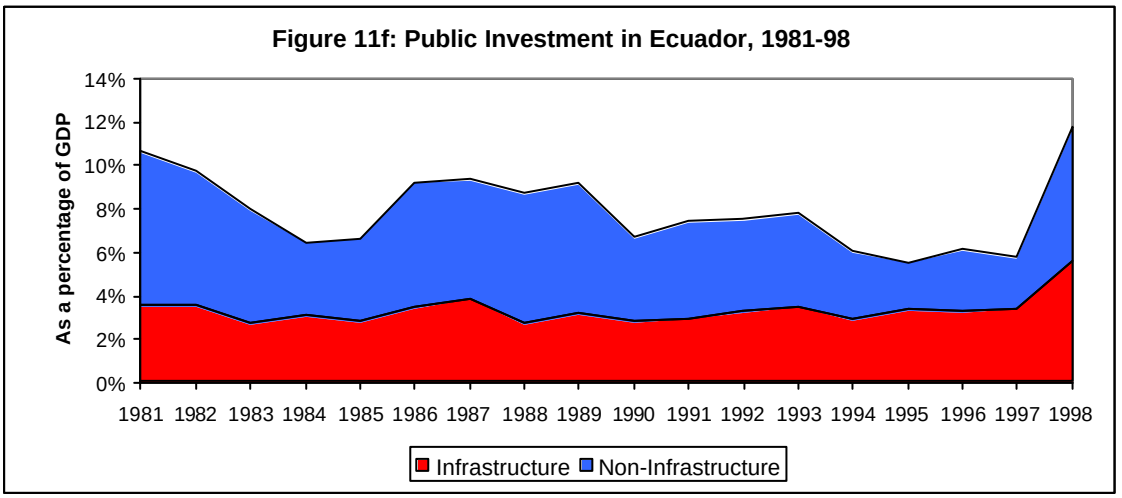


Figure 11f: Public Investment in Ecuador, 1981-98
As a percentage of GDP
14%
12%
10%
8%
6%
4%
2%
0%
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Infrastructure
Non-Infrastructure

