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Privatization, Institutional Reform, and Performance in the Latin American Electricity Sector*

Lenin Balza *Raul Jimenez* *Jorge Mercado*

Abstract

This paper explores the relationship between private sector participation, institutional reform, and performance of the electricity sector in 18 Latin American countries over the last four decades. As part of this study, an updated description of private participation and regulatory characteristics is provided, showing that private investment reaches US$155 billion translating into a participation of above 40 percent in generation and distribution, and around 25 percent in transmission. Still, it seems un-clear what are the positive outcomes that could be associated to this process; remaining performance challenges related with low coverage in rural areas, significant levels of electricity losses and high end-user prices. The empirical analysis herein addresses this issue by focusing on dimensions of efficiency, quality, and accessibility to the electricity service. The results suggest that privatization is robustly associated with improvements in quality and efficiency, but not with accessibility to the service. In contrast, regulatory quality is strongly associated with better performance in terms of both quality and accessibility. That is, regardless of the level of private participation, well-designed and stable sectoral institutions are essential for improving the performance of the electricity sector.

Keywords: Power sector reform, privatization, regulatory reform, Latin American countries, panel data analysis

JEL Codes: Q40, Q48, L50, L94

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1. INTRODUCTION

Approximately 30 years have passed since Latin American countries began undertaking reforms of the electricity sector, yet there is still no conclusive evidence on how this process has influenced the performance of the sector. Moreover, controversy respect of the social benefits of electricity sector reforms has led to declining public support translating into political backlash against private participation in countries such as Bolivia and the Dominican Republic.

This paper analyzes how certain reforms—specifically; privatization and institutional changes—have influenced the performance of the electricity sector in Latin American countries. To do so, it uses a panel data approach from 18 countries in the region with yearly aggregated data over the period 1971–2010. Performance indicators include dimensions of efficiency of the sector, as well as accessibility and quality of service. This analysis is complemented by an updated description of the private participation in the three main sub-sectors of the electricity industry.

Previous studies have used a wide range of approaches to study these dimensions. Country-specific studies, such as those conducted on Argentina, Bolivia, Chile, Mexico, Nicaragua, and Peru, have found positive effects of private participation on performance in the electricity sector. For example, Gonzales-Eiras and Rossi (2007) analyze the gradual privatization process in Argentina and find evidence that it increases both access to and quality of service. Results of their study also suggest that an increase in the access to services decreased the frequency of low birth weight and child mortality due to food poisoning, although the authors caution that these results are not strong enough to suggest policy implications.

In their study of the incomplete electricity privatization process in rural Peru, Alcázar, Nakasone, and Torero (2007) use a cross-sectional energy survey to compare the quality of services in areas served by public versus private distribution utilities. Their findings suggest that the quality improves when the private sector manages the distribution firms. Furthermore, they find evidence that these improvements are directly linked to more efficient time allocation in rural households, leading to an increase in non-farm activities and hours spent in leisure activities.

Fischer and Serra (2004) review the performance of the Chilean electricity sector and find improvements in installed capacity, generation, energy sold, labor productivity, and profitability of the utility. They also determine that there has been a reduction in rates and an increase in coverage. However, they emphasize that the growth in coverage could be attributed to the Rural Electrification Program, which subsidized most of the electrification projects in rural areas.

Through an analysis of household and employment surveys, Mookherjee and McKenzie (2005) examine the distributive effects of privatization in the electricity sector in Argentina, Bolivia, Mexico, and Nicaragua. They find that privatization has increased access to electricity services, in particular for lower income groups. Contrary to public opinion, they did not find a strong correlation between privatization and poverty or inequality.

In contrast to previous studies, Andres et al. (2008), in their analysis of 116 privatized electricity distribution firms from 10 Latin American countries over the period 1990–2004, find mixed results. They conclude that, while privatization leads to improvements in labor productivity and service quality and reductions in distribution losses, it does not necessarily have an effect on the number of connections, amount of energy sold, and extent of coverage. The authors also compare the performance of 250 public and private utilities in the distribution sector between 1995 and 2005. In line with their previous results, they find that, on average, private utilities perform better than public utilities in terms of labor productivity, distribution losses, quality of services, and tariffs, while there are no significant differences in coverage and operational expenditures. However, their analysis also shows that the results cannot be generalized, because the top 10 percent of public utilities performed better than the average private utilities, and the bottom 10 percent of private utilities performed worse than the average public utilities.

Those mixed results correspond with certain degree of skepticism respect to positive outcome of the reforms, particularly privatizations. Over the last decade, public opinion has remained critical of privatization. In fact, based on Latinobarometro (2012), an annual public opinion survey performed since 1998, the perception that privatization has benefited a country has never exceeded 50 percent, and satisfaction with privatized public service has remained below 40 percent. In 2011, the survey indicates that a high percentage of people are unhappy

with privatized public services in countries including Chile (82 percent), Peru (67 percent), and Argentina (64 percent). Using the same survey, Gaviria (2006) finds that the poorest quintiles of the region's households are the most likely to disapprove of privatization.

A plausible explanation for these mixed results and the dissatisfaction of the public opinion could be related to the inappropriate setting of the electricity institutional framework. In particular, the specific regulatory environment has been identified as a key element to impose incentives that allow improving the performance of the sector. In the subsector of generation, among those studies that emphasize the role of the institutional component, Cubbin and Stern (2006) assess whether new regulatory laws and higher quality regulatory governance are associated with superior outcomes. They analyze 28 developing economies between 1980 and 2001, finding evidence that good regulatory governance has a positive and statistically significant effect on per capita generation capacity. These results are in line with Zhang, Parker, and Kirkpatrick (2008) who analyze 36 developing and transitional countries for the period 1985–2003, concluding that performance improvements resulting from private participation depend on the presence of an effective regulatory regime that stimulates management. Specifically, the authors find that privatization does not lead to improved labor productivity, higher capital utilization, increased generating capacity, or higher output unless it is coupled with independent regulation.

The effect of privatization on electricity prices is less clear. Nagayama (2007; 2009) analyzes a multi-country panel data covering the period 1985–2003. The study emphasizes that privatization in conjunction with independent regulation may work to reduce electricity prices in some, but not all, regions. In particular, for the case of Latin America, the paper find that liberalization did not necessarily reduce electricity prices and contrary to expectations, prices had a tendency to rise. This result is attributed to the fact that wholesale and retail prices tend to rise under the process of unbundling and privatization in order to assure profit to private investors, which are comprised mostly of multinational corporations.

At the utility level, Andres et al. (2008) analyze the link between regulatory governance and sector performance in a dataset of 250 distribution firms. Their results suggest that the mere existence of a regulatory agency, regardless of utility ownership, has a significant effect on performance, for example, in terms of overall coverage, electricity losses, and residential prices.

In addition to the effect on sector-specific framework, differences in performance have been attributed to differences in the overall institutional power of the government to implement and support the reforms. For example, Estache, Guasch, and Trujillo (2003) argue that price-cap regulation in privatized sectors in Latin America has generally been unsuccessful in passing efficiency gains on to end-users due to lack of government commitment. In general, it has been argued that governments with weak institutions have performed poorly, even when they have had ambitious reform plans. Political interference or a weak rule of laws can obstruct market operation and hence the ability of governments to implement reform plans. Conversely, governments with strong institutions and sustained commitment to reform tend to fare much better, even when pursuing modest reforms (Besant-Jones 2006; Heller, Tjiong, and Victor, 2004; Jamasb et al., 2005; Tongia, 2003).

The extant literature analyzes the effects of reforms only through 2005. However, the average year of privatization in Latin America was 1997, and the maturity of investment in the sector ranges from five to seven years[1], which is in addition to the transition period required by utilities management after privatization (Andres et al., 2008) and the time required for strengthening regulatory entities (Cubbin and Stern, 2006). This raises the concern that previous studies may have analyzed timeframes that are too short to capture significant effects of the reforms.

This paper analyzes four decades of yearly aggregate data in 18 Latin American countries. This is a longer period than considered in previous studies, which makes it possible to account for the maturity of investment in the sector. In addition, this paper uses the private investments in the electricity sector as a measure of privatization (instead of a discrete 1 or 0, as in other studies) in order to capture the intensity of the privatization process.[2] Finally, it provides

[1] The average was estimated using two sources: the average maturity of the loans in the Inter-American Development Bank (IDB) electricity portfolio for the past five years, and consultations with an IDB energy specialist.

