INFRASTRUCTURE IN LAC – SOME PROGRESS, BUT NOT ENOUGH

Coverage and quality have improved for most infrastructure services in recent decades but gaps remain and ground has been lost relative to competitors. Progress has been steady if uneven across sectors and countries, as well as within countries, with rural areas lagging behind in terms of coverage. Major coverage gaps persist among the poor (both rural and urban), who also tend so suffer disproportionately when quality of service is poor. And progress has not kept up with competitors: middle income countries, East Asian "miracle" economies and China.

This dampens the region's growth and competitiveness and hampers the fight against poverty alleviation, exclusion and inequality. Recent analysis in Colombia shows that infrastructure services account for about 16% of production costs overall. While similar estimates are not available for LAC as a whole, it is clear that better infrastructure will have huge impacts on competitiveness, as well as on growth. Infrastructure is also essential in helping the poor improve their health, quality of life and ability to engage in productive activities. As a result improved infrastructure has been found to significantly contribute to reduced inequality (Calderón and Servén 2004b).

Coverage and quality have improved, but slowly

Coverage levels for most infrastructure services have improved steadily in Latin America and the Caribbean (LAC) over the last two decades. Since 1985, most countries in the region have made considerable progress in expanding access to fixed telephone lines, electricity, safe water and improved sanitation facilities. The last ten years have seen an explosion in the use of cellular telephones and the internet. Electricity generation capacity has also grown. In the transport sector, while road coverage has not changed substantially, numerous port concessions have led to substantial modernization. Only in roads has there been little change in terms of coverage. As to rail, it has actually shrunk as a number of rail companies were privatized and loss making routes closed. (Annex 1 has more details on the sectoral evolution of coverage).

However, progress has generally been slower than in other middle income countries, notably China. LAC has now fallen behind China as well as the middle income country average for major categories of productive infrastructure (electricity, roads and telephones) (table 1). Only in cellular telephony and access to safe water and improved sanitation facilities has Latin America performed comparatively well, particularly during the 1990s. This is particularly notable as Latin America as a region is wealthier than the middle income average and still substantially richer than China in per capita terms.

Table 1: Infrastructure coverage in LAC, China and middle income countries

	Access to electricity (%)	Roads (km/km2)	Mainlines per 1000 people	Cellular telephones	Water (%)	Sanitation (%)
LAC	87	0.008	170	246	89	74
China	99	0.189	209	215	77	44
MIC	90	0.06	178	225	83	61
Year	*2000*	*2002*	*2003*	*2003*	*2002*	*2002*

Source: World Development Indicators. Note that low road density in LAC is largely explained by much lower population density (26 persons/km2 vs. 43 in MICs and 137 in China) – the road density is much

lower in LAC regardless of the deflator used (population, area, GDP or any combination thereof) and whether we use total roads or paved roads. See Appendix Table 1 in Volume II for details. GDP per capita (in 2000 US$) is $983 for China, $1876 for middle income countries and $3759 for LAC.

The infrastructure gap with the seven East Asian "tigers" has widened.[5] The gap –the change in Asian infrastructure stocks per worker relative to Latin America's– grew by a huge margin over 1980-1997. Comparing simple averages for each region, the advantage of the East Asian tiger economies grew by 48% for fixed phone lines, 91% for power-generating capacity, and 53% for road length (Calderón and Servén 2003).

Quality has generally improved, but also lags behind competitors. Quality data is thinner, but generally follows the same improving trend as coverage. In the power sector, privatization of the distribution segment resulted in a reduction in distributional losses for electricity distribution from 16.7% in the three years prior to the change in ownership to 14.5% in the three years following privatization (Andres, Guasch and Foster 2005). This remains high compared to middle income countries (12%), China (7%) and the OECD (6%) although part of the difference may be due to differences in system design. Overall, a recent study of seven Latin American countries found that public infrastructure in the region (including privately owned public services) is only about 74% as effective as that of industrial countries because of poor quality (Rioja 2003). And survey data (discussed in depth below) shows that businesses consider infrastructure quality in LAC to be a problem.