Figure 11g: Public Investment in Mexico, 1980-98

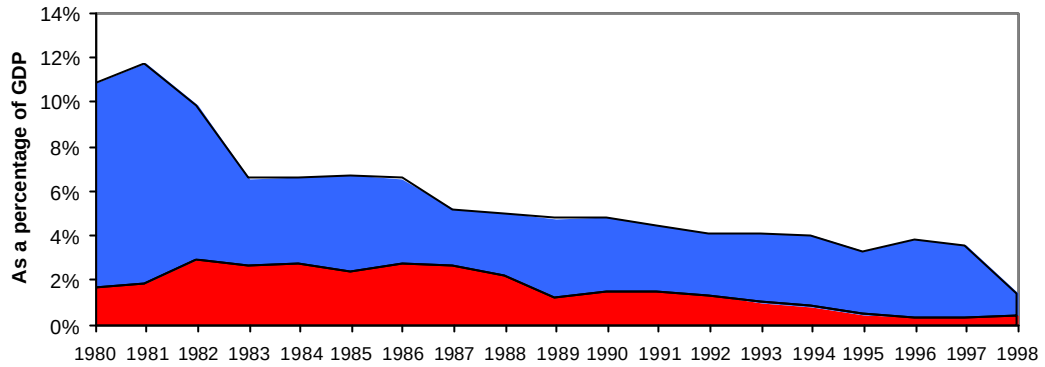


Figure 11h: Public Investment in Peru, 1980-98

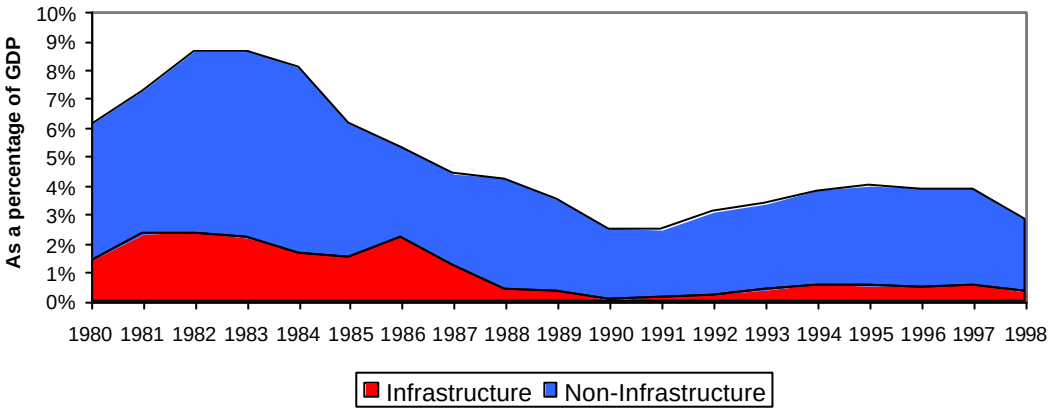


Figure 11i: Public Investment in Venezuela, 1980-98

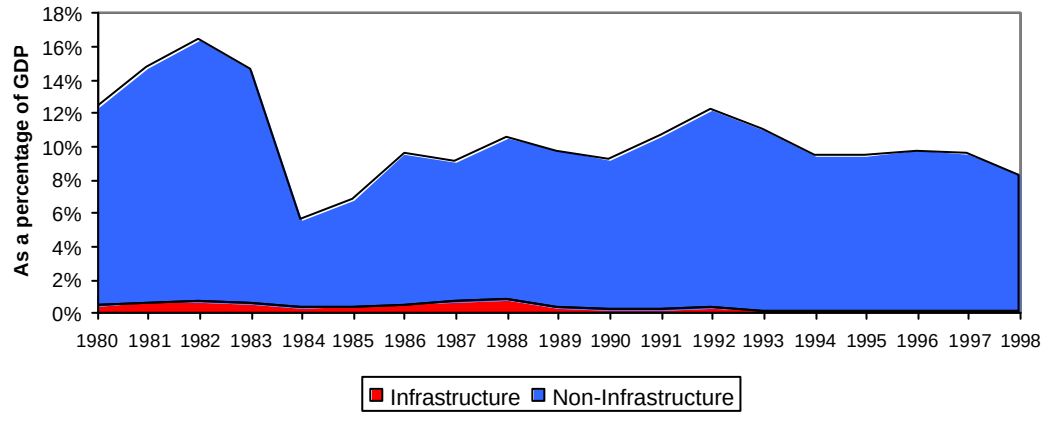


Figure 12a: Public Investment in Infrastructure by Sector, Argentina 1980-98

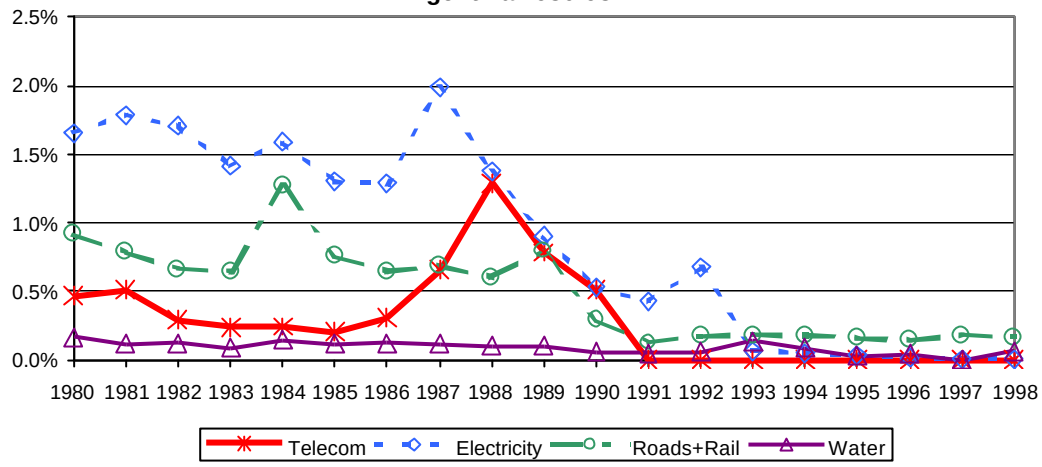


Figure 12b: Public Investment in Infrastructure by Sector, Bolivia 1980-98

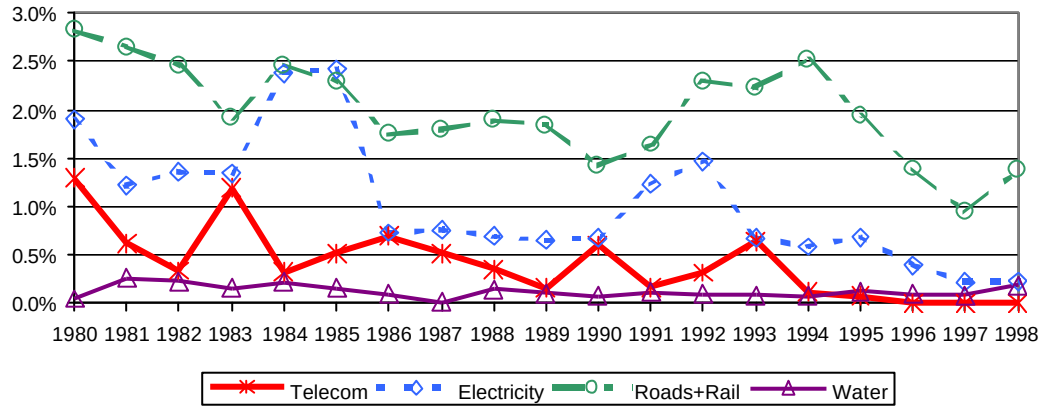


Figure 12c: Public Investment in Infrastructure by Sector, Brazil 1980-98

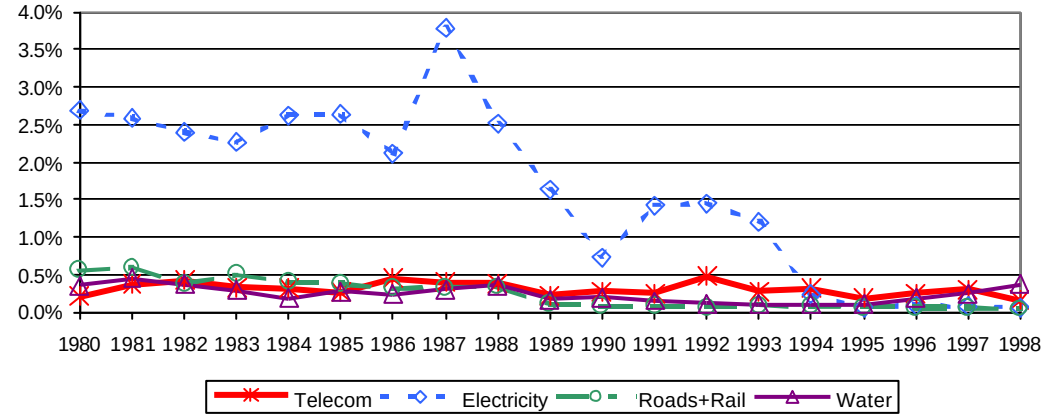


Figure 12d: Public Investment in Infrastructure by Sector, Chile 1980-98