[2] This paper uses the World Bank's Private Participation in Infrastructure (PPI) database. The PPI includes electricity projects in the subsectors of electricity generation, transmission, and distribution. The definition of privatization encompasses the following types of private participation: management and lease contracts, concessions (or management and operation contracts with major private capital commitments), greenfield projects, divestiture, public–private partnerships (PPP), and joint ventures. In addition, the current study considers projects to have private participation if a private company or investor bears a share of the project's operating risk; that is, a private sponsor is at least partially responsible for operating costs and associated risks, which means it either has the rights to operate alone or in association with a public entity or it owns an equity share in the project. The database covers infrastructure projects that meet the following four criteria: (i) the total investment commitments should be at least

an updated description of private participation in the sector, as well as the sector's institutional characteristics.

The rest of the paper is organized as follows. Section 2 presents an overview of the process of reforms in terms of private –investment and –participation, as well as, a description of the regulatory characteristics of the industry. Section 3 offers a briefly review of the cases of re-nationalization over the last decade. Section 4 analyzes empirically the long run relationship between the implementation of these reforms and the performance of the Latin American electricity sector. Section 5 concludes with a discussion of the findings.

2. OVERVIEW OF ELECTRICITY SECTOR REFORMS IN LATIN AMERICA

Before the reform period, the electricity industry in Latin American countries was made up of vertically integrated state-owned utilities. It has been argued that those utilities had low productivity levels, with prices lower than costs, leading to severe difficulties in expanding the electricity supply, increasing coverage, and improving the quality of service. In addition, political interference and overemployment of state-owned utilities led to low quality management with severe results at the commercial and technical levels. In general, over this period, the sector was not financially sustainable, showing significant levels of electricity losses.[3]

During the 1980s, in a context of macroeconomic imbalances and high external debts, utilities represented a heavy fiscal burden for the State. Due to debt default in Mexico (1982) and subsequent structural reforms, the electricity sector was subject to a process of reforms that included privatization and institutional and regulatory changes. Although this process took place in the midst of a severe economic crisis and was seen as a way of reducing fiscal imbalances, improved efficiency was also argued to foster the reforms.

US$1 million, unless it is a divestiture, lease contract, or management contract; (ii) they must be owned or managed by private companies in low- and middle-income countries (private parties must have at least a 25 percent participation in the project contract, except for divestitures, which are included when at least 5 percent of equity is owned by private parties); (iii) they must directly or indirectly serve the public—captive facilities (e.g., cogeneration power plants and private telecommunications networks) are excluded unless a significant share of output (20 percent) is sold to serve the public under a contract with a utility; (iv) they must have reached financial closure after 1983 (database coverage currently extends to 2012).

[3] For a complete review of the literature and detailed case analysis, see Chong and Lopez-de-Silanes (2005) and Nellis and Birdsall (2005).

This section briefly reviews the process of privatization and institutional change that followed those structural reforms in the electricity sector. As shown, the process of change in the Latin American electricity sector started in the early 1980s, and consisted of general, partial, and incomplete reforms in terms of both privatization and institutional/regulatory oversight.

2.1 Private Investment in the Electricity Sector

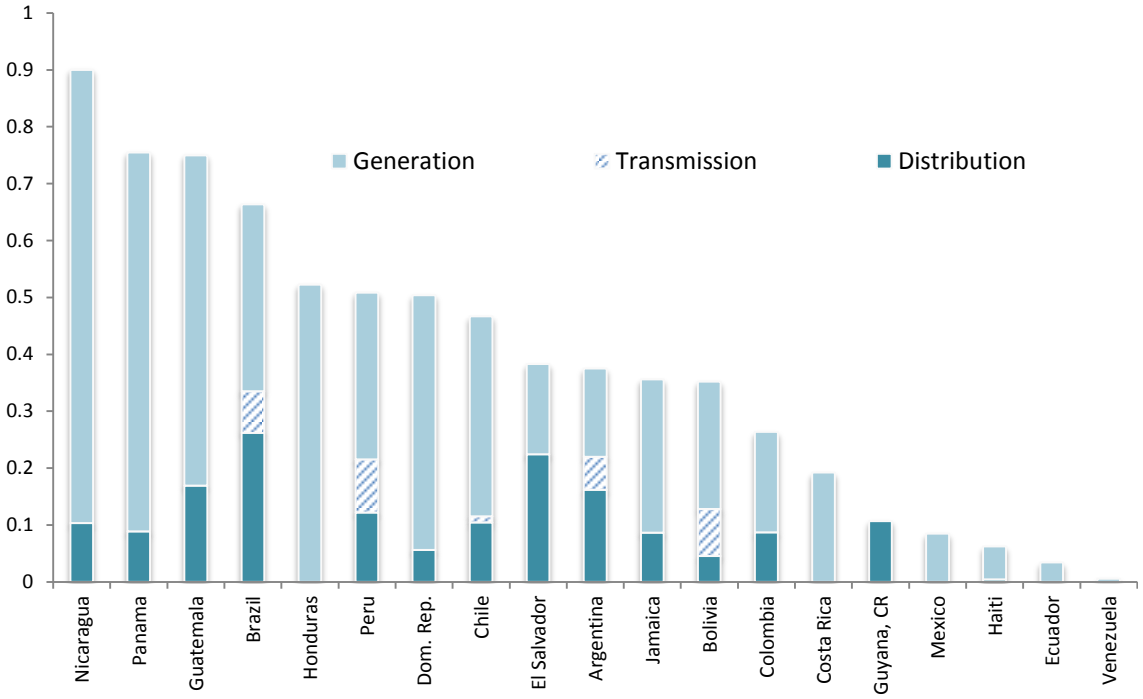
The earliest experience with privatization of the electricity sector in Latin America occurred in Chile, beginning in 1982 and culminating in 1989 with the privatization of its major firms (Fischer and Serra, 2004). Most countries began privatizing in the 1990s, through the division of vertically integrated state-owned utilities into distinct firms handling generation, transmission, and distribution. This division aimed to promote competition but also to facilitate the entry of private investors into the sector. While most countries in the region implemented at least partial privatization of the sector, four countries in the sample analyzed—Costa Rica, Ecuador, Paraguay, and Uruguay—remained at the margins of this privatization process, receiving minimal or no private investment in any subsector.

As a result of the reforms in most countries in the region, the flow of private investment into the sector reached a total of US$155 billion during the period 1984–2011, representing 38 percent of average fixed capital formation. Figure 1 shows the importance of private investment in electricity relative to total investment in each country (measured as gross fixed capital formation) over the last three decades. These investments ranged from 90 percent in Nicaragua to 30 percent in Colombia. Even countries with dominant public ownership of utilities (Mexico and Venezuela) received some private investment, mainly in the generation sector.[4]

[4] As can be seen in Table 1, some private investment occurred in Costa Rica, Ecuador, and Mexico in the generation subsector. In Costa Rica, private investment mostly went to support greenfield projects, adding a capacity of 357 MW through 18 small hydros and four onshore wind projects. In Ecuador, investments added 545 MW through two diesel plants, one large hydro, and one onshore wind project.

Figure 1: Private Electricity Investments Flows, 1984–2011

(as a percentage of the average Gross Fixed Capital Formation)



Source: Authors' calculations based on data from the PPI Database / WB.
Notes: Between 1998 and 2003, Venezuela received a total investment of US$142 million for the privatization of Compania Anonima Luz y Fuerza Electricas de Puerto Cabello, and investments in the electricity system of Nueva Esparta and the greenfield project Aggreko Cadafe Power Station. With the exception of Aggreko, these contracts were cancelled in 2007.

Private investments were mainly directed toward the generation and distribution subsectors. During the period examined generation received US$87 billion; distribution US$52 billion; and transmission US$14 billion. These amounts represent the purchase of assets as well as the implementation of investments projects. The lower private participation in distribution and transmission could be due in part to their characteristics as natural monopolies, including significant economies of scale and scope, as well as sunk investment costs. Depending of the size of the market, investment requirements and political risks, it was not always feasible to introduce private capital to the sector. Additionally, in the case of transmission, it is argued that there are strategic and security reasons to maintain the sector under public control. In the case of the distribution subsector, political considerations, such as rejection by the unions, could also be a factor.