Behind regional averages, performance varies greatly among countries. Some infrastructure sectors, particularly in the wealthier countries of the region, compare in quality and coverage to OECD levels while others are closer to Africa's. Less than a quarter of national roads are officially deemed in good condition in Brazil, Peru, Mexico and Nicaragua, while 80% are in Argentina. In Costa Rica, 98% of households have an electricity connection, while in Peru only 69% do. Uruguay has sixteen times more fixed telephone lines per capita than Haiti. Coverage patterns reflect not only the huge differences in income between countries but also the region's great geographical diversity. In the small densely populated island states of the Caribbean, road coverage levels tend to be higher than in larger, more geographically challenging countries.

There is also a sharp divide between rural and urban coverage within countries. For water, electricity, roads and telecommunications, coverage rates in rural areas tend to be much lower. While more than 90% of the urban population of most countries in the region have access to safe water, rural access in Brazil (58%) and Chile (59%) is worse than in several much poorer African nations such as Burundi (78%) and Zimbabwe (74%).[6] And in Colombia, one third of the rural population does not have ready access to the road network, and the average rural household lives 2.5 kilometers from an all-season road (World Bank 2004b). Given that poverty rates are usually much higher in the countryside, lower rural access rates explain much, though by no means all of the great disparity in coverage between the rich and poor in Latin America.

Urban coverage is usually extensive for most services, but rapid growth of cities has put pressure on infrastructure, and access and quality are often inadequate in poor

[5] Tigers include: Hong Kong (China), Indonesia, Republic of Korea, Malaysia, Taiwan (China), Thailand and Singapore

[6] Data is for 2002 and is from the World Bank World Development Indicators Database, using WHO and UNICEF data.

neighborhoods. LAC is the most urbanized developing region, with around 77% of its people living in cities and towns, up from 68% in 1985. The rapid expansion of many cities in recent years has strained existing infrastructure, particularly in the peri-urban areas where many migrants end up. While urban poverty rates tend to be much lower than rural ones, about half the region's poor (or around 113 million people, on World Bank estimates) live in urban areas, many of them in recently or informally settled areas that may lack basic services. Telephone access (including cellular) and sewerage and drainage tend to be the most unequally distributed services within cities (World Bank 2004c.)

Infrastructure provision tends to reflect and reinforce the region's existing poverty profile and extreme income inequality. Coverage levels are usually much higher for the fifth (i.e. richest) quintile, particularly in rural areas, as Table 2 shows for piped water connections. Only 3% of the poorest fifth of rural Paraguayans had these, against 32% of the richest quintile. And while overall urban coverage levels tend to be higher, aggregates can hide dismal coverage levels among the urban poor. Of this group only 35% had piped water in urban El Salvador, against 87% of the richest fifth.

Table 2: Piped water connections, by expenditure quintiles

		Urban - by quintile (percentage)					Rural - by quintiles (percentage)				
	Year	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Bolivia	1999	76	84	87	93	97	17	25	27	36	50
Brazil	1996/7	63	85	90	97	98	7	30	42	48	37
Chile	1998	97	98	99	99	100	30	39	41	42	40
Colombia	1997	92	97	98	98	99	50	54	58	63	70
Ecuador	1998	52	64	70	73	92	40	42	45	57	47
El Salvador	1998	35	52	66	75	87	19	27	30	41	35
Nicaragua	1998	57	75	83	89	93	13	32	42	44	53
Paraguay	1997/8	30	50	61	72	83	3	13	20	26	32

Source: PAHO (2001)

Slow infrastructure gains imply reduced growth and competitiveness

Infrastructure is critical to an economy's functioning. There is now a broad consensus among researchers around this common sense finding: an exhaustive survey of the literature by Calderón and Servén (forthcoming 2005) covering 62 papers confirms that studies that fail to cover a positive impact of infrastructure on output or a negative one on production costs have become very rare. Further, those that do cover developed, rather than developing, countries. This is consistent with another survey of 102 papers discussed in Briceño-Garmendia, Estache and Shafik (2004). Note however that the extent to which infrastructure investments translate into productive assets varies across countries with procurement efficiency, corruption, or even project selection capacity. As such, we do not expect to find a similarly robust relationship between (public) investment and growth.