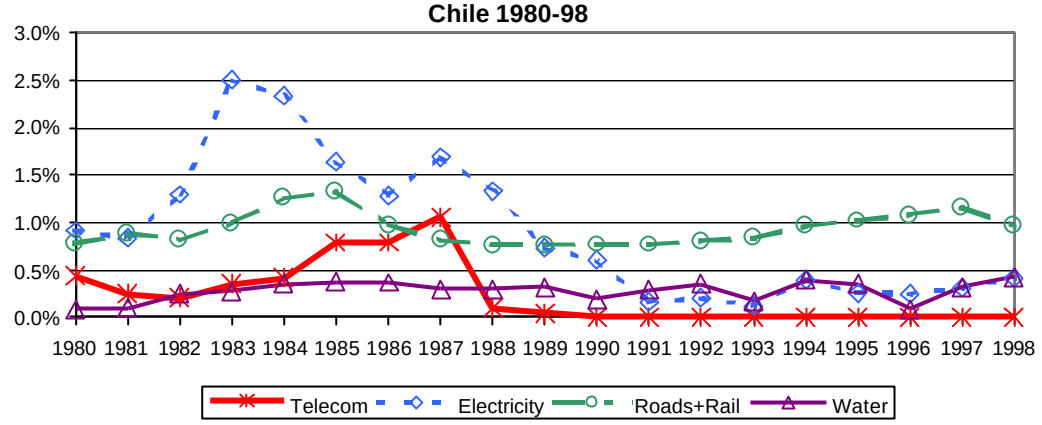


Figure 12e: Public Investment in Infrastructure by Sector, Colombia 1980-98

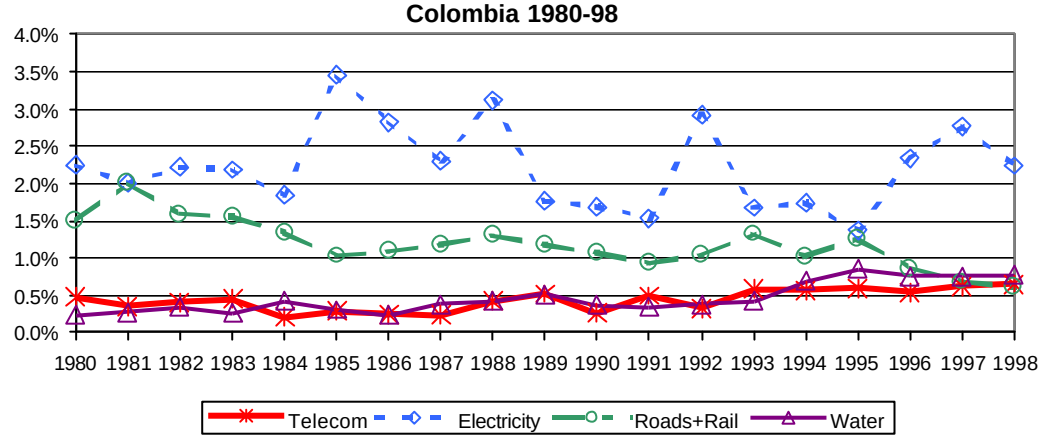


Figure 12f: Public Investment in Infrastructure by Sector, Ecuador 1981-98

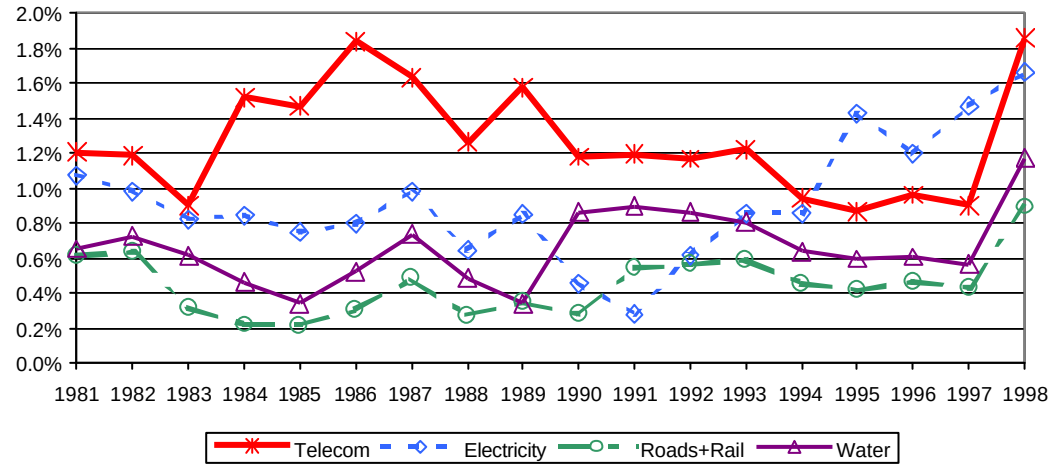


Figure 12g: Public Investment in Infrastructure by Sector, Mexico 1980-98

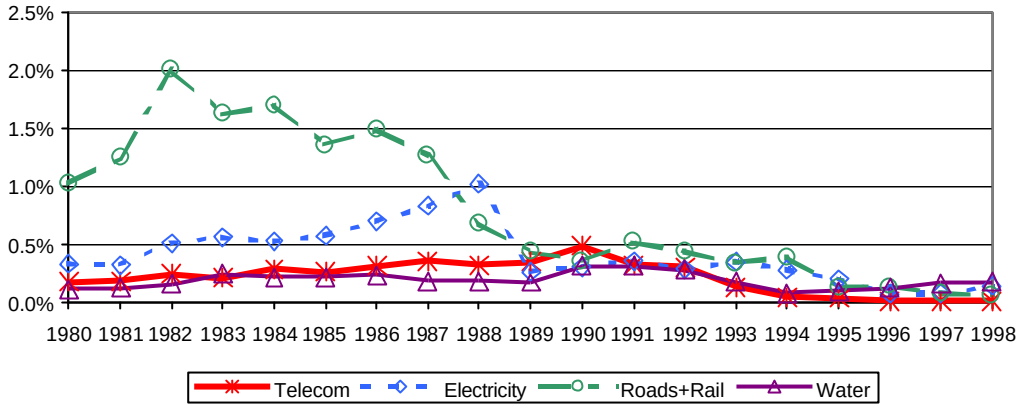


Figure 12h: Public Investment in Infrastructure by Sector, Peru 1980-98

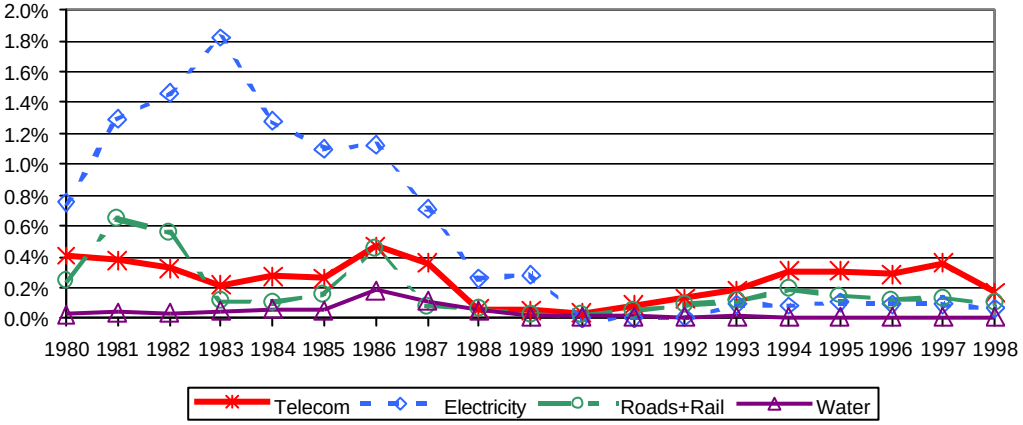


Figure 12i: Public Investment in Infrastructure by Sector, Venezuela 1980-98

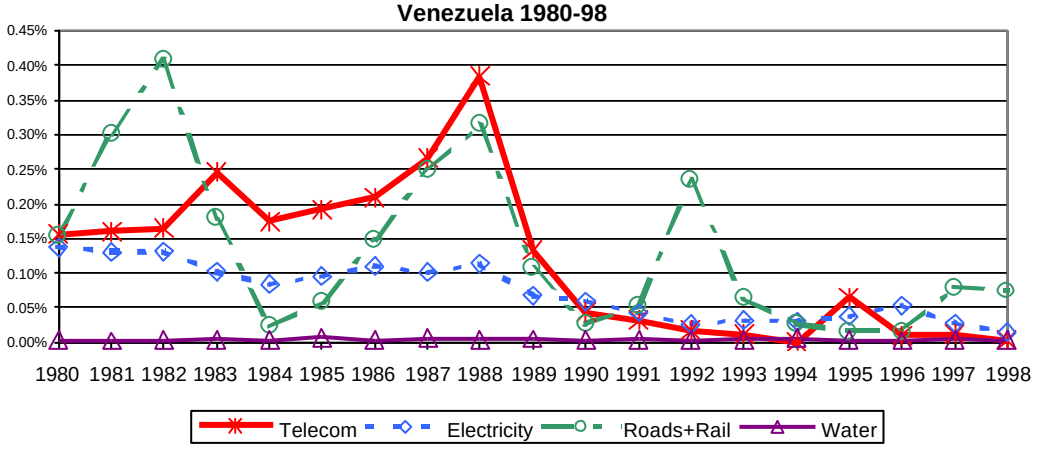


Figure 13: Private Investment in Infrastructure
Selected Latin American Countries, 1980-98