Table 1: Private Investments in LAC Electricity Sector 1984–2011

Country	Total investments (US$ millions)*				Related outputs		
	Total	Distribution	Transmission	Generation	Number of connections	KM	MW
Argentina	15,710	6,792	2,411	6,507	62,406	69,151	24,974
Bolivia	501	65	117	318	1,709	6,993	1,137
Brazil	95,369	37,692	10,454	47,224	575,675	102,447	144,498
Chile	8,812	1,976	199	6,636	35,605	18,308	16,621
Colombia	5,912	1,954	–	3,958	42,013	–	9,686
Costa Rica	588	–	–	588	–	–	358
Dom. Rep.	1,981	221	–	1,760	1,214	–	3,177
Ecuador	214	–	–	214	–	–	545
El Salvador	825	483	–	341	2,739	–	587
Guatemala	2,387	538	–	1,849	2,614	–	1,564
Honduras	906		–	906	–	–	851
Mexico	9,194	–	–	9,194	–	–	13,973
Nicaragua	999	115	–	884	5,037	–	540
Panama	1,858	218	–	1,640	5,118	–	1,603
Peru	6,756	1,621	1,237	3,897	15,786	20,575	8,974
Venezuela	142	9	–	132	50	–	498
16 countries	**152,154**	**51,684**	**14,418**	**86,048**	**749,966**	**217,473**	**229,586**
Total LAC	**153,529**	**52,164**	**14,418**	**86,947**	**751,878**	**217,473**	**232,101**

Source: Authors' calculations based on data from the PPI Database / WB.
Note: *includes investment greater than US$1 million in generation, transmission, and distribution.
**Total LAC includes 9 Caribbean countries presented in Annex 1.

Private investments in the electricity sector have helped to create: 750,000 new connections, 230 GW of installed capacity, and 218,000 KM of transmission lines. Table 1 presents the disaggregation by 16 countries and subsector, both in terms of total investment and its related outputs. Two countries considered in this review –Paraguay and Uruguay– did not receive private investment during the period under review[5]. Annex 1 extends Table 1 with available data of 9 Caribbean countries.

Those investments translate into a private participation of around 40 percent in generation and distribution, and 25 percent in transmission. Table 2 presents a snapshot of private participation by subsector at December 2010, showing the heterogeneity of market composition across Latin American countries. At one end, Bolivia and Chile reached 100 percent private

[5] According to information from the PPI Database/WB.

participation in the subsectors of generation, transmission, and distribution. At the other, Costa Rica, Ecuador, Paraguay, and Uruguay had minimal or no private investment in any subsector. Most countries tend to have a relevant degree of public participation, with state-owned utilities as key players in the three sub-sectors. What is more, in cases as Colombia and Panama, utilities can have mixed ownership as figure to its boost the management and financial leverage.

Table 2: Private Participation in the Electricity Sector, 2010

Country	Distribution		Transmission		Generation	
	Total Demand (GW)	Private (%)	Total Lines (km)	Private (%)	Total Inst. Capacity (MW)	Private (%)
Argentina	81,422	66	29,503	100	29,607	73
Bolivia*	5,309	82	3,008	87	1,390	35
Brazil	300,501	70	95,915	14	112,400	38
Chile	29,029	100	19,175	100	15,985	100
Colombia	37,758	52	24,391	15	14,423	74
Costa Rica	8,495	0	1,913	0	2,605	18
Dom. Republic*	11,091	0	3,658	0	3,159	83
Ecuador	16,333	0	3,605	0	3,730	17
El Salvador	5,546	100	1,180	0	1,481	68
Guatemala	5,450	93	3,750	36	2,475	77
Honduras	5,100	0	2,445	0	1,610	63
Mexico	186,639	0	97,037	0	51,611	23
Nicaragua	2,721	96	2,041	0	1,060	78
Panama	6,730	51	2,258	0	1,974	82
Paraguay	6,865	0	5,467	0	8,816	0
Peru	18,195	69	17,065	100	6,980	75
Uruguay	7,569	0	4,441	0	2,692	3
Venezuela*	80,878	0	28,829	0	24,838	0
18 LA countries	**815,629**	**42**	**345,681**	**25**	**286,836**	**41**

Source: Authors' elaboration based on information from Ministries' and Regulators' reports, and ECLAC

Notes:

*These countries experienced process of re-nationalizations: Dominican Republic started in 2003, Venezuela in 2007, and Bolivia in 2011. For details see Section 3.

**In Mexico, Paraguay, Peru, and Uruguay, distribution refers to billing by private utilities

***In the case of distribution in Colombia and Panama there utilities with mixed capital. As private were considered all utilities with private participation greater than 51 percent.

***Annex 2 presents information of private participation at 2001.

The process of privatization, however, was not always successful. For example, Mexico started the process of reform in 1992, but for political reasons, it did not establish private participation in transmission or distribution. By 2010, Mexico reached 25 percent rate of private participation in generation. Even successful cases of privatization presented serious difficulties in introducing private investors and consolidate their presence in the electricity market. For example, Alcazar, Nakasone, and Torero (2007) find that in Peru, the electricity distribution concession in rural areas has been unsuccessful due to low population density, which makes it difficult to recover costs without subsidies. Furthermore, as detailed below, some countries with high rates in this area made a decision to renationalize their utilities over the last decade. With data of Espinasa (2001), annex 2 presents the private participation in 2001 in comparison with table 2. Next section reviews the process of renationalization in the last decade.

2.2 Regulatory Changes

In each country reviewed, institutional and regulatory reforms accompanied the privatization process. In general, the results are described as competitive frameworks in most countries implementing these reforms. Broadly speaking, the new regulatory models were based in competition in the generation, and monopoly concessions in the transmission and distribution sub-sectors. Other two common characteristics include that prices were not regulated for large end-users and the establishment of accessibility of generation utilities to the transmission system. On the other hand, there were significant differences in the institutional framework as for example the election price system for regulated users. Those price setting mechanisms goes from free market setting to price cap, including marginal cost, efficiency standards and cost of services.

Despite, the country specific characteristics of the normative reforms; a key element in the soundness of the sector is related with the governance of its regulatory and supervisory agency. That is, besides the normative framework, the performance of the sector is greatly depending on the capacity of the government and regulatory agency to provide enforcement and credible implementation of such framework. The rights and interests of both; private investors and end-users are protected by the reliability of the rules of game and the autonomy of the

regulatory agency. This is why a relevant branch of the literature has focus in evaluating the governance of regulatory agency and its effects over the performance of the industry.

In this context, Table 3 presents the timing of regulatory changes and the main characteristics of the electricity regulatory agencies, with respect to their degree of independence. The definitions and compilation of indicators herein are based on the efforts of Andres, Guasch, and Lopez-Azumendi (2008); Cubbin and Stern (2006); Domah, Pollitt, and Stern (2002); and Zhang Parker, and Kirkpatrick (2008), including the following: (i) the presence of an electricity (or energy) regulatory law; (ii) whether the regulator is an autonomous agency or the sector ministry; (iii) whether the regulatory agency is funded by a fee originating from license obligation or a line item in customers' electricity bills versus a government budget; and (iv) whether the pay scales for regulatory staff are freely set or follow mandatory civil service scales. These variables represent formal attributes of regulation, and do not account for informal characteristics, such as transparency or quality of the regulatory process.[6]

Each country created an institutional framework for regulation and established a regulatory institution. The main differences across countries were the specific characteristics of those regulators, including their autonomy, their funding independence, and whether staff pay scales were competitive (Table 3).

As shown in Table 3, reforms in electricity laws tend to precede the establishment of the regulator, which is expected, since the creation and operation of the regulatory agency must be based on a specific legal framework. However, Chile, the Dominican Republic, and Nicaragua implemented reforms in their electricity laws after the regulator was established. What is more, in the last two countries, privatization was hardly criticized because of being implemented without appropriate institutional frameworks.

From the sample of countries analyzed herein, 13 regulators are considered to be autonomous, but only 5 have funding and pay scales that are independent from those of the government. It could be argued that some countries implemented institutional and regulatory reforms, such as the privatization process itself, partially or incompletely. However, it is important to consider that each institutional arrangement corresponds to a specific context.