Rates of return to infrastructure depend on the existing level of assets as well as their quality. As a result, the productivity of infrastructure is usually found to be higher among low and middle income countries, and decreases among high income countries (Box 1). Rates of return vary across countries and sectors but are mostly "normal". Indeed, estimated of social

rates of return from cost-benefit analysis of World Bank projects in Latin America vary from 11% to 22% depending on the sector (Briceño-Garmendia, Estache and Shafik 2004).

Infrastructure has a significant impact on growth in Latin America, both statistically and economically. Empirical analysis by Calderón and Servén (2003) finds a positive and significant contribution of infrastructure to output levels and growth in Latin America. In fact, the estimated marginal productivity of telecommunications, transport and power significantly exceeds that of non-infrastructure capital. Calderón and Servén also find that the region's slow infrastructure accumulation in the 1980s and 1990s relative to East Asia explains much of why it has also lagged behind economically: the differing evolution of infrastructure assets in Latin America and East Asia widened the cross-regional gap in GDP by some 30% over 1980-97.

Box 1: Infrastructure, productivity and growth: what the literature says

A number of studies have found empirical support for a positive impact of infrastructure on aggregate output, especially in developing countries. Overall, results suggest that the returns to infrastructure investment are probably highest during the early stages of development, when infrastructure is scarce and basic networks have not been completed. Returns on infrastructure investment tend to fall, sometimes sharply, as economies reach maturity, so that some studies of the U.S. have even found negative effects.(Briceño- Garmendia, Estache, Shafik 2004).

In a seminal paper, Aschauer (1989) found that the stock of public infrastructure capital is a significant determinant of aggregate TFP. However, the economic significance of his results was deemed implausibly large, and found not to be robust to the use of more sophisticated econometric techniques (Holtz-Eakin, 1994; Cashin, 1995; Baltagi and Pinnoi, 1995). Gramlich (1994) provides an overview of this literature.

A more recent empirical literature, mostly in a cross-country panel data context, has confirmed the significant output contribution of infrastructure. It relies on increasingly sophisticated econometric techniques to address reverse causation (infrastructure may cause growth, but growth also causes firms and people to demand more infrastructure - failure to take this into account would result in the over-estimation of the contribution of infrastructure to growth).

Notable papers include Canning (1999) using panel data for a large number of countries and by Demetriades and Mamuneas (2000) using OECD data. Roller and Waverman (2001) also find large output effects of telecommunications infrastructure in industrial countries, in a framework that controls for the possible endogeneity of infrastructure accumulation. Similar results for roads are reported by Fernald (1999) using industry data for the U.S. Calderón and Servén (2003), present a similar empirical analysis with a focus on Latin America. They find positive and significant output contributions of three types of infrastructure assets – telecommunications, transport and power.

A few papers go beyond measures of infrastructure spending and infrastructure stocks and consider the issue of infrastructure efficiency or quality. Hulten (1996) finds that differences in the effective use of infrastructure resources explain one-quarter of the growth differential between Africa and East Asia, and more than 40 percent of the growth differential between low- and high-growth countries. Esfahani and Ramirez (2002) report significant growth effects of infrastructure in a large panel data set in which the contribution of infrastructure is affected by institutional factors. Finally, Calderón and Servén (2004b) find a robust impact of both infrastructure quantity and quality on economic growth and income distribution using a large panel data set encompassing over 100 countries and spanning the years 1960-2000. They use a variety of specification tests to ensure these results capture the causal impact of the exogenous component of infrastructure quantity and quality on growth and inequality.

Source: Adapted from Calderón and Servén (2004b) with input from Briceño-Garmendia, Estache, Shafik (2004)

Improving the level and quality of infrastructure could have considerable growth payoffs. The work of Calderón and Servén (2004b) allows for an interesting thought experiment on the growth payoffs of raising infrastructure stocks and quality (Table 3). Based on their estimates, if all Latin American countries were to catch up with Costa Rica, the region's leader in terms of infrastructure quantity and quality, their long-term per capita growth gains would range between 1.4 and 1.8% per annum. Catching up with the East Asian median country, Korea, would entail even larger gains.