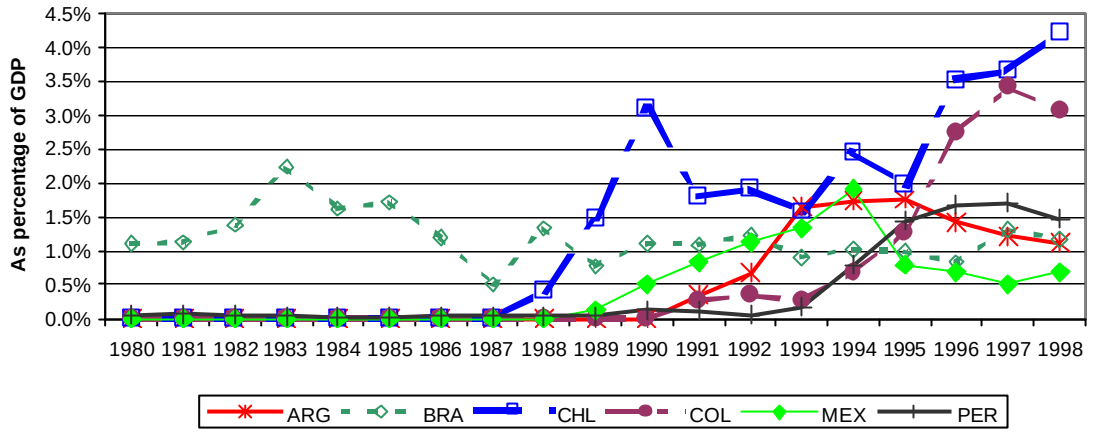


Figure 14a: Private Investment in Argentina, 1980-98

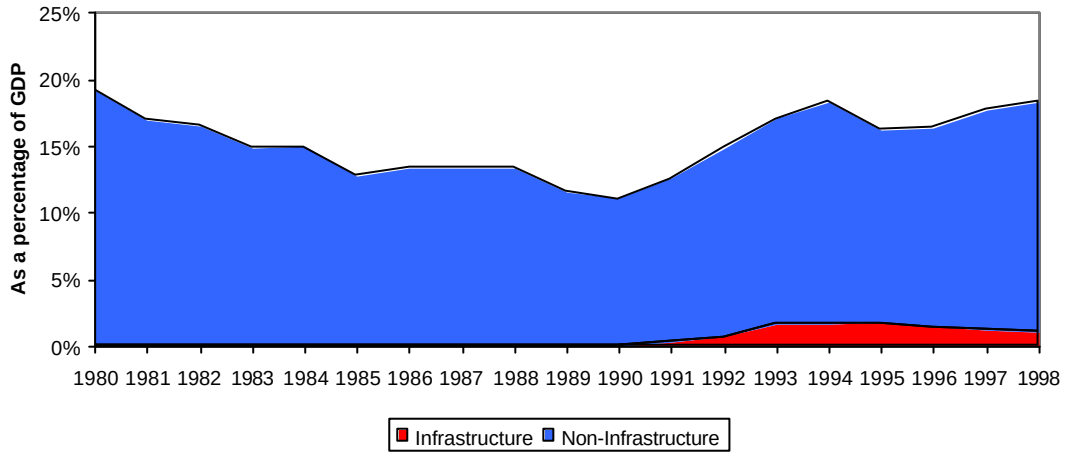


Figure 14b: Private Investment in Bolivia, 1980-98

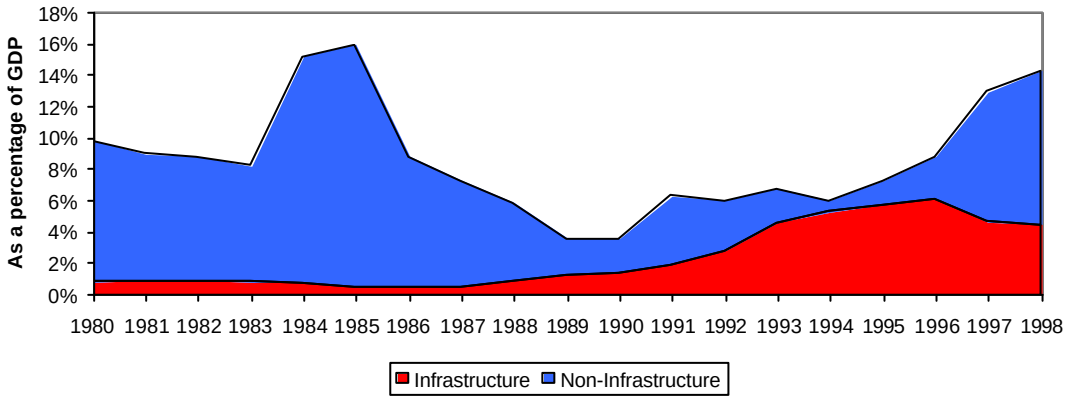


Figure 14c: Private Investment in Brazil, 1980-98

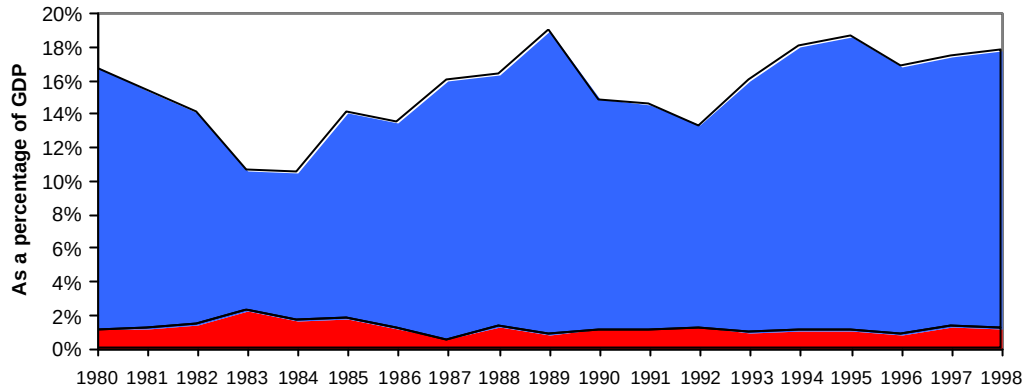


Figure 14d: Private Investment in Chile, 1980-98

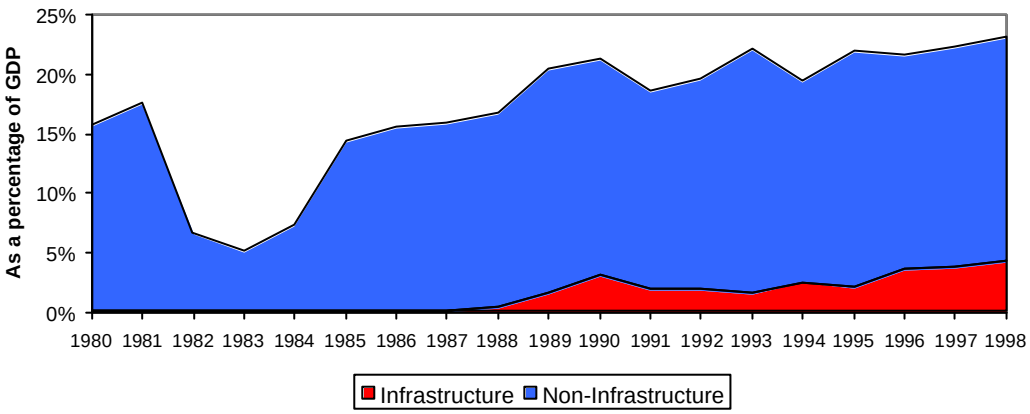


Figure 14e: Private Investment in Colombia, 1980-98

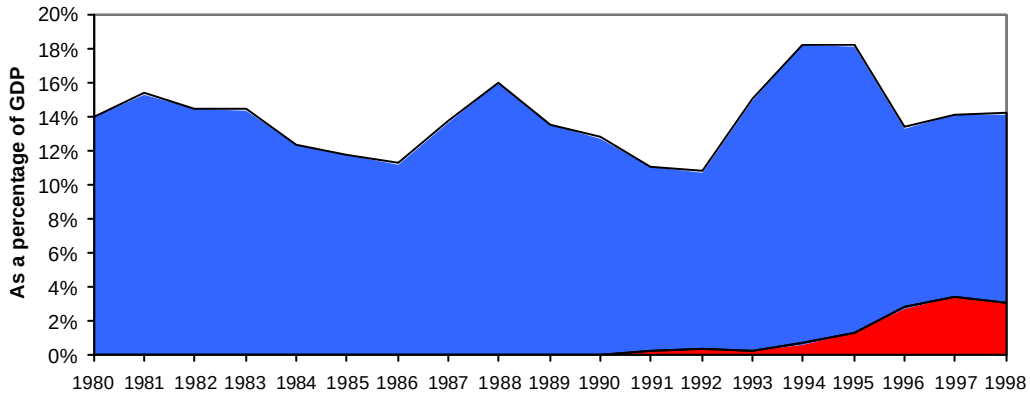


Figure 14f: Private Investment in Ecuador, 1981-98

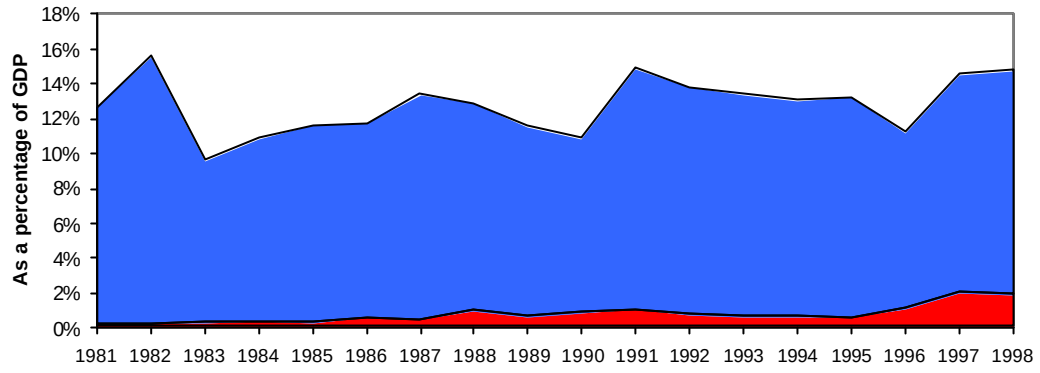


Figure 14g: Private Investment in Mexico, 1980-98

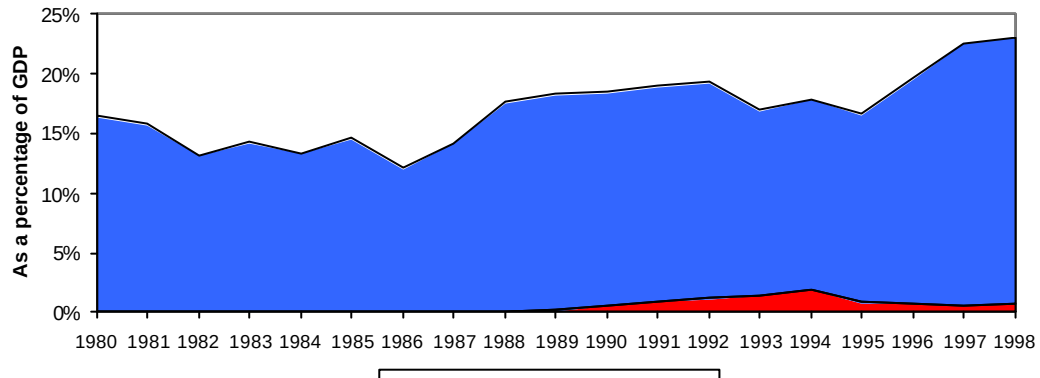


Figure 14h: Private Investment in Peru, 1980-98

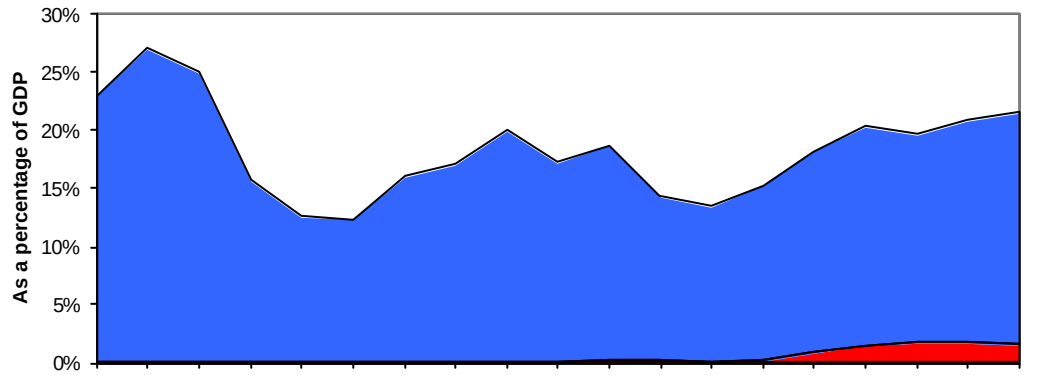


Figure 14i: Private Investment in Venezuela, 1980-98