[6] This represents a limitation and a potential source of bias in the estimations presented in the next section (Cubbin and Stern 2006); however, it allows accounting with homogenous definitions of institutional characteristics.

Table 3: Institutional Changes, 2010

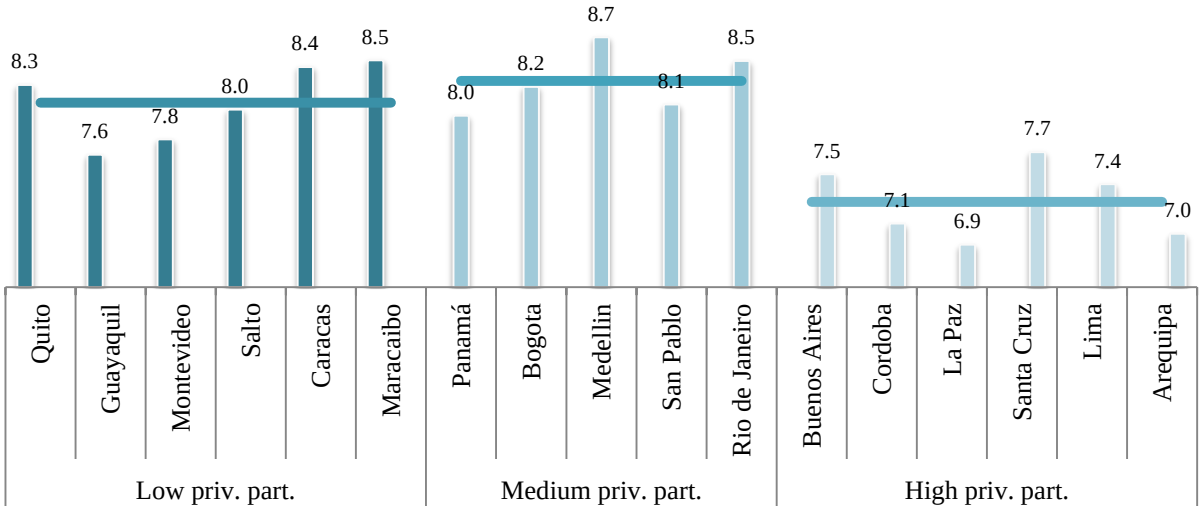
Country	Electricity reform law	Regulator established	Autonomous regulator	License fee or government budget regulatory funding	Free or mandatory civil service pay scales
Argentina	1992	1992	Yes	Regulation Tax (1993)	Mandatory
Bolivia	1994	1994	Yes	Regulation Tax (1996)	Free
Brazil	1996	1996	Yes	Regulation Tax (1997)	Mandatory
Chile	1982	1978	No	Government budget (1985)	Mandatory
Colombia	1994	1994	No	Regulation Tax (1994)	Free
Costa Rica	1990	1996	Yes	Regulation Tax (1996)	Free
Dominican Republic	2001	1998	Yes	Regulation Tax (1998)	Mandatory
Ecuador	1996	1998	Yes	Regulation Tax (1999)	Mandatory
El Salvador	1997	1996	Yes	Regulation Tax (1997)	Free
Guatemala	1996	1996	No	Regulation Tax (1996)	Free
Honduras	1994	1994	Yes	Government budget (1995)	Mandatory
Mexico	1992	1995	Yes	Government budget (1995)	Mandatory
Nicaragua	1998	1995	Yes	Regulation Tax (1994)	Free
Panama	1997	1996	Yes	Regulation Tax (1996)	Mandatory
Paraguay	1993	1964	No	Government budget	Mandatory
Peru	1992	1997	Yes	Regulation Tax (1996)	Free
Uruguay	1997	1997	Yes	Regulation Tax (2000)	Mandatory
Venezuela	1999	1999	No	Government budget (2002)	Mandatory

Source: Authors' elaboration based on information from Cubbin and Stern (2006) (autonomous regulators and electricity law); Andres et al. (2008) (pay scales); Domah, Pollit, and Stern, 2002 (funding); and ministry and regulators' reports.

2.4 Performance of the Electricity Sector

In general, public opinion has remained skeptic respect to the positive outcomes of the reforms and in particular with the privatization. In fact, at 2010, the rate of satisfaction with electricity services in 17 Latin American Cities shows even a higher degree of discontent in those countries with greater degree of private participation. This intuition is against was expected from the private investment flows to the electricity sector in terms of improvements in efficiency, quality and accessibility, these last two more related to the perception of the end-user.

Figure 2: Electricity Service Satisfaction 2010
(Average index, 10 total satisfaction)



Source: Authors' calculations based on CAF' household–surveys.

To certain degree, last figure is supported by the inspection of four performance indicators in the sense that it could not be appreciated a clear association between a higher degree of private participation and better performance. Figure 3 shows the five-year average outcome variables of the electricity sector during the period 2006–2010, classified by level of private participation.[7] The heterogeneity in per capita generation capacity is notable, ranging from 0.15 in Bolivia to 1.35 in Paraguay (MW per thousand population). Country-specific characteristic could play a relevant role in the differences between countries; for example, high hydro capacity in Paraguay and Venezuela has an important effect on per capita generation capacity and electricity prices. The abundance of fossil fuel is also related with low electricity prices in Mexico, Ecuador, Argentina, and Bolivia.

[7] This classification comes from the simple average of the private participation in all subsectors in Table 2.

Another notable finding is the high level of electricity losses in almost every country. In 2010, the average for LAC countries (excluding Haiti), was 16 percent, well above the OECD mean of 6 percent. It is worth noting that the average losses in those countries with greater private participation tend to be relatively lower. However, regardless of the increasing economic development of the LAC region and the level of private participation, electricity losses remain above the international standards of around 7 to 8 percent. This represents a severe financial and environmental cost which seems to be more severe in the Region.

Besides, it is important to highlight that the information presented here is prepared with data from the International Energy Agency (IEA). However, reports from utilities and regulatory agencies suggest that the levels of electricity losses are in fact greater for the cases of Paraguay and Dominican Republic. According with ANDE (*Administracion Nacional de Electricidad*) the annual electricity losses were above 30% between 2007 and 2011, mainly explained by distribution losses around 23%, while transmission losses are around 7%. In Dominican Republic; CDEEE (*Corporacion Dominicana de Empresas Electricas Estatales*) also report annual distribution electricity losses of above 30%, during the period between 2009 and 2013. In general, differences could be due to the definition and calculation method used to estimate electricity losses. IEA includes losses in transmission between sources of supply and points of distribution and in the distribution to consumers, including pilferage. Further analysis of electricity losses is required.

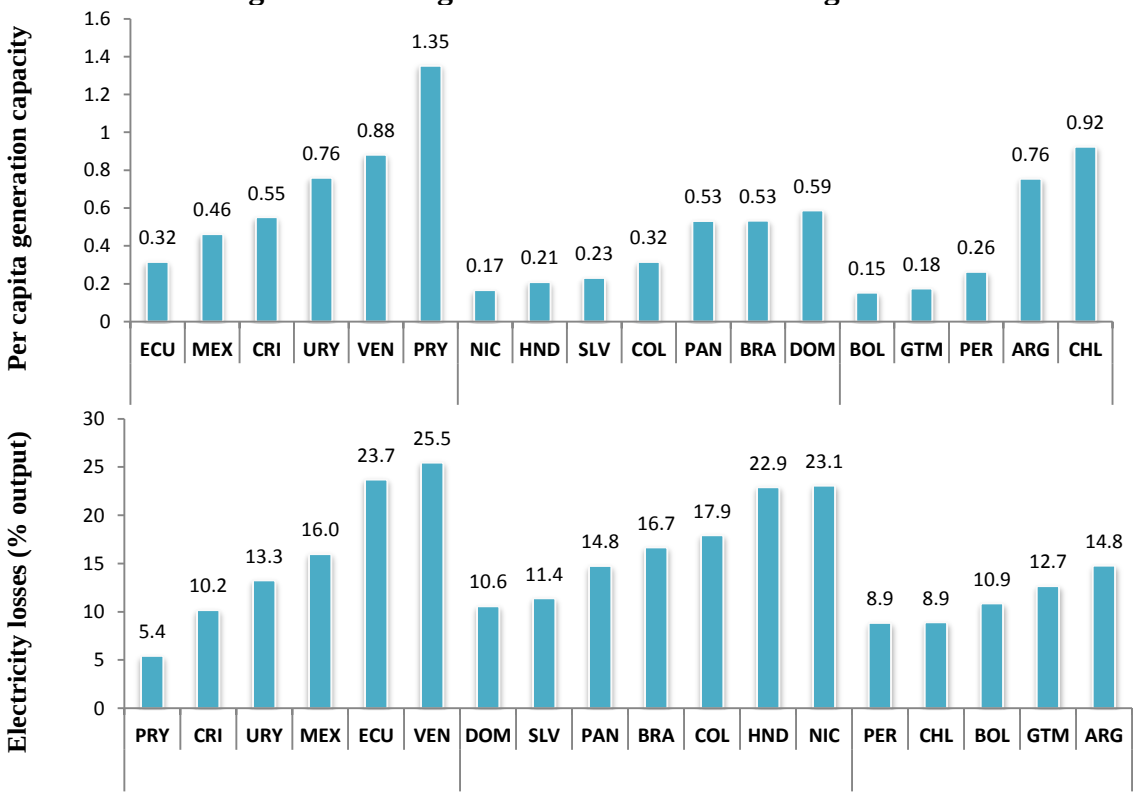
In the 18-country sample, the prices are below US$0.2 per MWh. As previously mentioned, these prices depend in the electricity generation matrix and on the type of resource abundance of the country. In particular, in those fossil fuels imported countries, prices tend to be highly sensitive to international oil prices and different subsidies structures exist in order to maintain tariffs affordable. That is, different market structures (both regulatory and technical) and country characteristics lead to different schemes of price formation which could be not very sensitivity to the ownership of the utilities.