The investment needed would be large, but not impossibly so. LAC would need to invest 4% to 6% of GDP every year for 20 years to reach Korea's level of productive infrastructure.[7] While ambitious, this is not unrealistic.[8] Similar increases were in fact achieved by Korea (as well as China, Indonesia, and Malaysia) over the 20 year period from the late 1970s to the late 1990s. Indeed, Korea's infrastructure endowments 25 years ago were substantially worse than Mexico's, Argentina's or Brazil's at the time. And if Calderón and Servén are right, the payoffs in terms of growth and decreased inequality would be substantial.

Table 3: Potential growth improvement in LAC countries due to infrastructure development

Country	*Improvement to levels of LAC leader*			*Improvement to levels of East Asian tigers median*		
	Stocks	***Quality***	***Total***	***Stocks***	***Quality***	***Total***
Argentina	1.3%	0.4%	1.7%	2.2%	0.9%	3.2%
Bolivia	3.8%	0.5%	4.3%	4.8%	1.0%	5.8%
Brazil	1.5%	1.4%	2.9%	2.4%	1.9%	4.4%
Chile	1.3%	0.0%	1.3%	2.3%	0.6%	2.8%
Colombia	1.9%	1.2%	3.1%	2.9%	1.7%	4.6%
Costa Rica	-	-	-	1.0.%	0.5%	1.5%
Dominican Rep.	1.3%	0.1%	1.4%	2.3%	0.7%	2.9%
Ecuador	2.0%	1.0%	3.0%	3.0%	1.5%	4.5%
Guatemala	3.3%	0.4%	3.7%	4.2%	0.9%	5.2%
Honduras	3.1%	1.1%	4.2%	4.1%	1.6%	5.7%
Mexico	1.4%	0.2%	1.7%	2.4%	0.8%	3.2%
Nicaragua	3.4%	1.4%	4.8%	4.4%	1.9%	6.3%
Panama	1.4%	0.2%	1.5%	2.4%	0.7%	3.1%
Peru	3.0%	0.6%	3.5%	4.0%	1.1%	5.0%
El Salvador	1.6%	0.4%	2.1%	2.6%	1.0%	3.6%
Uruguay	0.7%	0.4%	1.1%	1.7%	0.9%	2.6%
Venezuela	1.1%	0.4%	1.4%	2.0%	0.9%	2.9%

Source: Calderón and Servén (2004)

Infrastructure is an important determinant of productivity. Infrastructure in developing countries is used in approximately equal shares by households as a final consumption item and by firms as an intermediate consumption item (Prud'homme 2004). The availability and quality of

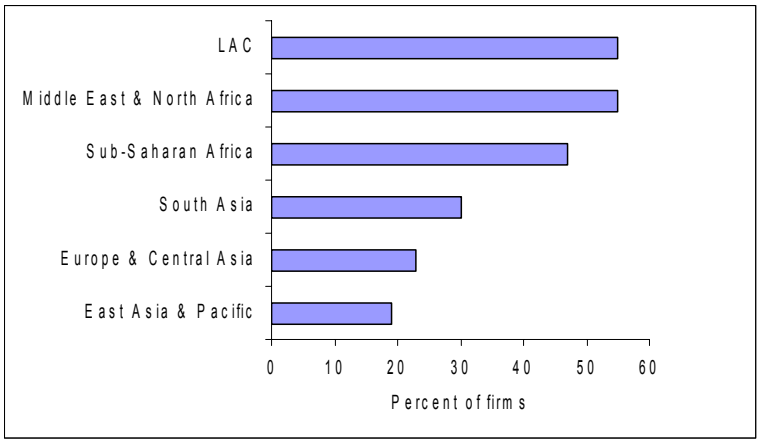
[7] This assumes a 2.7% per annum GDP growth, 1.24% per annum population growth and an alternative goal of one third the road density of Korea. Infrastructure includes telephone (fixed and cellular), electricity generating capacity and paved roads. Using overall roads as a goal, the estimated cost over 20 years is 4%, for paved roads, the needed investment is 6% per annum. See Appendix II for detailed results.

