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## **Infrastructure in Latin America: Achieving High Impact Management**

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# Infrastructure in Latin America: Achieving High Impact Management<sup>1</sup>

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## 1. Introduction

Infrastructure is key for a society's development. Basic services such as transportation, electricity, telecommunications, water and sanitation affect both the conditions under which productive activities take place and families' quality of life. Improving the quantity and quality of infrastructure is therefore not only fundamental for a society's welfare, but also an important challenge in terms of public policy.

The term "infrastructure" is commonly used to identify a variety of durable goods that share a set of common characteristics, such as the fact that consumption by an individual does not exclude that of others, high fixed costs, and the fact that the larger the number of consumers the lower the operating costs (i.e. network effects). These elements cause market failures and create conditions of natural monopoly that require government intervention and create a challenge in designing public policies for infrastructure provision.

Economists agree that infrastructure plays a role in growth, although the nature and scope of that role is still very much debated. The consensus that appears to emerge from the literature is that infrastructure matters for growth, but the relationship varies across countries, over time, and between sectors<sup>3</sup> (Estache and Fay, 2007). A minimum level of infrastructure is essential for a modern economy, and that minimum level tends to rise in line with a country's per capita income. Without this basic level of infrastructure not only is welfare negatively affected, but resulting bottlenecks hamper a country's growth possibilities (Tanzi, 2007).

Improving the stock of infrastructure, both in terms of quantity and of quality, is a priority for countries of Latin America. Such improvements take on added relevance in a context of structural weaknesses in the region, which include a growing productivity gap with respect to the rest of the world, a fall in relative participation in world trade and an entrenchment of social and geographic inequalities within the region. In Peru, for example, energy demand has accelerated beyond generation capacity, creating congestion in electric transmission lines and natural gas networks. Other countries in the region face similar bottlenecks that limit the sustainability of economic growth.

Latin America has made important advancements in the provision of infrastructure services, but continues to lag behind other developed and developing regions. Furthermore, improved access hides large differences across regions, between urban and rural settings, and across income groups. Finally, quality of service has often not accompanied increased access.

Latin American governments have consistently faced severe obstacles in funding much needed infrastructure investments. In the nineties, this situation led to a

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<sup>3</sup> Romp and de Haan (2005) and Briceño *et al.* (2004) carry out extensive reviews of papers that study the link between infrastructure and growth and find that the majority point to a positive impact of infrastructure on growth, especially in the case of developing countries.

reassessment of the traditional model of public provision of infrastructure and related services, and increased participation of the private sector. In particular, Public-Private Partnerships (PPPs) in the provision of infrastructure services have increased substantially. But private participation in infrastructure and the provision of its services has had mixed results. While private participation remains a valuable instrument for infrastructure investment, improvements in contract design and in the associated regulatory and institutional framework would allow for increased social and economic benefits.

A precondition for effective infrastructure investment is efficient strategic planning and evaluation based on high quality information. In this regard, more study is needed on the channels through which infrastructure affects productivity, growth and welfare. In particular, there is a need for increased, and better quality, impact evaluations of infrastructure projects, to serve as a basis for decision making in the planning stage and to assist in the allocation of public resources. Unfortunately, the underlying characteristics of infrastructure, in particular its close relationship with location, make it difficult to determine counterfactuals and identify the true impacts of investment.

Improving infrastructure in Latin America requires, from the policy perspective, an appropriate combination of incentives for private participation, suitable regulatory frameworks, and proper planning and coordination, at both the sector and territorial level. In particular, a public sector capable of planning, evaluating, regulating and overseeing infrastructure investments, both public and private, is required, as well as adequate coordination with the private sector.

The rest of the paper is structured as follows. Section two considers the channels through which infrastructure affects development. Section three provides an overview of the state of infrastructure in Latin America. Section four discusses policy recommendations for improved infrastructure management in the region. Finally, section five presents some concluding remarks.

## **2. Understanding the Channels Linking Infrastructure and Development.**

Infrastructure affects a country's development essentially through three channels: enhancing productivity of firms and industries, expanding opportunities of internal and international trade, and improving the quality of life of households through access to public services.

With respect to the first channel, empirical evidence – although limited – points to a positive effect of infrastructure on productivity.<sup>4</sup> Furthermore, this positive effect is potentially non linear, given the presence of strong externalities and network effects.

For example, improvements in the capacity and distribution of electricity promote a stable and high quality supply which may allow for the use of more sophisticated machinery in various productive sectors and the reduction of costs associated to firms' need for self-supply. The positive effects of investments in transportation infrastructure are particularly pronounced in industries that use vehicles intensively (Fernald 1999)<sup>5</sup>. The case of telecommunications technology is more complex, given that its impact on productivity is not limited to its use as a technological productivity improving input, but is enhanced by its role in the creation of information

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<sup>4</sup> See for example Aschauer (1989), Biehl (1986), Munnell (1990, 1992), and Ahmed y Miller (2000).

<sup>5</sup> In the case of the United States, Fernald (1999) finds that roads contributed to a 1.4% productivity increase before 1973, and 0.4% afterwards. This also reflects the nonlinearity of infrastructure effects. Using data for Colombia, Cárdenas and Sandoval (2008) find that a 1% increase in road density increases firms' total factor productivity by 0.8%.

networks that reduce transaction costs and increase firms' organizational efficiency. (Duggal *et al* 2007)<sup>6</sup>

For infrastructure to maximize its positive impact on productivity, it is important that once constructed it continue to operate efficiently. Evidence points to a positive relationship between the level of efficiency with which infrastructure is managed and its impact on growth (Hulten 1996). This leads to an important policy implication: the need to dedicate more resources to infrastructure maintenance and to choose appropriate policies of infrastructure use and management to avoid congestion.

The relationship between infrastructure and trade has become increasingly evident as the lowering of tariff and non tariff barriers has revealed the importance of transportation costs in limiting real access to export markets. In the case of Latin America, the reduction of transportation costs would have more significant effects on trade than a further reduction in tariffs, due in part to the success of trade liberalization in the region (Blyde *et al.* 2008). Besides geographical characteristics of the region, infrastructure – in particular the state of the region's roads, ports, railways and airports - is a key determinant of transportation costs.

Transportation costs are also closely tied to other logistic costs, such as inventory costs, that also represent an important obstacle to trade in Latin America. According to Guasch and Kogan (2005), in 2004 average logistic costs in Latin America represented twice those of OECD countries.