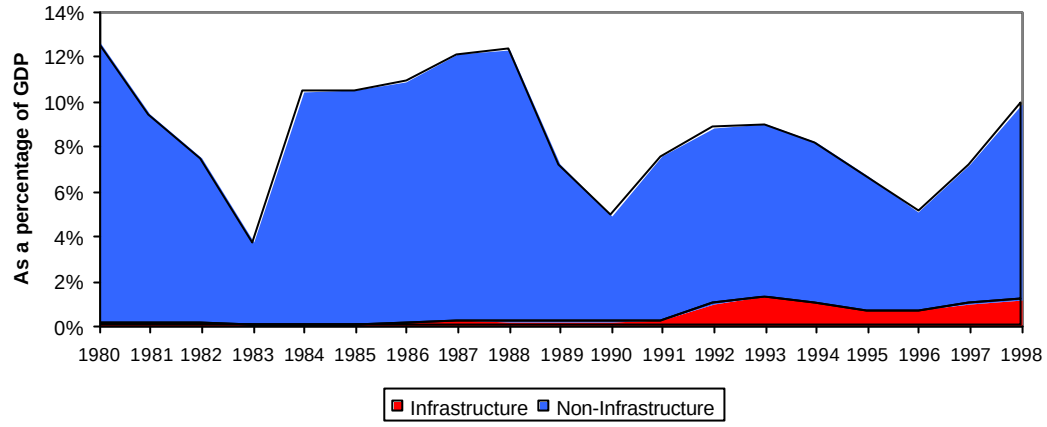


Figure 15a: Private Investment in Infrastructure by Sector, Argentina 1980-98

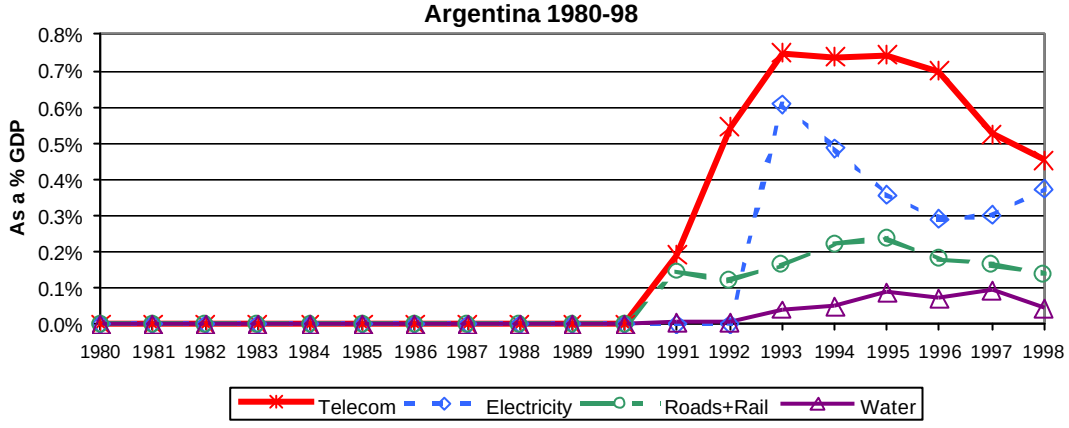


Figure 15b: Private Investment in Infrastructure by Sector, Bolivia 1980-98

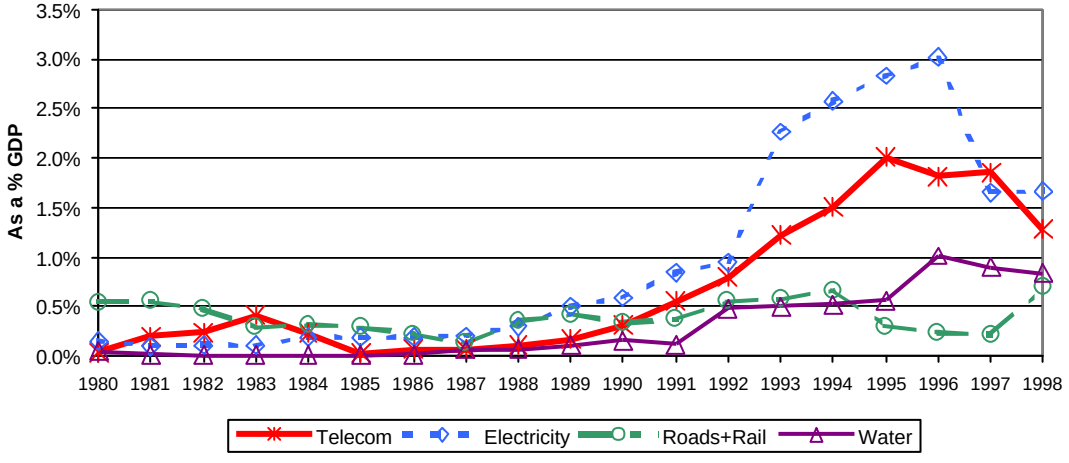


Figure 15c: Private Investment in Infrastructure by Sector, Brazil 1980-98

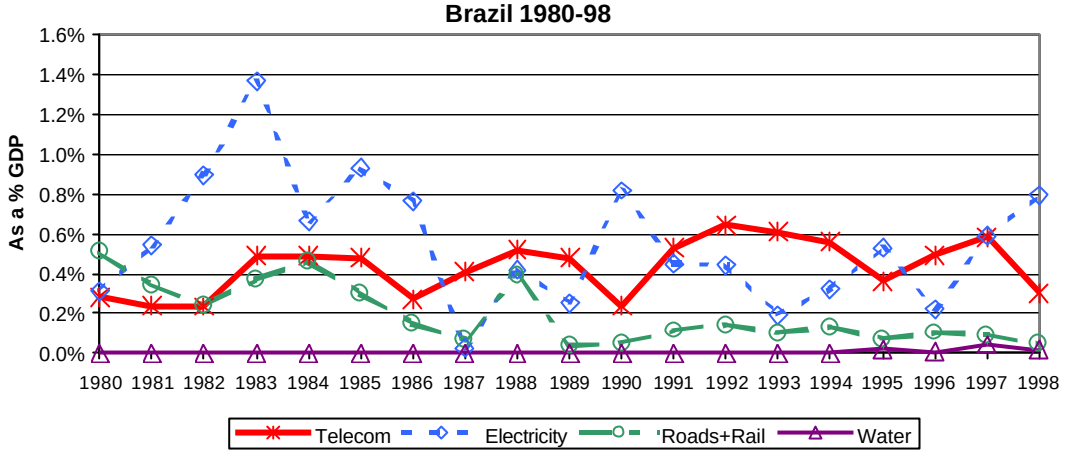


Figure 15d: Private Investment in Infrastructure by Sector, Chile 1980-98

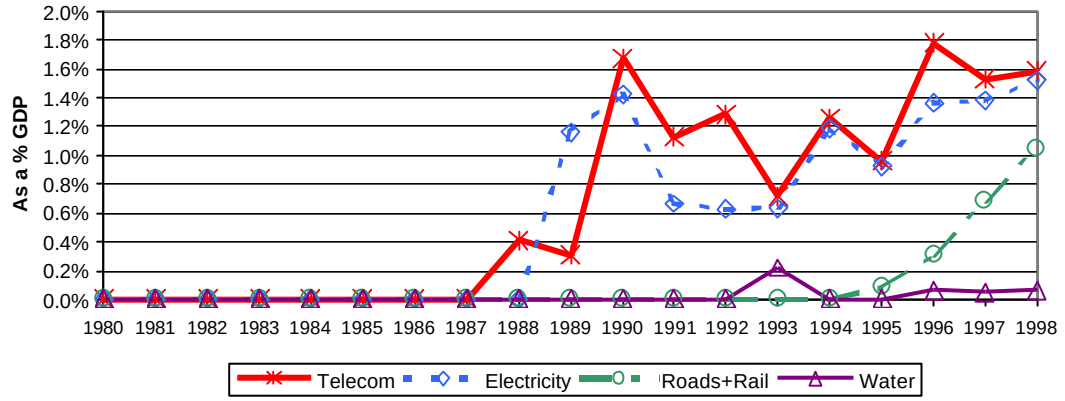
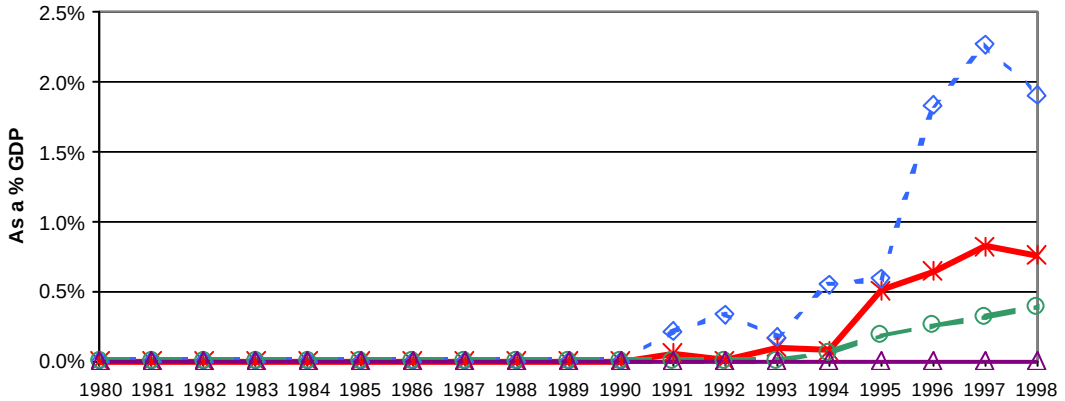


Figure 15e: Private Investment in Infrastructure by Sector, Colombia 1980-98



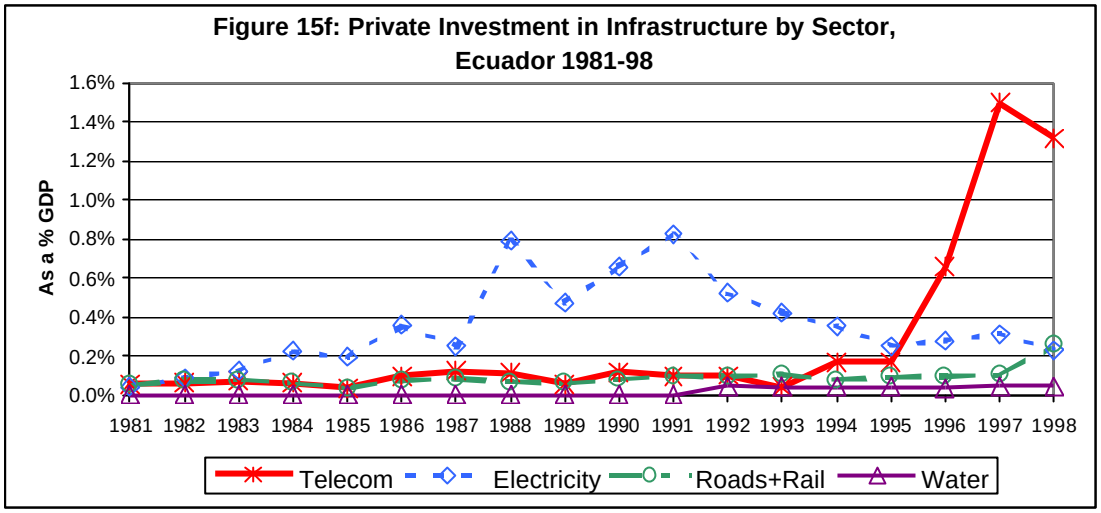


Figure 15f: Private Investment in Infrastructure by Sector, Ecuador 1981-98
As a % GDP
1.6%
1.4%
1.2%
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Telecom
Electricity
Roads+Rail
Water