Respect to the electricity coverage levels; as a whole, the region presents a relative high ratio of access to electrification of 94% (WDI, 2010) nevertheless figure 3 shows that still remains a significant access problem in Bolivia, Guatemala, Honduras, Nicaragua, Peru, and Panama. In part, those low rates are due to topological reasons to expand the grid in rural areas.

However, the impact of private participation in this area has to be evaluated carefully since the rural grid expansion is explained mostly by subsidies of national government programs.

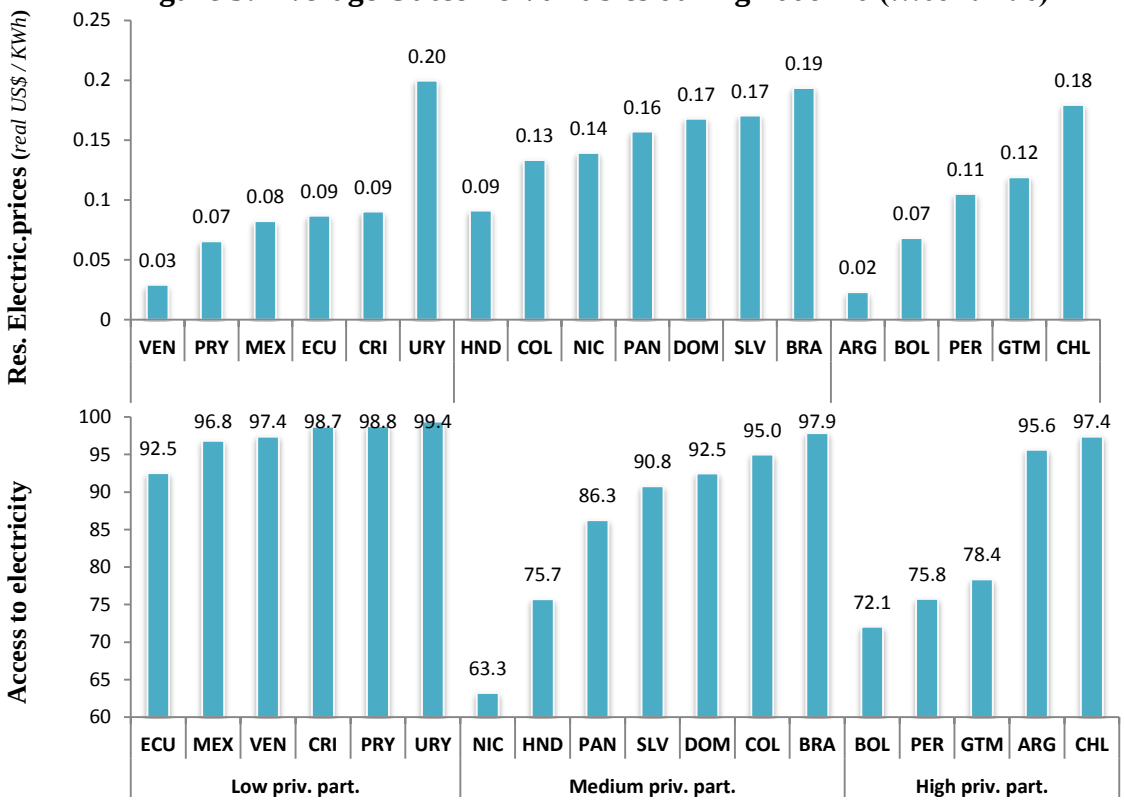
From another point of view, annex 3 presents the outcomes variables averaged for the periods before and after the *main* year of privatization. This refers to the year in which the privatization reaches at least the 50 percent of the assets of the sector. This annex supports previous results in the sense that it does not show a clear association between the occurrence of the privatization and a reduction in real electricity prices or electricity losses. Besides, increases in the rate of electricity coverage and capacity generation per-capita are present regardless of the degree of private participation or occurrence of this type of reform.

Figure 3: Average Outcome Variables during 2006–10



(Continue…)

Figure 3: Average Outcome Variables during 2006–10 (…continue)



Source: Authors' calculations based on data from the PPI Database / WB, ECLAC, OLADE and IEA.

3. CASES OF RENATIONALIZATION

The mixed results shown above, along with the complex political and economic contexts in each country lead to a reform process that was not neither linear nor continuous. It has received strong criticism and undergone structural changes in both the ownership of utilities and the institutional frameworks. This subsection presents a synopsis of the three experiences on renationalization in the LAC region.

3.1 Bolivia

Before the beginning of the reform in 1994, the electricity sector in Bolivia was regulated by the Electricity Code (issued in 1968 and later modified). The Ministry of Energy and Hydrocarbons was in charge of regulating the sector through DINE (Dirección Nacional de Electricidad). With respect to the structure of the market, four utilities met the demand for energy in the country. ENDE (Empresa Nacional de Electricidad) was responsible for both generation and transmission, while COBEE (Compañía Boliviana de Energía Eléctrica), a U.S. private company, was in

charge of generation and distribution in the areas of La Paz and Oruro. Two private rural electricity cooperatives controlled distribution in Santa Cruz and Sucre. Additionally, two subsidiaries of ENDE distributed power to Cochabamba and Potosi.

During this period, the lack of incentives to generation and distribution utilities was emphasized to improve their efficiency, reduce marginal costs, and stimulate competition and investments. In particular, areas that decreased efficiency in the late 80s and early 90s included lack of transparency in the granting and renewal of licenses, weak regulatory capacity of DINE, and prices distortions due to politicized process of tariff approval (World Bank, 1999).

The Reform

In 1995, the Bolivian administration at the time (in office between 1993–1997) implemented a new legal and regulatory framework based on the Law on Capitalization (Ley de Capitalización, March, 1994) and the Law of Creation of the Sectoral Regulatory System (Ley de Creación del Sistema de Regulación Sectorial, October, 1994). This framework authorized private investments in state-owned utilities and established independent superintendencies for the electricity, telecommunications, hydrocarbons, transport, and water sectors. The Superintendency of Electricity, which was funded by power companies, was defined as an autarchic organization with technical administrative independence (Bojanic and Krakowski, 2003). This agency would oversee compliance with the sectorial regulations and approve tariff rates.

As part of the reforms, ENDE's assets were divided up to create three companies (Corani, Guaracachi, and Valle Hermoso), which in turn were sold to private investors. Likewise, using the assets of COBEE, generation and distribution companies were formed and sold to private bidders. ENDE also created a transmission company that was later passed into the hands of a private company. The distribution subsidiaries of ENDE and COBEE were privatized. The method of privatization required that private investors acquired 50 percent of the shares of the new public companies, while the employees purchased 2 percent of the shares, and the rest were used to create two pension funds for senior citizens over 65 years old. This mechanism also included a contract that enabled private investors to obtain control of the management of the company and stipulated that profits generated from the sale, most of which came from outside of Bolivia, would remain in the hands of the privatized companies. In turn, these companies were required to invest the proceeds into new commercial projects.