The third channel through which infrastructure affects development is associated with its impact on quality at the household level and its effect on social inclusion. Countries in Latin America continue to be characterized by high levels of poverty and income inequality. Increasing access to basic infrastructure services, such as water, sanitation and electricity are key elements for increasing the quality of life of the region's poor. Access to water and sanitation improves health conditions and frees time for more productive activities (including education). Access to electricity allows access to information, the possibility of heating water and keeping food cold, and illumination extends the number of hours dedicated to productive activities. Access to gas allows for lower cooking and heating costs, freeing scarce resources for other uses. Finally, better roads reduce travel time to schools, health centers, and work opportunities.

Finally it should be mentioned that the relationship between infrastructure and development is clearly two-way. As seen above, infrastructure reduces transaction costs, promoting both production and international trade, and improves access to services that enhance quality of life. At the same time, as a country's level of production and income increases, demand for various types of services linked to infrastructure also increases. New investments in infrastructure can create new opportunities or, in their absence, create bottlenecks and reduce the productivity of factors such as land and physical and human capital.

### **3. Infrastructure in Latin America: Where We Stand**

Improving the stock of infrastructure, both in terms of quantity and of quality, is a priority for countries of Latin America. Important infrastructure bottlenecks are increasingly apparent, creating obstacles to trade and economic growth. Problems associated with congestion and inadequately maintained infrastructure threatens the region's competitiveness and have contributed to the decline of Latin America's participation in world trade. Quality of life of the region's inhabitants can also be

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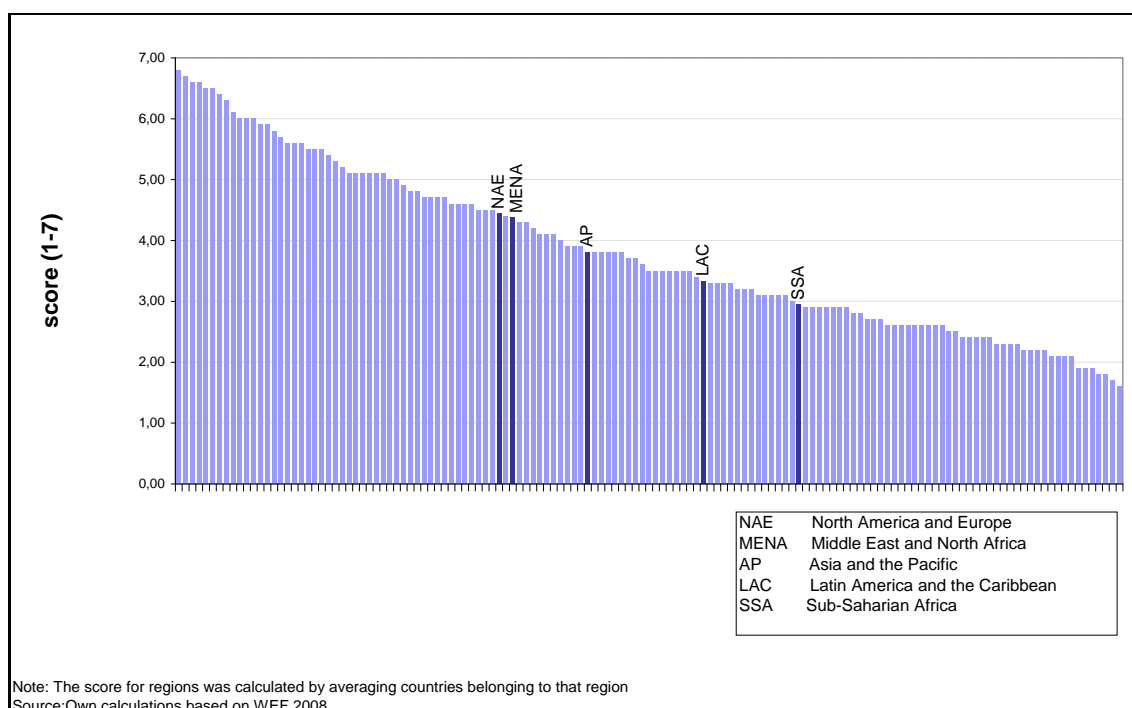
<sup>6</sup> For example, Jorgenson *et al* (2008) find that in the US investment in telecommunications explained approximately 80% of the labor productivity of the sector, and 59% of that of the entire economy, over the period 1995-2000.

affected directly by improvements in infrastructure that provides basic services. Empirical evidence has shown that the level of infrastructure is a key determinant of long term economic growth in Latin America, and that an increase in the stock of infrastructure would have significant effects on the region's growth rate (Calderón and Servén, 2004).

Poor infrastructure contributes to the region's low performance in international competitiveness indexes and hinders the inflow of FDI. According to the World Economic Forum's most recent "Global Competitiveness" report, most countries in the region rank consistently in the bottom half of the sample with respect to overall infrastructure quality, with average Latin American ranking well below East Asia and North Africa and the Middle East, as is evident from Figure 1.