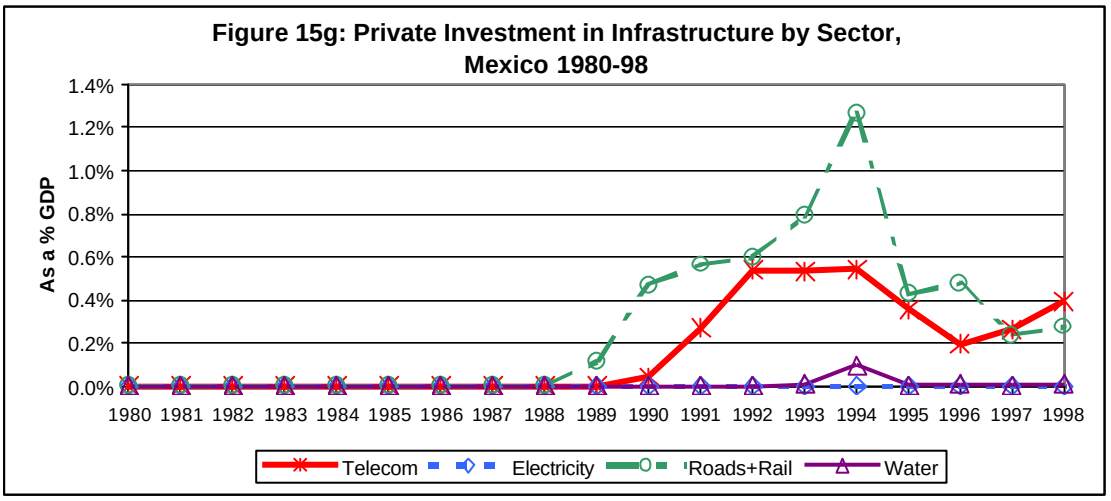


Figure 15g: Private Investment in Infrastructure by Sector, Mexico 1980-98
As a % GDP
1.4%
1.2%
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Telecom
Electricity
Roads+Rail
Water

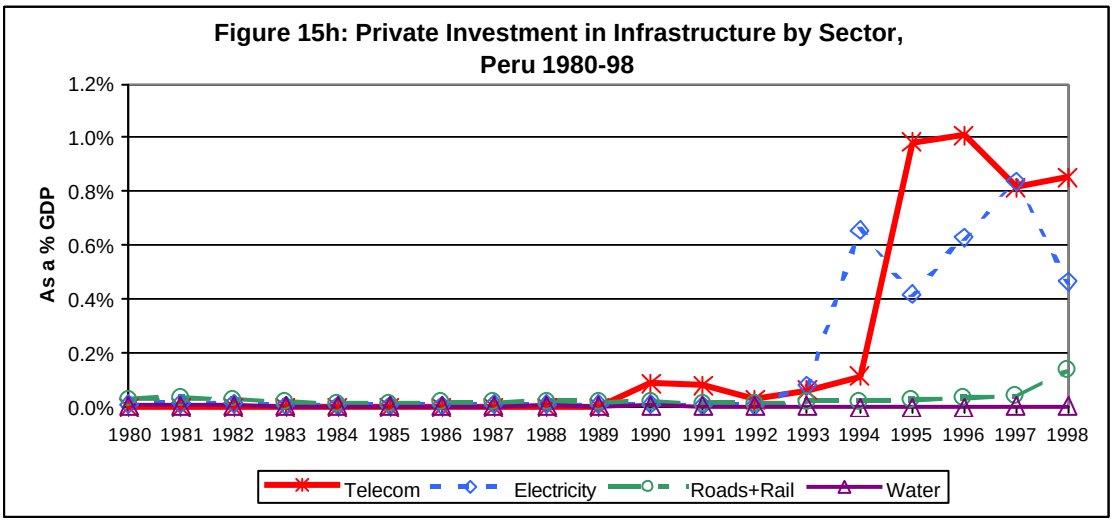


Figure 15h: Private Investment in Infrastructure by Sector, Peru 1980-98
As a % GDP
1.2%
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Telecom
Electricity
Roads+Rail
Water

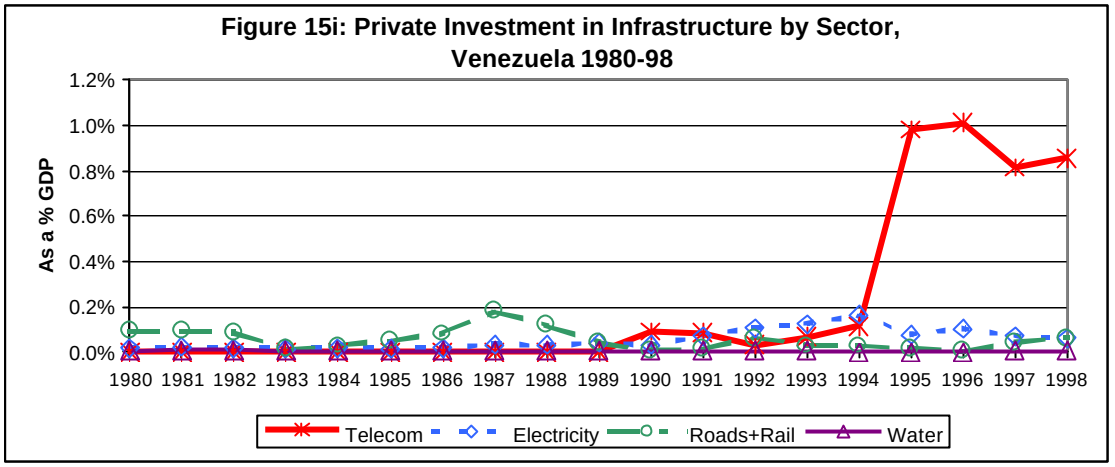


Figure 15i: Private Investment in Infrastructure by Sector, Venezuela 1980-98
As a % GDP
1.2%
1.0%
0.8%
0.6%
0.4%
0.2%
0.0%
1980 1981 1982 1983 1984 1985 1986 1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998
Telecom
Electricity
Roads+Rail
Water

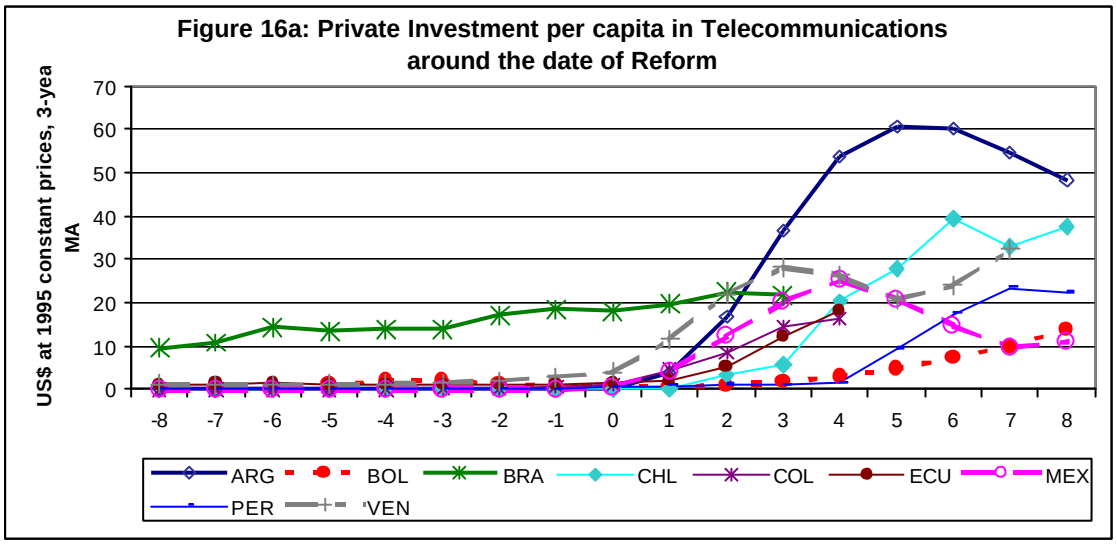


Figure 16a: Private Investment per capita in Telecommunications around the date of Reform
US$ at 1995 constant prices, 3-yea MA
70
60
50
40
30
20
10
0
-8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8
ARG
BOL
BRA
CHL
COL
ECU
MEX
PER
VEN

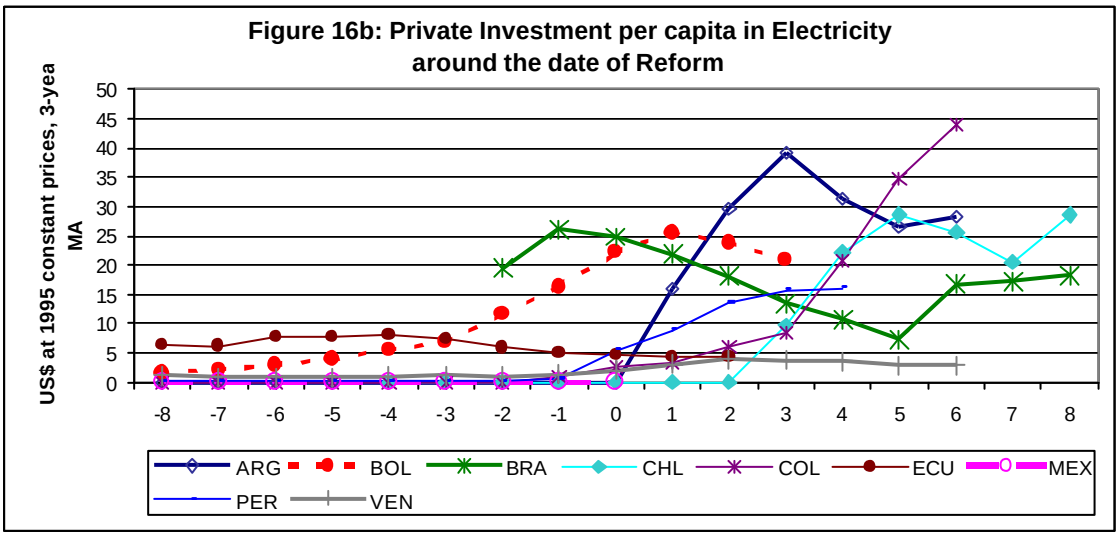


Figure 16b: Private Investment per capita in Electricity around the date of Reform
US$ at 1995 constant prices, 3-yea MA
50
45
40
35
30
25
20
15
10
5
0
-8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8
ARG
BOL
BRA
CHL
COL
ECU
MEX
PER
VEN