Nationalization of the Electricity Sector

In 2008, through Supreme Decree 292224 (enacted in August 2007) the government, which entered into office in 2006 and remains there today, authorized the formation of a semipublic corporation with ENDE. It introduced reforms that aimed to reestablish state control in the electricity sector by including the participation of ENDE in three subsectors (see Supreme Decree 29644, enacted in July 2008). In this way, through Supreme Decree 493 (enacted in May 2010) the government nationalized the assets owned by Corani, Guaracachi, and Valle Hermoso, in favor of ENDE, establishing a scenario in which the Bolivian government's participation was nearly 72 percent of the generation sector, making it responsible for a large part of the supply of electric energy in the SIN.

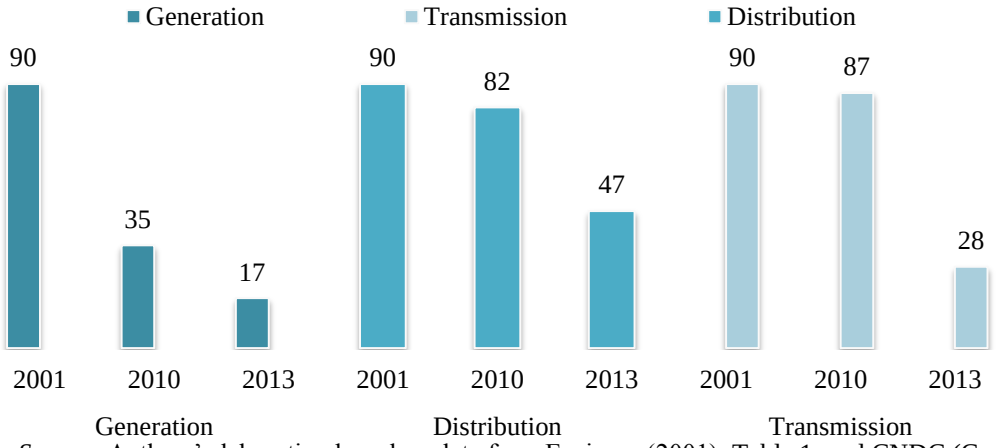
Likewise, the Bolivia's new political constitution of the State (enacted in February 2009) led to structural changes in institutions by prohibiting (in Article 314) "private monopolies and oligopolies and any other form of association or agreement of private individuals or corporations, Bolivian or foreign, seeking to control and exclusivity in the production and marketing of goods and services." What is more, in Article 351, it declared: "The State will assume control and management on the exploration, exploitation, processing, transportation and marketing of strategic natural resources through public entities, cooperatives or community, which may in turn hire private companies and forming joint ventures."

In line with the previous mandates, the Supreme Decree 0071 (enacted in April 2009) created the Electricity Oversight and Social Control Authority (Autoridad de Fiscalización y Control Social de Electricidad), and mandated that this new agency assume responsibility for the attributes, competencies, rights, and responsibilities of the Superintendency of Electricity, as long as it did not violate the constitution. In February 2010, through Supreme Decree 428, the government took responsibility for regulating an administrative intervention in the electricity sector to guarantee the provision of services in case their continuity and normal supply were put at risk.

During 2012, the government renationalized most of the transmission and distribution sector. In May of that year, it expropriated the shares of the utility company Transportadora de Electricidad (TDE), which controlled 74 percent of the transmission lines in the country. In December, thought Decree 1448, the government initiated the renationalization process for four

distribution utilities in the areas of "La Paz" and "Oruro", which were subsidiaries of the Spanish group Iberdrola.

Figure 4: Private Participation in Bolivia



Source: Authors' elaboration based on data from Espinasa (2001), Table 1, and CNDC (Comité Nacional de Despacho de Carga).

In August 2013, Decree 1691 defined the structure of ENDE, which includes the renationalized utilities as subsidiaries. This decree outlines the organizational and functional structure of ENDE, and approves a salary scale for its specialists.

3.2 Venezuela

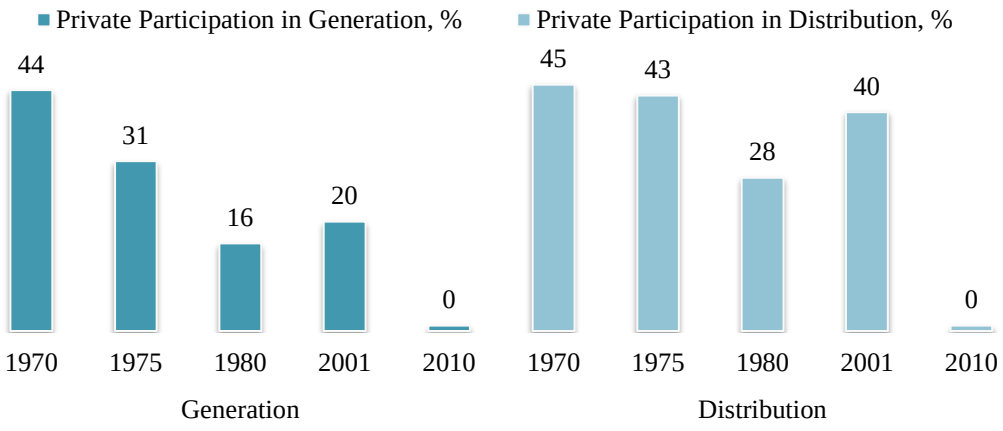
The Venezuelan electricity sector has had several phases; however, in the period under review, it is possible to identify two. Before the mid-1970s, the electricity industry was integrated by both private and public owners. In fact, Venezuela was the only country in the region with relevant private participation. Under Decree 62 (enacted in 1974), at least 80 percent of the utilities' shares must be made available for purchase by national investors. This allows the government to increase its participation from 56 to 84 percent in generation and from 55 to 72 percent in distribution between 1970 and 1980.

Since 1989, in the context of macroeconomic adjustments and stabilization policies, the government has tried to minimize its presence in the sector by fostering private participation and market competition. During the 1990s, several laws and norms (Ley de Privatization of 1992, Decree 2383 of 1992, Decree 1558 of 1996, and Decree 2384 of 1992) set the framework for a gradual opening of the sector, requiring the separation of the generation, transmission,

distribution, and commercialization subsectors, and establishing two institutions to orient and implement this process (Comision Reguladora de Energia Electrica, or CREE, and Fundacion para el desarrollo del Servicio Electrico, or FUNDELEC). However, the political context slowed the implementation. At the end of the 1990s, the structure of the Venezuelan electricity system had changed very little compared to its structure at the beginning of the decade, despite the intense reform efforts. When the new administration took office in 1999, the privatization process was stopped. The following key aspects of privatization attempts during the 1990s are worth mentioning:

- The Law on Privatizations (Ley de Privatizaciones, enacted in 1992) progressively opened the electricity sector to free competition.
- Decree 1558 (enacted in October 1996) mandated the separation of the generation, transmission, distribution, and commercialization subsectors, and implied the disintegration of CADAFE (Compañía Anónima de Administración y Fomento Eléctrico).
- The electric energy regulatory commission (CREE) was created to guarantee free access of energy suppliers to the national transmission system.
- Decree 2385 created FUNDELEC, which was given the responsibility to design a model of operation of the electrical system that would foment competition and minimize costs.

Figure 5: Private Participation in Venezuela



Source: Authors' elaboration based on data Coing (2011), Espinasa (2001), and Table 1.

Nationalization of the Electricity Sector

In January 2007, President Chávez announced the imminent nationalization of the main energy

company in Caracas (Electricidad de Caracas, or ELECAR), whose owner, since 2002, had been the AES Corporation, a North American company. Venezuela acquired it after investing nearly US$1.1 billion through a public offering in the stock market.

PDVSA (Petroleos de Venezuela S.A. purchased 82 percent of the shares in ELECAR—a deal valued at US$739 million—and minority shareholders maintained an 18 percent ownership. Since then, there have been numerous events and effects of the nationalization. The government promised that electricity service and tariffs would improve relative to the inefficiency in service delivery by CADAFE and its affiliated companies.