**Figure 1: Quality of overall infrastructure by country and region**

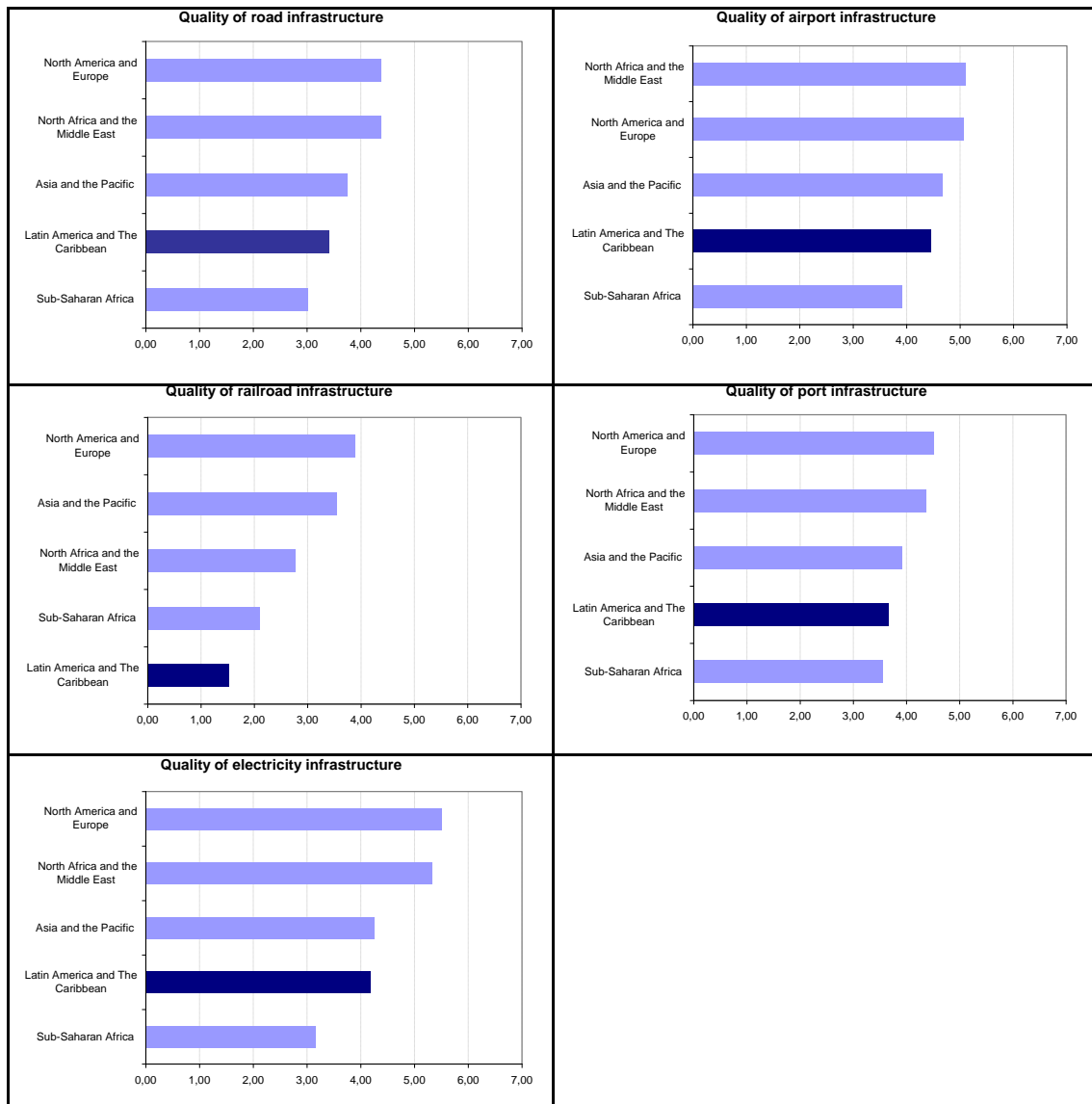
(1 to 7 scale, with 1=underdeveloped and 7=as extensive and efficient as the world's best)



Latin America's poor infrastructure performance is even more evident if one considers individual sectors. Figure 2 shows the Global Economic Forum competitiveness scores by infrastructure sector for different geographic regions, with 1 being the lowest and 7 the highest score. Latin America consistently scores behind all regions except South Saharan Africa, except for the case of railroads, where Latin America scores worse. Only in the case of electricity does Latin America score comparably to Asia and the Pacific.

**Figure 2: Quality of infrastructure by sector and region**

(1 to 7 scale, with 1=underdeveloped and 7=as extensive and efficient as the world's best)

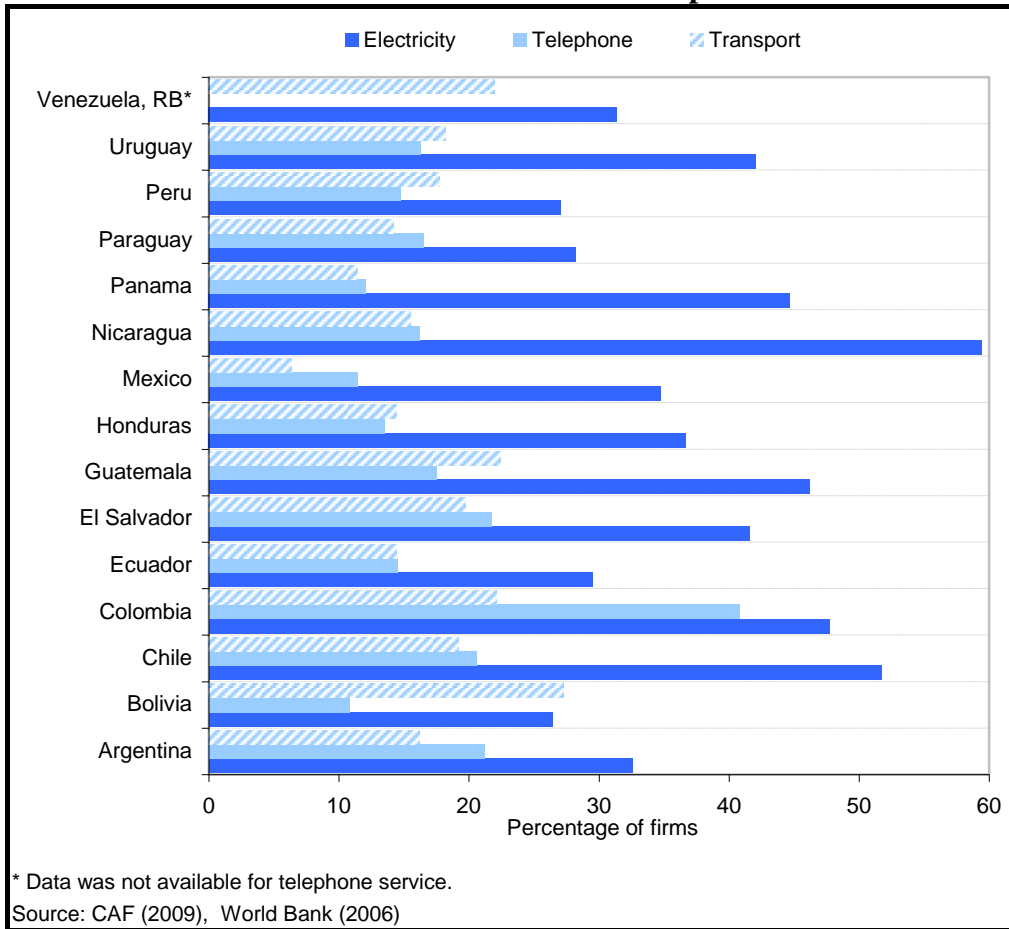


Note: Scores for regions was calculating by averaging countries belonging to that region  
 Source: Own calculations based on WEF 2008

Business surveys indicate a general perception that problems associated with infrastructure supply and quality constitute an important obstacle to firms' activities and growth potential. In particular, over 50% of firms that operate in Latin America consider infrastructure a problem, the highest proportion of any world region (World Bank 2006). Figure 3 allows us to breakdown the analysis by type of service and by country. One can see that problems related to electricity services are considered obstacles by the largest percentage of firms across all countries. For example, 60% of firms in Nicaragua and approximately 50% of firms in Chile and Colombia indicate that electricity services constitute a serious or very serious obstacle to firm operations. There appear to be less problems associated with telecommunications and transportation, nonetheless almost 40% of firms surveyed in Colombia consider telecommunications an obstacles, while approximately one fourth of firms in Bolivia, Guatemala and

Venezuela, RB consider themselves adversely affected by problems associated with transportation infrastructure.