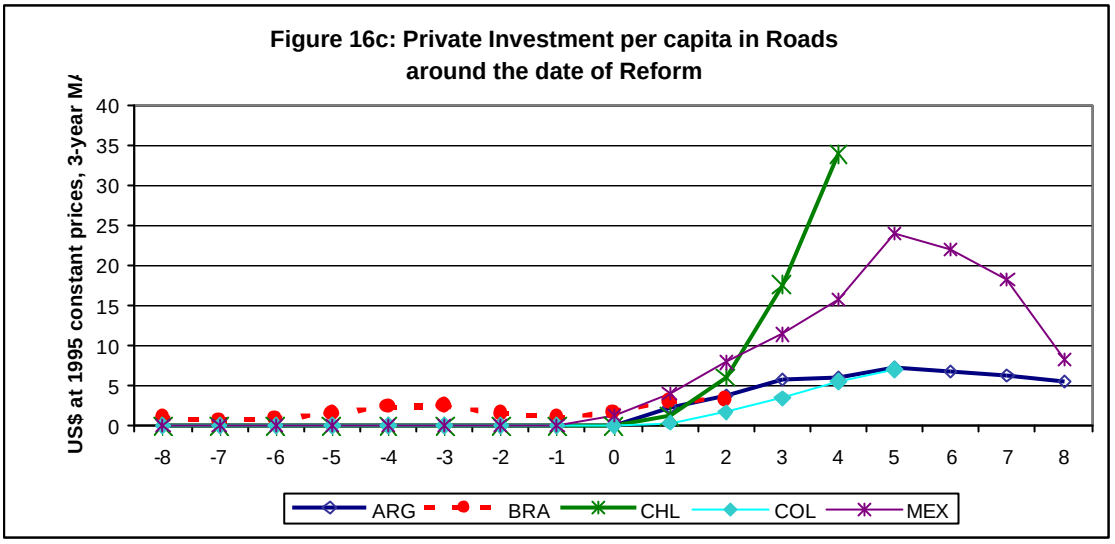


Figure 16c: Private Investment per capita in Roads
around the date of Reform
US$ at 1995 constant prices, 3-year MA
40
35
30
25
20
15
10
5
0
-8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8
ARG BRA CHL COL MEX

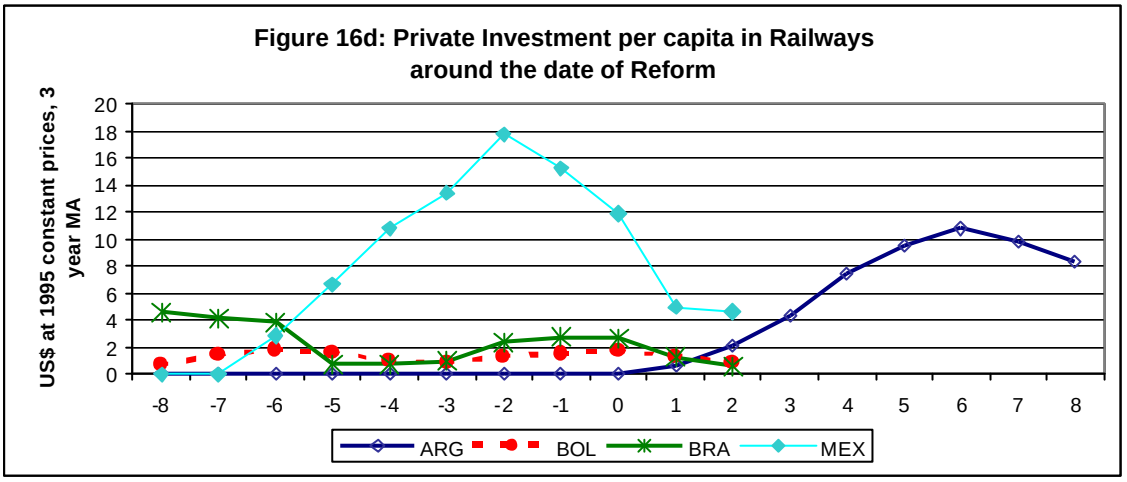


Figure 16d: Private Investment per capita in Railways
around the date of Reform
US$ at 1995 constant prices, 3
year MA
20
18
16
14
12
10
8
6
4
2
0
-8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8
ARG BOL BRA MEX