[8] However, this could not be funded by public resources alone (or would require massive reallocation of resources): public expenditures amounted to an average of about 22% of GDP in the region in 2000-2001, with total public investments around 3% of GDP.

infrastructure affects the investment climate in which firms operate. Good infrastructure contributes to making firms more productive hence more competitive internationally. At the macro-economic level, the performance of infrastructure stock influences total factor productivity (TFP), generally referred to as the only quantifiable measure of competitiveness (Krugman 1994). [9] It is also critical to countries' ability to reap the benefit of trade liberalization as infrastructure is central to the "behind the border" agenda. This is clearly topical in LAC, as trade liberalization continues to advance in many countries.

The poor performance of infrastructure variables contributes to the low ranking of Latin American countries in competitiveness indices. Several such indices, aggregating infrastructure variables, have been developed internationally. These include the World Economic Forum's Growth and Business Competitiveness Indexes and the International Institute for Management Development's (IMD) World Competitiveness Yearbook. These indices combine statistics and opinion data coming from firm surveys, to compare and rank the ability of nations to create and maintain an environment that sustains the competitiveness of enterprises. Firm surveys such as the World Bank's investment climate assessments (ICAs) also provide information on how firms perceive the environment in which they operate, notably the performance of infrastructure. As Figure 4 shows, 55% of survey respondents in LAC considered infrastructure to be a major or severe obstacle to the operation and growth of their business. That level (shared by MENA) is the highest in the world.

Figure 4: Businesses that see infrastructure as a serious problem



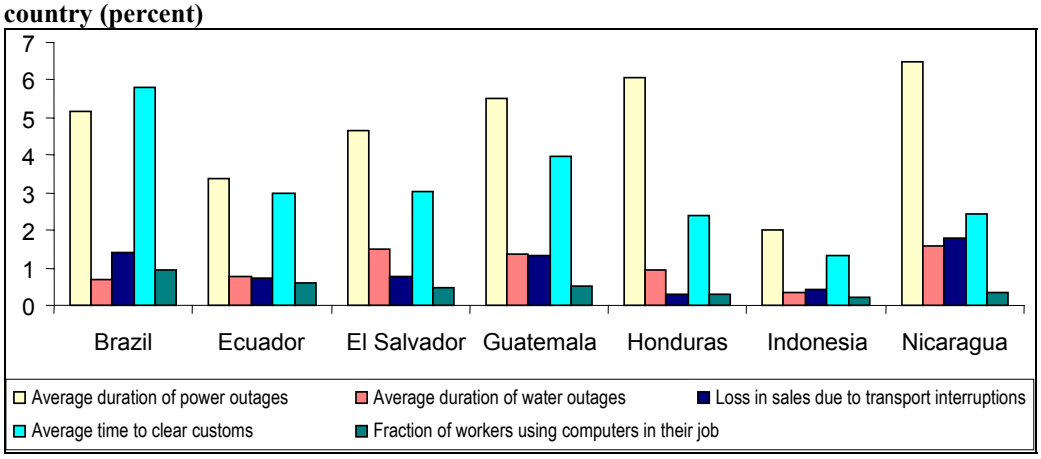
Source: World Bank 2004a based on Investment Climate Surveys data.
Note: Figure shows the share of firms that report any of electricity, telecommunications, or transportation as "major" or "severe" obstacles to the operation and growth of their business.

Latin American firms rank infrastructure as a serious problem, which negatively affects their productivity. Investment climate surveys completed in Brazil, Ecuador, El Salvador, Guatemala, Honduras and Nicaragua suggest that infrastructure is deemed a serious issue by most Latin American entrepreneurs. Indeed, an in-depth cross country analysis of the ICAs for those 6 Latin America plus Indonesia was conducted as background work for this report and confirms this finding: Escribano et al. (2005) find that infrastructure is a major determinant of TFP in the 6 LAC countries that were considered: the cumulated effect of infrastructure-related variables on

[9] TFP is defined as the residual output not explained by capital or labor. Similarly growth in TFP is the growth of output not attributable to the growth in capital or labor.