**Figure 3: Percentage of firms in Latin America that consider infrastructure a serious obstacle to their operation**



With respect to access to basic infrastructure services, Latin America has made important advances, but such advances have been slow and uneven across regions and income groups. Table 1 shows improvement in infrastructure coverage in Latin America over the last 15 years. Regional averages however conceal important variations across countries. In the case of sanitation, for example Bolivia is well below the national average, with only 46% of the population with access to improved sanitation (CAF 2007).

**Table 1: Access to infrastructure services, by region**

Region	Improved sanitation facilities (% of population with access)		Improved water source (% of population with access)		Telephone mainlines (per 100 people)		Electrification rate (% of households with access to electricity)	
	1990	2004	1990	2004	1990	2004	1990	2005
Europe & Central Asia	83,6	85,0	91,7	91,7	12,4	24,8		100,0
Latin America & Caribbean	67,3	77,0	82,8	90,9	6,0	17,2	70,0	90,0
Middle East & North Africa	69,9	76,2	87,5	89,5	3,4	12,6	61,0	78,0
East Asia & Pacific	29,7	50,6	71,8	78,5	0,8	18,8	56,0	88,5

Source: IEA 2007

Improvements in access have not benefited different income groups in the same way. As one can see from Table 2, as income declines so does access for all basic services. Furthermore, in general it holds that the lower the overall level of coverage, the greater the income inequality of service.

**Table 2: Access to infrastructure in Latin America, by income quintile**

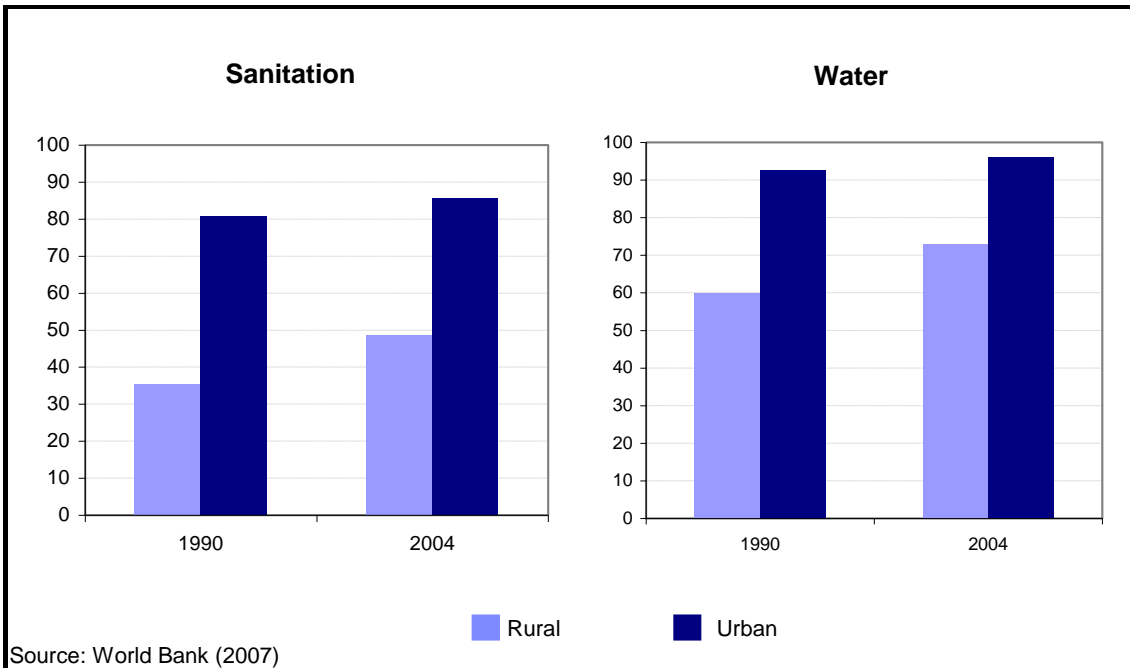
Service	Per capita household income					Average
	1 (lower)	2	3	4	5 (higher)	
Access to water in property	77	83	87	90	94	87
Access to public sewage	36	45	55	65	78	58
Toilet connected to sewage system	45	54	64	74	84	66
Access to electricity	86	90	93	95	98	93
Telephone mainlines	25	34	44	58	75	49

Source: Own elaboration based on CEDLAS (2007).

Aggregate data also hides the considerable difference between access to basic services in rural and region areas, as is evident from Figure 4. Although the percentage of population with access to improved water sources has increased from 67% in 1990 to 77% in 2004, only 73% of rural population had access, compared to 96% of urban population (World Bank 2007). This bias is even more pronounced in the case of sanitation.



**Figure 4: Percentage of rural and urban population with access to improved water sources and sanitation facilities in Latin America and the Caribbean**



Furthermore, increased access to basic services has often not been accompanied by improvements in service quality. One way of measuring service quality is *reliability*, whether households can count on a service being provided in a reliable manner. Table 3 presents measures of declared satisfaction by households for various basic services, where the level of satisfaction can be considered a function of the quality of service. This data is based on a survey on infrastructure services conducted by CAF in 16 Latin American cities (CAF 2008).

The case of water is particularly interesting, given that in urban settings access is currently very high. Although in most cities households with direct access to water also display high levels of reliability, in some cases (such as those of Caracas and Maracaibo) water service is very unreliable, with over 55% of households in Maracaibo reporting not receiving water everyday.

**Table 3: Quality indicators for selected cities in Latin America (percentage of households) <sup>7</sup>**

City	Water	Electricity	Gas	Telephone mainline	Mobile phone	Internet	Waste collection
Buenos Aires	98,0	76,3	99,0	81,7	76,3	71,2	99,7
Córdoba	97,7	63,8	100,0	90,2	63,8	72,2	98,2
La Paz	98,9	86,3	n.a	92,4	69,4	64,0	92,8
Santa Cruz	100,0	88,1	n.a	92,3	77,4	77,3	82,4
Río de Janeiro	99,7	86,8	n.a	80,9	78,3	60,4	99,7
San Pablo	92,9	89,2	n.a	87,0	90,7	77,5	100,0
Bogotá	99,5	89,7	98,5	88,2	94,6	82,2	95,3
Medellín	100,0	97,2	98,4	98,0	84,4	71,3	98,2
Quito	99,0	75,4	n.a	91,3	75,0	34,2	96,3
Guayaquil	100,0	86,1	n.a	90,7	83,2	73,7	95,7
Lima	99,4	86,5	n.a	82,3	75,1	58,6	90,7
Arequipa	98,1	82,4	n.a	84,8	67,6	69,0	82,0
Montevideo	100,0	94,2	n.a	98,5	86,6	77,6	96,9
Salto	98,9	94,7	n.a	97,3	87,0	90,0	99,5
Caracas	81,1	90,6	98,9	96,4	89,5	69,8	97,4
Maracaibo	44,2	90,5	94,0	96,2	84,9	81,4	39,4
<b>Weighted Average</b>	<b>95,6</b>	<b>85,3</b>	<b>98,8</b>	<b>87,0</b>	<b>81,6</b>	<b>70,0</b>	<b>94,9</b>

Source: CAF (2008).