In an effort to reorganize the national electricity sector, in July of 2007, the government created the National Electricity Corporation (Corporación Eléctrica Nacional, or CORPOELEC) through Decree 5330. The goal was to improve the quality of service throughout the country, maximize efficiency in the use of primary sources of energy production and in the operation of the system, and redistribute the responsibilities and functions of the operators in the sector.

CORPOELEC, which falls under the responsibility of the Ministry of Energy (Ministerio del Poder Popular para la Energía y Petróleo), is the company in charge of generation, transmission, distribution, and commercialization of electric power and energy. Decree 5.330 stipulates that the electricity service companies, as well as, all the other companies affiliated to CORPOELEC, should, within three years from the time that it took effect, merge into a single corporation. In October of 2009, the government created the Ministry of Energy through Decree 6.991, and designated its minister as president of CORPOELEC.

3.3 Dominican Republic

Prior to the 1990s, the CDE (Corporacion Dominicana de Electricidad), a state-owned company in charge of generation, transmission, and distribution of electrical energy, controlled the country's electricity sector. However, due to various operational and administrative problems, the State, through is General Law on Reform of Public Companies (Ley General de Reforma de la Empresa Pública), began restructuring the CDE to promote the participation of the private sector in the generation and distribution. The aim was to expand the sector and improve the overall efficiency. The State would have only a regulatory function, through the Superintendency of Electricity (Superintendencia de Electricidad, or SIE).

Key Aspects of the Reforms (1996–2000)

The General Law on Reform of Public Companies enacted in 1997 allowed for the capitalization of CDE, creating five new enterprises to be privatized: two thermoelectric generation companies (ITABO and HAINA) and three distributors (EDENORTE, EDESESTE, and EDESUR). The CDE would control the hydraulic generation and electricity transmission. The law permitted large foreign investments; for example, Union Fenosa (a company from Spain) acquired the distributors EDENORTE and EDESUR. In 1998, it is created the "Organismo Coordinador", which was given the responsibility to coordinate the utilities that formed the National Interconnected Electrical System (Sistema Eléctrico Nacional Interconectado, or SENI).

Renationalization Process

In 2000, the new administration introduced significant changes to the General Law of Electricity (enacted in 2001). These changes led to the creation of CDEEE (Corporación Dominicana de Empresas Eléctricas Estatales), ETED (Empresa de Transmisión Eléctrica Dominicana), and EGEHID (Generación Hidroeléctrica Dominicana). Thought this law, SIE was given the responsibility to regulate the sector and the CNE (Comisión Nacional de Energía) was put in charge of establishing the overall electricity policies.

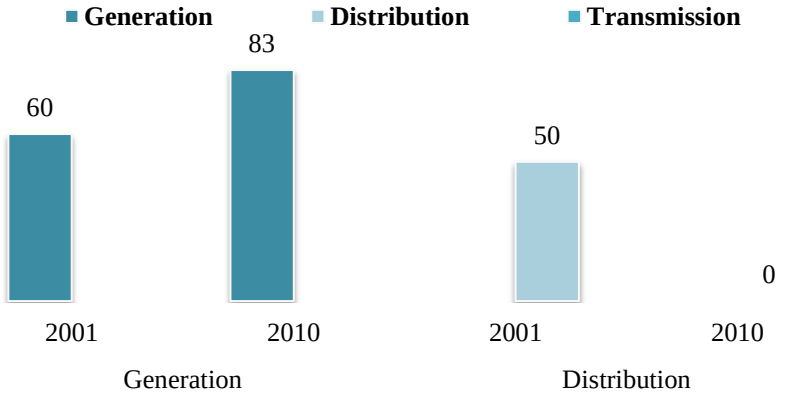
This period was characterized by a difficult economic and fiscal situation, which the government tried to improve through subsidies. In particular, with the increase of the international oil prices (1999–2001), given a high dependence from fossil fuel in the electricity generation matrix, it was necessary to adjust the tariffs. However, the Government opted to absorb this adjustment through subsidies granted directly to distributors. Additionally, in 2000, through Resolution SEIC 283-00, a fuel subsidy for electricity generation was authorized. The government could comply in delivering these subsidies due the devaluation of the Dominican peso, the increasing fiscal debt, and financial crisis of 2003. This situation led to the collapse of the sector.

As a result, in September 2003, the State, through CEDEE, had to acquire 50 percent of the shares of EDENORTE and EDESUR. However, the state-owned distribution companies continued to have negative cash flows, showing high levels of inefficiency in terms of service and administration (more electricity losses and lower collection levels).

After another increase in petroleum prices (2006–08), in 2009 the government purchased

50 percent of the shares in the private company EDEESTE, regaining control of the distribution sector.

Figure 6: Private Participation in Dominican Republic



Source: Authors' elaboration based on data from Espinasa (2001) and Table 1.

4 EMPIRICAL ANALYSIS

This section aims to address whether or not the market reforms can be associated with improvements in the overall performance of the electricity industry in Latin America. To this end, specification (1) intends to estimate reliable correlations between the performance of the industry and the process of privatization and regulatory reform occurred during the 1990s. Following the approaches of Gutierrez (2003) and Cubbin and Stern (2006), the present study incorporates the following long-run static model:

$$Y_{it} = \beta_1 X_{it} + \beta_2 R_{it-2} + \beta_3 Z_{it} + \omega_i + \varepsilon_{it} \ldots (1)$$

For performance (Y), the focus is on four available variables: (i) real end-user prices for residential electricity (excluding taxes); (ii) percentage of households with access to electricity; (iii) electricity capacity generation; and (iv) electricity loss as a percentage of total electricity production. Through these variables, we expect to capture dimensions of accessibility, quality, and efficiency of electricity services.

With regard to explanatory variables, we define privatization (Z) as the cumulative investment in the electricity sector as a percentage of average gross capital formation in the period 1984–2010. This variable is intended to capture cumulative private electricity investments since the start of the privatization process. The denominator is fixed by country, and is intended

to scale this investment to the relative size of each economy. As a robustness exercise, we measure privatization as a dummy variable, taking the value of 1 in the year the country reached at least 50 percent private participation in any subsector, and 0 otherwise.

With respect to institutional variables, following Cubbin and Stern (2006), we consider an additive index of four regulatory dimensions (R): (i) electricity law; (ii) independent regulation; (iii) license fee regulatory funding; and (iv) free pay scale for staff. The variables categorically take the value of 1 if they satisfy the condition in a given year and 0 otherwise; thus, the index range is [0 4]. Since it is possible to adopt each dimension in a different period for different countries, this institutional index has temporal variability both within and across countries. Since it would likely take time before the establishment of new regulatory agencies or characteristics could lead to any significant increase in the outcome variables, we introduce a two-year lag in R.

To account for differences across countries and over time, we include some control variables (X) that could be correlated with the variables of interest: GDP PPP per capita at constant 2005 prices, percentage of electricity generated from fossil fuels, and the political democratic index (Polity IV). The income is expected to capture the general economic condition of the country. It is expected to have a positive demand effect on capacity, coverage and prices as the market is more capable to afford better electricity services, as well as, consuming greater quantities. Electricity mix expects to capture important characteristics of the natural endowment of a country to generate electricity with potential relevant effects in capacity and prices. Polity IV captures democracy and autocracy, ranging from -10 (full autocracy) to 10 (full democracy). It expects to capture the overall institutional framework including the strength of institutions, rule of law and the degree of political interference that support or undermine the private investment of specific electricity regulatory framework.

We gathered annual data for 18 Latin American countries during the period 1971–2010 from different sources, including the Latin American Energy Organization (OLADE), the International Energy Association (IEA), the Economic Commission of Latin America and the Caribbean (ECLAC), the World Bank, Penn tables, and INSCR. All the variables, with the exception of the institutional indices, were transformed to natural logarithms.

In accordance with the nature of the long-period panel (>35 years), the data reveal the presence of the following characteristics in the proposed specification: (i) non-constant variance of error (heteroskedasticity) and (ii) cross-sectional dependence, which could lead to biased estimations of the standard error leading to an incorrect inference. Additionally, the test for stationarity, using the IM-Pesaran-Shin W statistic, rejects the presence of a unit root in the residuals, suggesting its nonstationarity and implying that the variables in level of specification (1) are cointegrated (see Annex 8).