TFP adds up to about 55% per country. Infrastructure variables with the highest impact on average productivity include poor electricity and transport services (Figure 5).

Figure 5: Productivity gains from a 20% improvement in selected investment climate variables by country (percent)



Source: Escribano et al. (2005)

Poor infrastructure also affects firms' ability to export or attract foreign investments. Escribano et al. also found the poor conditions of infrastructure in Latin America to affect firms' integration into global markets. In particular, it affects the capacity of firms to export, as well as the ability of countries to attract foreign investments, thus reducing opportunities for greater international integration, higher competitiveness and enhanced technology and innovation.

Poor infrastructure also contributes to high logistics costs and requires high inventory levels in Latin America and the Caribbean. Logistics costs range from a low of 15% of product value in Chile to a high of 34%, in Peru.[10] The average in OECD countries is around 10% (Guasch 2002).[11] While part of this difference is due to the higher value relative to weight of OECD products, much of it can be attributed to differences in infrastructure quality and reliability. Poor quality and reliability require higher inventory levels. While U.S. businesses typically hold inventories of around 15% of GDP, inventories in Latin America and other developing regions are often twice that (Guasch 2004). Such levels are expensive to maintain, principally because they tie up capital which has a high cost in most of LAC. This significantly increases unit costs, diminishing competitiveness and productivity. Guasch estimates that, assuming an interest rate for financing holdings of 15-20%, the cost to an economy of additional inventory holdings is more than 2% of GDP.

[10] Logistics cost is the cost of getting products from factory to markets) is very sensitive to the quality of infrastructure, especially transport. Unreliable or inexistent infrastructure will result in higher losses in transit, the need to hold higher inventory rather than order just-in-time, and generally higher cost of transport

[11] This is partly due to the fact that high income OECD countries' exports have higher value relative to weight.

The fight against poverty and inequality has also been hampered

The recent expansion of infrastructure coverage has tended to benefit the poor but with some exceptions. As the poor, particularly in remote rural areas, are usually the last to be connected, the gradual recent expansion of services in Latin America can be expected to have benefited them more than the better off. But country data presents a mixed picture (Estache, Foster and Wodon 2002). For example, Brazil made great progress in providing water access to the lowest urban income decile between 1989 and 1996. The proportion of this group with access jumped from 53% to 74%, against a rise from 92% to 97% for the seventh decile. But in rural areas, absolute increases benefited the seventh decile more than the poorest: coverage in that group rose from 64% to 77% but only from 12% to 21% for the bottom decile. Similarly, over the same period, Mexico's electricity coverage fell slightly for the urban poorest and rural seventh deciles, barely changed for the urban seventh decile and jumped for the rural bottom decile.

Infrastructure access is critical for improving economic opportunities for the poor. As poorer individuals and underdeveloped areas become connected to core economic activities, they can access additional productive opportunities (Estache 2003). Likewise, infrastructure development in poorer regions reduces production and transaction costs (Gannon and Liu, 1997). For example, in poor rural areas infrastructure expands job opportunities for the less advantaged by reducing the costs of accessing product and factor markets (Smith et al. 2001). And infrastructure access can raise the value of the assets of the poor. Recent research links the asset value of poor farm areas - as proxied by the net present value of the profits generated by their crops —to the distance to agricultural markets. Improvements in communication and road services imply capital gains for these poor farmers (Jacoby 2000).

Evidence of complementarities across infrastructure services suggests the need to promote access to a bundle of services. Chong, Hentshel and Saavedra (2004) find that urban households with access to more than one service (e.g. water, sanitation, electricity and telephone) tend to do much better than those with only one, with the effect of multiple services being multiplicative rather than additive. Similarly, Escobal and Torero (2004), relying on rural data for Peru find a significant impact on both agriculture productivity and diversification outside agriculture. Both sets of studies address the issue of reverse causality (richer people buy more infrastructure services) so that the net effect they estimate does argue in favor of bundling infrastructure services for the poor, in order to maximize their impact on rural households' incomes.