Another dimension of the problem is linked to the process of urbanization in Latin America. According to Habitat, the United Nations agency for human settlements, in the last decades Latin America has experienced a process of “premature urbanization”. In fact, in many cases urbanization in the region has been the product of an accelerated process of migration from rural areas to the cities due to poverty or insecurity resulting from armed conflicts. The cities of Latin America often were not prepared to receive this wave of immigration, with its new supply of labor and demand of basic services. Furthermore, this immigration has not been accompanied by programs of urban planning that would allow these immigrants acceptable living conditions. The result has been marginalized areas of poverty within the big cities, characterized by high population density, inadequate public services and high levels of insecurity (Escobal and Ponce 2007).

In synthesis, Latin America has achieved some important advances with respect to both stock and quality of infrastructure. Nonetheless, the region continues to lag behind other developing countries and has not managed to close the gap with respect to more developed countries. Furthermore, aggregate numbers hide large variability across countries, income levels, and between rural and urban area, and quality has not kept up with improved access.

The analysis of infrastructure in Latin America is incomplete without an overview of the patterns of infrastructure financing in the region. Over the last decade, infrastructure investment has fallen considerably in most of the region’s countries (see

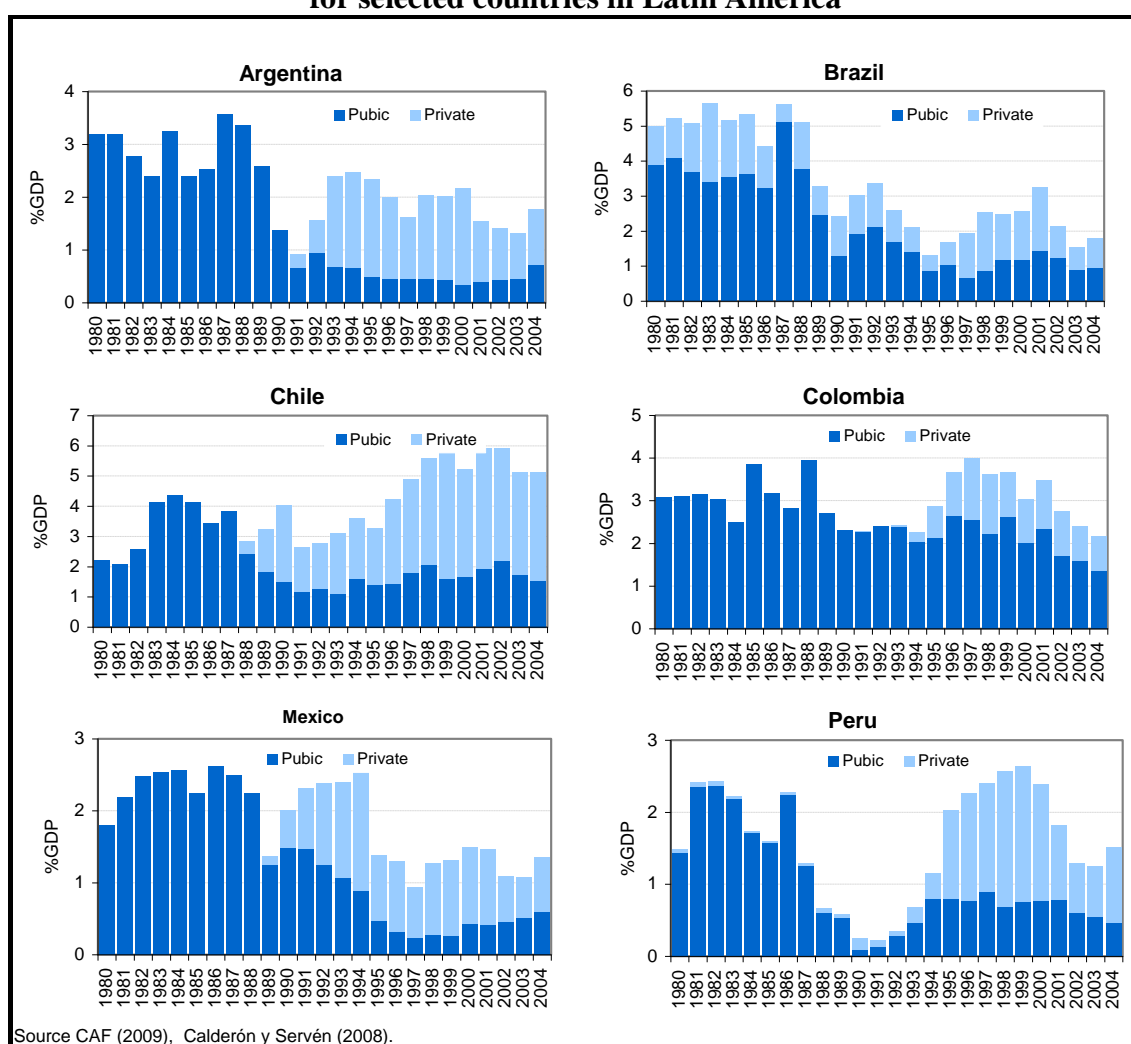
<sup>7</sup> Quality, or reliability, is measured according to whether the household reported the following: for water, receiving water every day; for electricity, never – or almost never – experiencing electricity shortages; for gas, never or almost never experiencing problems with the service due to problems outside the family’s control; for telephone mainlines, mobile phone and internet services, no interruptions for reasons out of their control. In the case of waste collection, the service is reliable if waste is collected more than once a week.

Figure 5). In fact, total infrastructure investment in the region has fallen from a weighted average<sup>8</sup> of 3.6% of GDP in 1980-84 to 1.9% of GDP in 2000-04.

An important characteristic of infrastructure investment in Latin America has been an increase in private sector participation, and the fall in public investment. Nonetheless, as we can see from Figure 5, in most countries the increase in private investment was not sufficient to offset the fall in public investment (with the exception of Chile). This suggests that the public sector continues to play a key role in infrastructure investment and management.

This fall in infrastructure investment explains in part the bottlenecks and congestion observed in many infrastructure related services and the problems of access and quality of service experienced by many lower income households.

**Figure 5: Public and private investment in infrastructure as a percentage of GDP for selected countries in Latin America**



<sup>8</sup> We consider a weighted average over GDP for six Latin American countries: Argentina, Brazil, Colombia, Chile, Mexico and Peru.