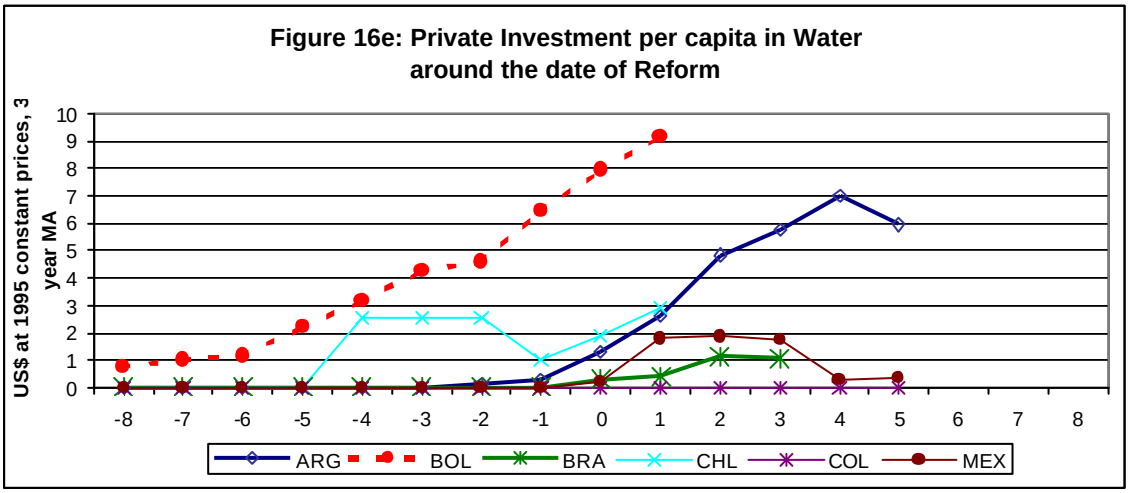
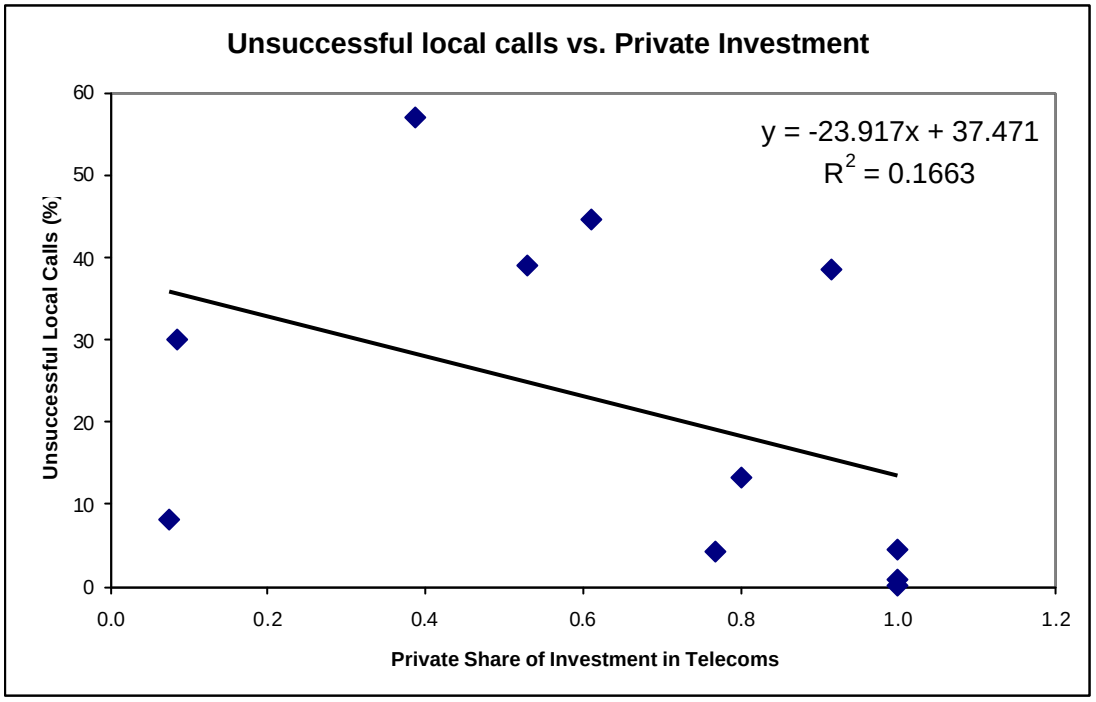
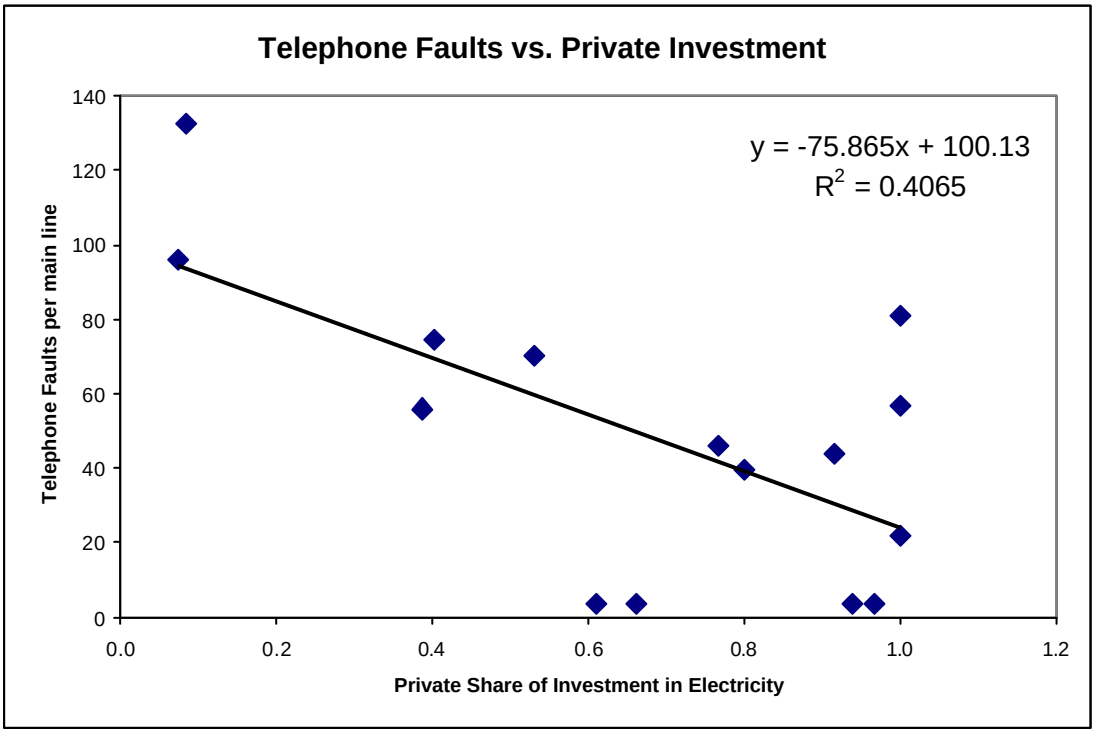
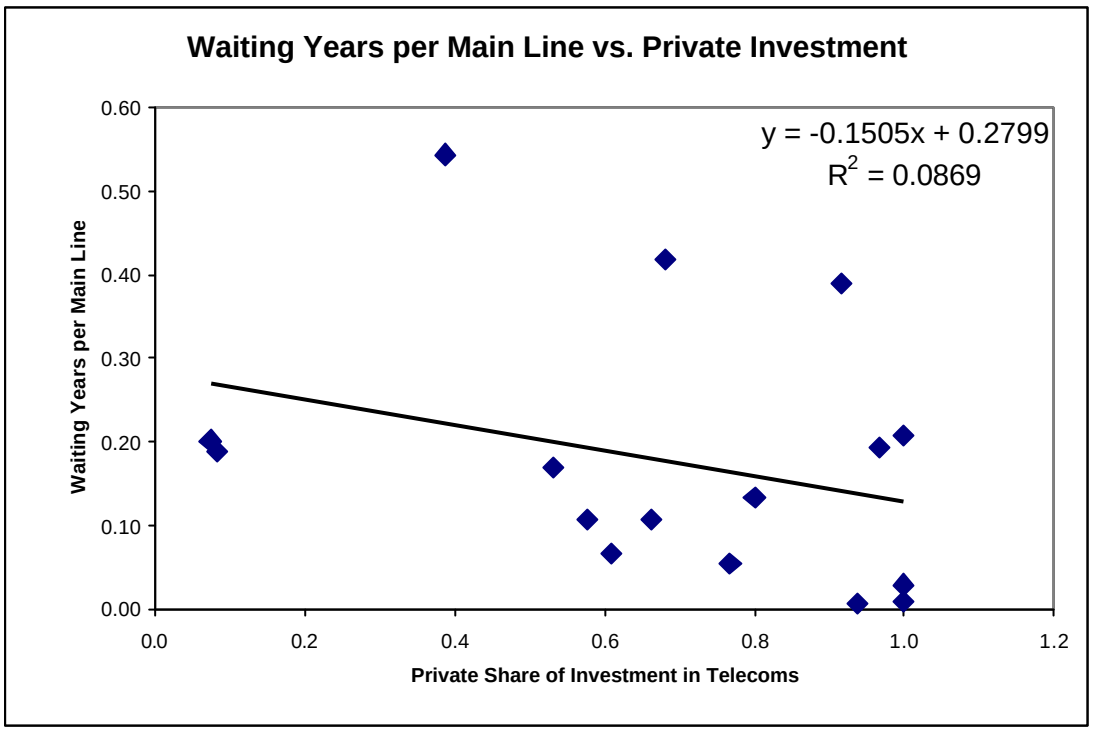


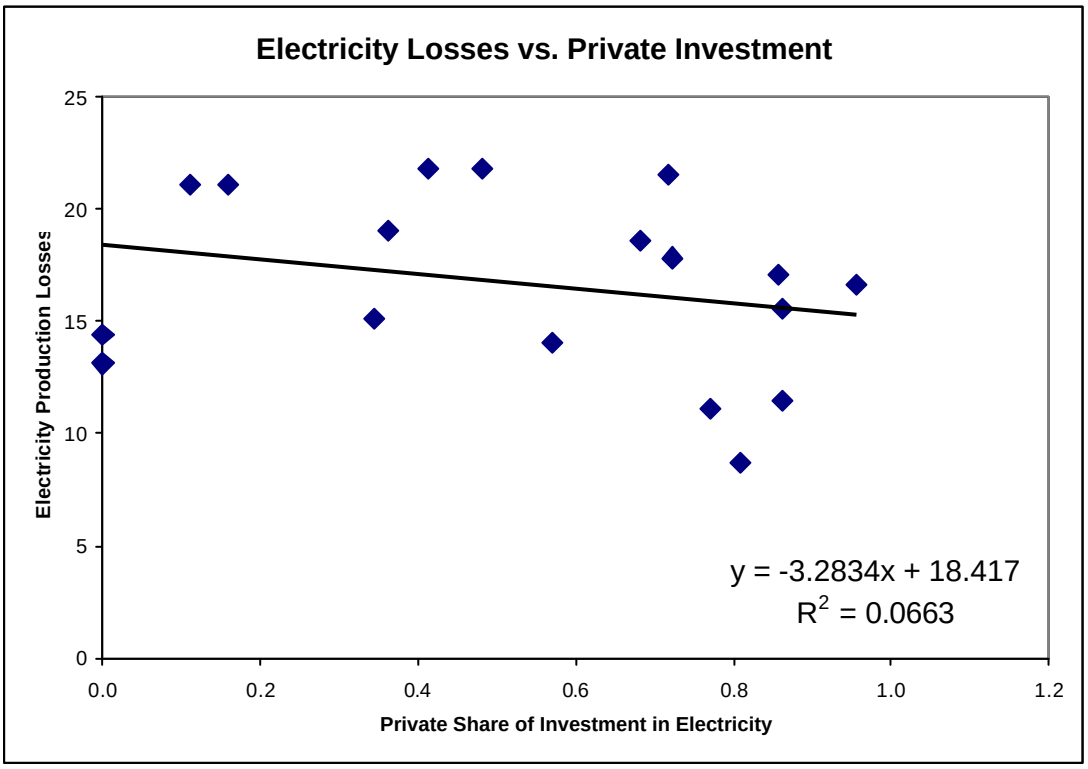
Figure 16e: Private Investment per capita in Water
around the date of Reform
US$ at 1995 constant prices, 3
year MA
10
9
8
7
6
5
4
3
2
1
0
-8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8
ARG BOL BRA CHL COL MEX

Figure 17
Infrastructure Quality and the Private Share of Investment in Infrastructure






Waiting Years per Main Line vs. Private Investment
y = -0.1505x + 0.2799
R2 = 0.0869
Waiting Years per Main Line
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Private Share of Investment in Telecoms


Electricity Losses vs. Private Investment
y = -3.2834x + 18.417
R2 = 0.0663
Electricity Production Losses
25
20
15
10
5
0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
Private Share of Investment in Electricity

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