Improved infrastructure also affects the health and education levels of the poor. For health, access to clean water and sanitation is clearly fundamental. Diseases from drinking contaminated water and a lack of safe water and sanitation for household hygiene are among the main causes of child mortality (World Health Organization 2002). In Argentina, a recent study by Galiani et al. (2005) finds that child mortality fell by 8% in areas which had privatized water utilities (and hence experienced improved coverage and quality), with most of the reduction occurring in low-income areas where the water network expanded the most. More generally, Fay et al. (2005) find that allowing the poorest quintile in developing countries the same access to basic services as the richest would reduce child mortality by 8% and stunting by 14%. There are other, less obvious, linkages (explored in Brenneman 2002). Improved transport facilitates access to healthcare, as well as easier staffing and operation of clinics. For girls, enrollment is also helped by greater access to piped water, which would otherwise have to be fetched. Electricity also allows more time for study, while the positive health impacts of clean water allow more time in the classroom.

Perhaps as a result, improved infrastructure reduces income inequality. Calderón and Servén (2004) find a significant impact of infrastructure access and quality on overall inequality. This is particularly important for two reasons: (i) Latin America is the most unequal region in the world, with a Gini coefficient estimated at 50.5; (ii) reducing inequality is very difficult. Indeed, Latin America's Gini has hovered around 50 for at least the last 25 years (De Ferranti et al. 2004). Calderón and Servén's work suggest that if Latin American countries raised their infrastructure stocks and quality to the levels of the region's leader, Costa Rica, their Gini coefficients would fall by between 0.02 and 0.10 (Table 4) Catching up with the East Asian median country, the Republic of Korea, would entail drops of 0.05 and 0.13. These are significant changes.

Table 4: Changes of inequality (Gini coefficient) in LAC countries due to higher infrastructure development

Country	Improvement to levels of LAC leader			Improvement to levels of EAP median		
	Stocks	Quality	Total	Stocks	Quality	Total
Argentina	-0.03	-0.01	-0.03	-0.05	-0.02	-0.06
Bolivia	-0.08	-0.01	-0.09	-0.10	-0.02	-0.12
Brazil	-0.03	-0.02	-0.06	-0.05	-0.03	-0.09
Chile	-0.03	0.0	-0.03	-0.05	-0.01	-0.06
Colombia	-0.04	-0.02	-0.06	-0.06	-0.03	-0.09
Costa Rica	-	-	-	-0.02	-0.01	-0.03
Dominican Rep.	-0.03	0.0	-0.03	-0.05	-0.01	-0.06
Ecuador	-0.04	-0.02	-0.06	-0.06	-0.03	-0.09
Guatemala	-0.07	-0.01	-0.08	-0.09	-0.02	-0.11
Honduras	-0.07	-0.02	-0.09	-0.09	-0.03	-0.12
México	-0.03	0.00	-0.03	-0.05	-0.01	-0.06
Nicaragua	-0.07	-0.02	-0.10	-0.09	-0.03	-0.13
Panama	-0.03	0.00	-0.03	-0.05	-0.01	-0.10
Peru	-0.06	-0.01	-0.07	-0.08	-0.02	-0.10
El Salvador	-0.03	-0.01	-0.04	-0.06	-0.02	-0.07
Uruguay	-0.02	-0.01	-0.02	-0.04	-0.02	-0.05
Venezuela	-0.02	-0.01	-0.03	-0.04	-0.02	-0.06

Source: Calderón and Servén (2004)

In sum, coverage and quality of infrastructure has improved in Latin America over the last decades, but not enough. The result is that the region has lost ground relative to peers or countries whose economic success could be emulated and has become less competitive. It also has meant less progress than could have been possible in reducing poverty and improving the standard of living and economic opportunities of the poorest. The next section turns to some explanations for this somewhat disappointing performance.