#### **4. How to Improve Infrastructure Management in Latin America**

As the previous section has illustrated, deficiencies in the stock and quality of infrastructure represent an important obstacle to economic and social development in Latin America. A more comprehensive diagnosis of the situation requires the examination of the mechanisms and institutions that govern the supply and operation of infrastructure. Infrastructure management consists essentially of three components: the provision of new infrastructure, maintenance of existing infrastructure, and the policies that govern its administration and use. Investment in new infrastructure has been the area that usually received more attention, in part due to the need to expand and upgrade services, but also because of its greater visibility. Maintenance of existing infrastructure, notwithstanding its lower relative costs and evident complementarities with the installation of new infrastructure, has often been given lower priority in Latin America. This is due both to its lower political value and also because it is often more difficult to secure financing within traditional public works' designs. Finally, infrastructure administration includes policy that govern the use of existing infrastructure, such as quantity or price-based rationing. Infrastructure policy should be thought of as a portfolio of initiatives in each of these areas, taking into account relative costs and benefits with the understanding that intervention in each of the areas is important for a successful infrastructure policy.

Increasing the impact of infrastructure investment in the region requires advances in two key areas. Firstly, a more systematic and methodologically sound approach to impact assessment of infrastructure projects, as an input to the decision making process. Secondly, a more efficient infrastructure management that combines adequate incentives for private participation, a sound regulatory framework, and territorial and sector specific planning and coordination. These two issues will be discussed in the following two subsections.

##### *4.1. The need for high quality impact assessments of infrastructure projects.*

A fundamental requirement to improve the supply of infrastructure and increase the efficiency of infrastructure related policies is to improve the quality of information surrounding infrastructure projects and policies. In particular, there is an urgent need for systematic and high quality impact assessments of infrastructure projects so that we can measure the effects of such projects on welfare and development. Studies that evaluate the actual economic and social impact of infrastructure policies, subject to high scientific standards, would serve to better guide the decision making process, with respect both to sectors and type of policy intervention (new investment, maintenance or administration of existing facilities). Furthermore, high quality impact assessment studies could help improve the quality of information used in *ex ante* evaluations of infrastructure projects, which are often a prerequisite for their approval and financing.

A crucial feature of an impact evaluation is the use of a counterfactual, which identifies what would have happened to the beneficiaries absent the infrastructure program or policy. So besides information on the group directly affected by the intervention or policy (the "treatment group"), one also needs information over a "control group" - a similar group, not affected by the policy, to establish a counterfactual scenario of how things would have been without the intervention.

There are various cases of social policies (such as programs for food subsidies, employment, etc) where it has been possible to do solid impact assessments. In the case of infrastructure investments, however, it is highly likely that the project's characteristics be strongly correlated to the characteristics of the project site, given that in general infrastructure projects respond to a locality's specific needs and traits.

Furthermore, infrastructure projects often involve the use of large quantities of resources that cannot be replicated elsewhere, making it very difficult to find a control group in a geographically comparable location. Rigorous impact evaluation in this context is extremely difficult, which explains the dearth of this type of analysis for infrastructure projects. Sidestepping this situation would require finding creative solutions for mechanisms to be included in infrastructure projects as a way to gather new information, or even designing interventions in a way that would facilitate an initial evaluation.<sup>9</sup> Box 1 gives an example of an impact evaluation performed for a project of extending households' connections to the natural gas network in Buenos Aires, taking advantage of the exogenous characteristic of the program's allocation mechanism which make it a "natural experiment" (Goytia et al 2008).

### **Box 1: The connection to natural gas network in Buenos Aires**

In Buenos Aires, for many low income households the connection to the natural gas network is not possible due to high fixed (installation) costs and the requirement of deeds (often non-existent). Families must therefore resort to bottled gas, of lower quality and more expensive. For private firms providing the service, it is also risky to connect these households to the network without having accurate estimations of their future demand for the service. So it is basically a failure of credit markets that prevents lower income households from enjoying network gas services.

To overcome this failure, a new mechanism involving private firms operating the gas service, municipalities and community participation was implemented. In the municipality of Moreno, such a mechanism was "Redes Solidarias", which consisted of extending the main network up to 150 meters from each block in each *barrio*, and then, connecting each block to the network once at least 70% of the households on it had agreed to contract the connection. Local community organizations in each *barrio* and block were responsible for advertising the benefits of being connected to the network, since only with ample participation could economies of scale materialize into savings for each family. The financing plan was simple: households would keep paying roughly the same amount they destined to bottled gas prior to the Plan, but since the network gas was cheaper, the leftover surplus would cover the connection fees in 24 to 36 months, at which time families would start saving money on their gas expenses. The extension of the external network (that is, connecting the *barrio* to the main network) was financed with funds from World Bank, the municipality, The National Fund for Social Capital (FONCAP for its Spanish acronym) and the Fundación Pro Vivienda.

Goytia *et al* (2008), through a "natural experiment" were able to evaluate the impact that the program had on house improvement, health and satisfaction indicators on the 8000 households that were connected to the network through this program. The experiment consisted in evaluating both a treatment group and a control group of blocks from the *barrio*, which were separated in the first stage of the program by technical and geographical considerations, since due to distance to the main pipeline the control group was not connected at the earlier stage.

Their results show that connection to the gas network had impacts on housing quality, health and satisfaction indicators. Regarding house infrastructure, there is evidence of positive effects on walls and floors improvements, and the installation of hot water system in bathrooms. For health indicators, houses that were connected to the

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<sup>9</sup> It is important to underline that the difficulties associated with impact assessments of infrastructure, as described above, are most relevant for projects of new infrastructure, and much less so for projects of infrastructure maintenance or administration.

network also show lower incidences of respiratory diseases, flu and, especially, gastrointestinal diseases. Finally, a survey to estimate individuals' satisfaction with their home, found an improvement of between 0,26 to 0,45 points (in a 1 to 10 scale) for homes connected to the gas network.

The findings in Goytia *et al* (2008) not only support the fact that infrastructure matters for quality of life, but they also stress the importance of careful planning and organization between stakeholders in order to allow services to reach poor households.

Fuente: Goytia *et al.* (2008)

Impact evaluations that focus on the effect of infrastructure investments on the productivity of firms and industries are complicated by the nonlinear effects associated with infrastructure networks and congestion. In the first case, the fact that infrastructure services are often part of a network and therefore associated with important economies of scale entail that a positive – and potentially nonlinear – effect on the economy's productivity may result. For example, if the stock of infrastructure is low, and network effects are limited, the productivity effect of new investment will be low. However, once the network capacity of infrastructure reaches a certain threshold, the marginal productivity of new investment increases markedly. Furthermore, once infrastructure networks are very developed, the rate of return of new infrastructure falls (Hurlin 2006).

On the other hand, as a certain infrastructure starts to experience congestion in its use, its capacity to provide services will fall, with a negative effect on productivity (Fernald 1999, Cardenas and Sandoval 2008). Policies to manage congestion potentially have the same effect as an increase in capacity and often, if based on adequate planning and regulation of use, require limited resources. These different policies will affect the infrastructure's ultimate impact on productivity.

#### *4.2 Towards a more efficient infrastructure management*

There is no blanket solution for improving the provision of infrastructure services in Latin America. Improving both the quality and the supply of infrastructure in the region requires an appropriate combination of incentives for private participation, suitable regulatory frameworks, and proper planning and coordination at both the sector and territorial level. Such a system of infrastructure management would allow individual infrastructure projects to adjust more fully to specific needs, with a greater likelihood of sustaining a supply of high quality services over time. To understand and evaluate the various forms of infrastructure management it is necessary to consider the special characteristics of infrastructure and its related services.

Infrastructure investment differs from other kinds of investment for a number of reasons. In the first place, there are large sunk costs involved, meaning that assets cannot be destined to other activities, or can be redirected only at a high cost should market conditions change. Second, inherent network characteristics (the fact that costs decline with the number of consumers), together with the significant upfront costs, often entails increasing returns to scale, making it inefficient to have more than one provider of the service. These characteristics often imply that the service be offered under conditions of natural monopoly. Finally, infrastructure often provides basic services necessary for minimum standards of quality of life. Hence, its provision had traditionally fallen on public hands (Guasch 2004).

As we saw in section 3, over the last two decade private participation in infrastructure investment in Latin America has increased notably, with respect to both financing and operation. Private participation in the provision of infrastructure services

in the region has taken a variety of forms. In the nineties privatization was common, as was the charging of user fees (as in the case of the telecommunications and energy sectors). From the end of the nineties private participation has increasingly taken the shape of Public-Private Partnerships (PPPs), a variety of possible contractual arrangements between the public sector and private whereby the private sector assumes the commitment to build, operate and maintain infrastructure over a period of time, usually 20 to 25 years.

A common argument in favor of PPPs is that private participation allows the infrastructure project to be more efficient, given that private firms seek to maximize a project's profitability, while the public sector is often motivated by different objective. Nonetheless, it is important to keep in mind that private firms' profit-seeking behavior could result in social welfare losses. A well designed contract can align profit-seeking incentives with social welfare, providing an improvement over public provision.

More importantly, PPPs often entail *bundling* of the construction and operations phases of the project, i.e. the different phases of the project are the responsibility of the same firm, which allows for the internalization of cost-reducing incentives. For example, if the firm responsible for building the infrastructure is also responsible for operation and maintenance, the firm will be inclined to invest in technology that reduces operating costs over the projects life cycle.<sup>10</sup> In this way PPP can also contribute to improving infrastructure maintenance. In fact, if a PPP contract includes both construction and maintenance, it will create incentives for improved preservation of the infrastructure.<sup>11</sup>

Notwithstanding the increase in private sector participation in infrastructure in Latin America, it is important to underline that the public sector should continue to be a main player in this arena, increasing the amount of funds dedicated to infrastructure investment. Estache (2005) notes that although Latin America recorded a massive \$361 billion in private infrastructure investment between 1990 and 2001, the largest volume recorded for any region, this only covered between 25 and 33% of the region's annual investment needs. Infrastructure continues to be an area where the public and the private sector must work together.

A key component of PPP contracts is risk allocation. Without a suitable allocation of risk, the benefits of PPPs can be notably reduced. In the past, governments in the region have often assumed too large a share of the risks associated with infrastructure projects, resulting in an excessive fiscal cost, reducing firms' incentives to operate efficiently and promoting opportunistic behavior. Two basic principles should guide risk allocation: 1) the party responsible for the risk (or which has more control over it) should bear it, and 2) risk should be allocated to the less risk-averse party, or the one with lower risk-aversion (Guasch 2004). When the less risk-averse party is also the one responsible for the risk, the solution is trivial, but this is often not the case. In practice, given that part of the risk is often endogenous to the contract, risk should be shared so as the marginal loss associated to shifting risk from one party (for example the government) to another (for example a private firm) equal the marginal gain associated to the increased effort of the latter to reduce the probability of an undesirable event (for example, higher costs) (Dewatripont and Legros, 2005).

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<sup>10</sup> For example, if the same firm builds and operates a bridge, it could be induced to invest in a technology that, while maintaining the security of the structure, reduces pressure on the beams, reducing maintenance costs (Dewatripont and Legros, 2005).

<sup>11</sup> Such incentives can be strengthened if the contract calls for service payments tied to the maintaining the infrastructure in good order (Yescombe, 2007).

The size and complexity of risks associated with PPPs and with infrastructure projects in general, and the difficulty in many cases of distinguishing which party has greater control over risks, complicates risk allocation in PPP contracts, and entails that investors often require some type of government guarantee. A first step towards improving risk allocation in PPPs is designing better guarantees, –how risks and their associated guarantees are measured and included in the public budget– which in turn would allow for more informed decisions. In fact, when guarantees are not properly valued, governments tend to undervalue their costs, and pass them on to future administrations. (Thobani, 1999).

Reducing project risk would also go a long way towards improving PPP contracts. Experience – both inside and outside the region – has proved that good planning plays a key role in infrastructure projects. Without proper project preparation, the probability of cost overruns and construction delays increases, and with it the probability of contract renegotiations. Better planning at the project stage, together with more careful design of both the bidding process and resulting contracts, would entail both lower risks and reduce perverse incentives often associated with the implementation of infrastructure projects. Finally, multilateral organisms can play an important role in the risk allocation process, by offering risk mitigation instruments and by mobilizing international funds, allowing for greater financing diversification.

As discussed above, infrastructure presents a set of characteristics that imply market failure, thereby requiring government intervention. Although one would expect the public sector to make decisions based on maximizing social welfare, in practice its decision-making is affected by a series of factors that can adversely affect the government's ability to achieve socially optimum policies with respect to infrastructure investment and administration. Firstly, the government is not represented by a single agent, but is composed of a number of different branches and agencies that do not necessarily share the same objectives or agenda. These could include, among others, the executive branch and its ministries, regulatory agencies with varying degrees of independence, public enterprises, and/or subnational levels of government. Furthermore firms, industries and interest groups can influence public decisions through a variety of channels. Also, consumers exert pressure on government policies, both directly through consumer associations and indirectly through their political support of specific candidates or policies. Finally, one must take into account that governments' policy decisions are not driven solely by the desire to maximize social welfare, but also take into account the impact of these decisions on the probability of maintaining power in the future.<sup>12</sup>

It is possible to face these issues with adequate institutionalities, providing rules, procedures and institutional mechanisms that create the correct incentives. In the first place, the planning and evaluation capacity of public investment should be increased, even for projects which are expected to be executed and operated by the private sector. Such planning and evaluation should be part of a long-term budget, so as to establish continuity of investments and insure the conclusion of the project at a reasonable cost.

National Systems of Public Investment (SNIPs, for their acronym in Spanish) could represent an important step towards improved planning and evaluation of infrastructure investments. The objective of SNIPs is improving the efficiency and quality of public spending by strengthening public investment evaluations. In general, SNIPs include all public sector entities that do investments: ministries, public enterprises, decentralized government agencies, etc. Projects financed by PPPs however

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<sup>12</sup> See Drazen (2000), Persson and Tabellini (200) and Grossman and Helpman (2001) for examples of the literature that seeks to explain the political economy of public policy.



are usually not included, given that they often do not entail direct public expenditures. Given their important potential fiscal effects, it would be important that PPPs be included in SNIP evaluations.

The benefits of strategic and long term planning and efficient ex ante project evaluation can be negated if public investment is cut in the face of fiscal sustainability requirements. Evidence points to a bias against infrastructure spending when governments are faced with the need for fiscal adjustments. There is a need for fiscal rules that, while creating incentives for intertemporal fiscal sustainability, do not act negatively on productive public investment. One option is to introduce exceptions for certain expenditures associated with infrastructure. Another is a variation of the “golden rule”, requiring a balanced current account but allowing for deficits or increased debt in the case of infrastructure. The problem with these solutions is that they create an incentive to “pass off” current expenditures as investment, and require a strong system of evaluation for public investment. Finally, another option would be to include exceptions for public investment involved in projects with private financing.

Improving the public sector capacity for planning and evaluation would also contribute to improving the efficiency of PPPs. Experience has shown that PPPs that are the result of a process of public planning are much easier to legitimize before voters and consumers, especially when public funds are involved. And, as seen above, better planning and evaluation serves to decrease project risk, reducing the incidence of renegotiations and other opportunistic behavior.

Improving the regulatory framework surrounding infrastructure investment and operations is crucial for better infrastructure management when applying PPP schemes. More effective regulation should include separating planning and design from the functions of contract monitoring and control, to be exercised by separate government agencies. The separation of ex ante planning and design from ex post monitoring helps avoid opportunistic behavior on both sides. On the one hand, the public sector will be less likely to reduce tariffs or introduce other contract changes which could negatively affect the private partner, on the other, the private sector will have less incentive to demand contract renegotiations.

To achieve more efficient PPPs the following distribution of functions could be considered: 1) strategic planning and project identification to be conducted by sector ministries, 2) prioritization and coordination by the Ministry of Finance, 3) tender and contract design by special PPP agency, 4) contract monitoring and collection of information on service provision by independent regulatory agency, 5) ex post impact monitoring and assessment, by same regulatory agency together with research institutions, for example universities (Guasch and Fajnzylber 2008, Birtrán 2008).

As indicated above the establishment of regulatory agencies in charge of monitoring public services is a crucial ingredient of the institutional framework.<sup>13</sup> Independence of this regulatory agency is key to ensure autonomy of decision-making. This involves: 1) organizational and budgetary independence; 2) top officers should be elected for a fixed term that does not coincide with political cycles; 3) technical and administrative personnel should be sufficient and capable of allowing the agency to perform its own analysis and monitoring activities, among others; 4) limitations with respect to ex employees of the agency working in industry, and vice versa.<sup>14</sup>

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<sup>13</sup> In recent years the number of regulatory agencies in various infrastructure sectors (electricity, transportation, water, among others) has increased notably. Over the last 15 years, more than 200 infrastructure regulatory agencies have been created across the world (Stern, 2007).

<sup>14</sup> See, for example, Joskow (1998) for a discussion of prescriptions for regulatory reform in the infrastructure sector.

The countries of Latin America have all reformed their regulatory frameworks, although there is much heterogeneity across the region and across sectors, in particular with respect to the degree of independence of regulatory agencies. In the case of energy, almost all countries in Latin America have designed regulatory frameworks where planning is separated from the functions of monitoring and control. In the case of transportation, various countries have developed some type of regulatory framework, be it multisectoral (as in Bolivia, Colombia, and Uruguay) or based on a different regulatory agency for each subsector (as in Argentina) to oversee service provision, quality and pricing. In general these agencies have less autonomy than their energy counterpart, in as they often depend on a Ministry.<sup>15</sup> The case of water and sanitation is more complex. While the tendency has been towards decentralized provision, regulation is in some cases at the national (Colombia, Peru and Uruguay, for example), regional (the metropolitan area of Buenos Aires in Argentina) or municipal level (as in Ecuador). In this case, as in transportation, regulatory autonomy is often more limited than in the case of energy (Urbiztondo and Cont, 2008).

## 5. Conclusions

Improving the stock of infrastructure is a priority for Latin America. The region's infrastructure gap with respect to other world regions appears to be widening, and notwithstanding important advances with respect to access, quality continues to be deficient in many cases.

An examination of the state of infrastructure in Latin America, coupled with evidence that points to infrastructure's fundamental role in growth, underlines not only the need for greater investment, but the importance of improved management. This requires on the one hand better information, to be provided through high quality impact assessments, as a crucial input in the planning stage. On the other, an institutional framework based on a combination of appropriate incentives for private participation, independent and effective regulation, and proper planning and coordination.

The government's role in infrastructure is not limited to that of financier, but includes that of monitor, regulator and enabler. In this sense, governments in the region face the challenge of not only increasing infrastructure financing, but of creating the necessary conditions to promote and retain quality investment in the sector. In particular, governments play a fundamental role in providing necessary institutional, and must dedicate themselves to establishing the necessary juridical and regulatory framework to promote credibility and security in the sector.

As mentioned above, the size and complexity of infrastructure investments often entails long-term investment horizons. Decisions regarding financing, both from the point of view of the public sector and of the private sector in the event of its participation, must be consistent with long term planning and seek to ensure that political consensus and prioritization not change over the relevant time frame. Regulatory institutions and budgetary frameworks should be established so as to protect infrastructure investments and their administration from both economic and political cycles. This could help reduce the negative effect of short term fiscal adjustments on infrastructure investments.

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<sup>15</sup> Furthermore, in some countries, such as Bolivia and Uruguay, the transportation sector continues to be characterized by a strong public presence. In Bolivia, in particular, no concessions or alternate provision schemes have been introduced, and the public sector continues to provide all services associated with maintenance, repair, etc through public works contracts (Urbiztondo and Cont, 2008).

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