Taking the above into consideration, we proceed to estimate equation (1) through Generalized Least Squares (GLS). As noted above, these estimations take into account differences between countries that are both fixed and changing over time, the latter of which should be captured by income, fuel-mix, international petroleum prices, and overall institutional performance. The estimated coefficients for these covariates tend to be in line with expectations (see Table 4 and Annex 9 for results).

Table 4: Electricity Performance Regressions

Explanatory variables	ln(Capacity)	ln(Elect. Losses)	ln(Coverage)	ln(Price)
Ln(Cumulative private investments ratio)	0.489**	-0.0129*	0.106**	-0.0150**
	(0.0604)	(0.00777)	(0.0115)	(0.00743)
Regulatory index$_{t-2}$	0.0429**	0.000711	0.00605**	-0.00286**
	(0.00879)	(0.00103)	(0.00125)	(0.00105)
Ln(GDP per capita, constant 2005 PPP)	0.554**	-0.0109*	0.0510**	0.0802**
	(0.0496)	(0.00595)	(0.00768)	(0.00791)
Ln(Electricity from fossil fuels)	-0.0476**	0.00249*	-0.00231**	0.00482**
	(0.00900)	(0.00129)	(0.000940)	(0.00147)
Ln(Petroleum prices)	0.0419**	-0.000217	0.00759**	0.00210
	(0.0193)	(0.00160)	(0.00354)	(0.00177)
Overall institutional index	0.0143**	0.000527**	0.00120**	-0.00185**
	(0.00144)	(0.000166)	(0.000236)	(0.000267)
Obs. per country	38	38	38	38
# countries	18	18	18	18
Total observation	684	684	684	684

Source: Authors' estimations.
Notes: Standard errors in parentheses* p<0.10, ** p<0.05; All specifications contain country fixed effects.

According to our estimations, the variables of interest—private investment in the electricity sector and regulatory quality—return coefficients in line with expectations. In the case of cumulative private investment, an increase of 1 percent is statistically significantly associated with: (i) a 0.49 percent increase in electricity generation capacity; (ii) a -0.13 percent reduction in electricity losses; (iii) a 0.11 percent increase in access to electricity services; and (iv) a -0.015 percent reduction in electricity prices.

With respect to the regulatory quality variable, a one-point increase is strongly associated with: (i) a 5 percent increase in generation capacity; (ii) a -0.3 percent reduction in prices; and (iv) a 0.7 percent increase in coverage. In the sample analyzed, electricity losses did not seem to be statistically associated with the measure of quality used in the exercise.

The robustness check partially reinforces these findings (see Annex 9). The estimated coefficients of the regulatory variable remained stable even if lags were not used. However, our results for the cases of coverage and prices are not robust with respect to the definition of private participation. That is, in the case of privatization, when we use a dummy as a proxy, the statistical results maintain only for capacity and electricity losses, while coverage and prices are no longer correlated with privatization. At a certain point this was to be expected, as the electricity coverage in the region was mainly increased through expanding service to rural areas, in most cases fostered by rural electrification programs funded with public resources.[8] With respect to electricity prices, the low economic relevance of the coefficients in Table 4 (and those not statistically significant in Annex 9) could be related to the fact that costs in state-owned utilities tend to be highly subsidized, while private utilities represent the true cost of services without subsidies.

Previous literature has already found robust empirical evidence of the positive effects of private participation on generation capacity and efficiency (electricity losses). Our non-robust results are also in line with the empirical literature, as evidence is also less clear in the case of coverage and electricity price. However, we found robust evidence that those countries with higher private investment tend to provide more efficient and better-quality electricity services. The evidence also supports the notion that better regulatory framework tends to improve quality and coverage and reduce average prices of electricity. That is, on average, regardless of the

[8] This is the case with Chile, which has performed an aggressive electrification program over the last few decades.

levels of private participation, well-designed and stable sector-specific institutions are significantly statistically associated with better utilities performance.[9]

5 CONCLUDING REMARKS

Electricity sector reforms in Latin American countries began in the early 1980s. Generally, they consisted of partial or incomplete reforms in the two dimension analyzed; privatization and changes in regulatory frameworks. As a result, private investment in the Latin American electricity sector totaled around US$155 billion over the last three decades, concentrated mainly in generation (US$87 billion), distribution (US$52 billion), and, to a lesser extent, transmission (US$14 billion). By 2010, private participation had reached 41 percent in generation, 42 percent in distribution, and 25 percent in transmission in 18 Latin American countries. Still, it seems unclear what are the positive outcomes which could be associated with this process; remaining performance challenges related with high level of electricity losses and end-user prices, as well as low coverage in rural areas. This paper has provided an empirical analysis of the relationship between these reforms and the performance of the sector.

In line with empirical literature, the econometric analysis suggests that the privatization process is statistically associated with improvements in efficiency and quality of the sector through reduction of electricity losses and expansion of generation capacity. However, no robust results were found in terms of whether privatization improves accessibility of electricity services in terms of coverage or electricity prices. In contrast, a strong and robust association was found between regulatory quality and generation capacity, coverage, and end-user-prices. Thus, regardless of the country characteristics and level of private participation, an efficient and well-designed institutional and regulatory setting is key to the sound performance of the electricity industry.

The findings of this paper emphasize the need for further research in market structures, investment dynamics, and institutional framework in the LAC region's electricity industry. A case-specific approach may be required to deeply assess the determinants of utilities performance

[9] However, the impact of private participation could be indirect. For example, it could be argued that those countries with high private participation have more capacity to direct their public resources to uses that are not attractive to the private sector.

in each subsector (generation, transmission, and distribution) and its interactions with the regulatory framework. Some areas to be addressed include price formation—with emphasis in subsidy schemes—as well as public and private investment plans to achieve a sustainable electricity generation matrix. Other dimension in this regard refers to the impacts of environmental regulations over the energy projects cost and their related end-user prices. Further studies are also needed to evaluate the overall end-users' satisfaction, an area where managerial practices and regulatory framework can have significant impact. Finally, special attention should be paid to electricity losses. Despite the findings of this paper, and regardless of the level of private participation, the average levels of electricity losses remain well above the international standards, requiring a more detailed analysis of this variable.

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Annex 1: Private Investments in the LAC Electricity Sector *(continued from Table 1)*

Country	Cumulate investment 1984–2011 *(US$ millions)*				Outputs		
	Total	Distribution	Transmission	Generation	Number of connections	KM	MW
Belize	354	156	–	198	506	–	141
Guyana	25	25	–		–	–	
Haiti	67	5	–	63	130	–	65
Jamaica	660	161	–	499	–	–	1,025
Cuba	123	-	-	123	-	-	913
Dominica	19	19	-	-	-	-	18
Grenada	33	33	-	-	314	-	-
St. Kitts and Nevis	17	-	-	17	-	-	5
St. Lucia	80	80	-	-	563	-	-
Total	153,529	52,164	14,418	86,947	751,878	217,473	232,101

Source: Authors' calculations based on data from the PPI Database / WB.
Note: Includes investments greater than US$1 million in the sector of electricity including generation, transmission, and distribution.

Annex 2: Private Participation in 2001 and 2010 *(continued from Table 2)*

Country	Generation		Transmission		Distribution	
	2001	2010	2001	2010	2001	2010
Argentina	60%	73%	100%	100%	70%	66%
Bolivia	90%	35%	90%	87%	90%	82%
Brazil	30%	38%	10%	14%	60%	70%
Chile	90%	100%	90%	100%	90%	100%
Colombia	70%	74%	10%	15%	50%	52%
Costa Rica	10%	18%	0%	0%	10%	0%
Dominican Republic	60%	83%	0%	0%	50%	0%
Ecuador	20%	17%	0%	0%	30%	0%
El Salvador	40%	68%	0%	0%	100%	100%
Guatemala	50%	77%	0%	36%	100%	93%
Honduras	n/d	63%	n/d	0%	n/d	0%
Jamaica	20%	n/d	0%	n/d	0%	n/d
Mexico	10%	23%	0%	0%	0%	0%
Nicaragua	n/d	78%	n/d	0%	n/d	96%
Panama	n/d	82%	n/d	0%	n/d	51%
Paraguay	0%	0%	0%	0%	0%	0%
Peru	60%	75%	20%	100%	80%	69%
Trinidad & Tobago	40%	n/d	0%	n/d	0%	n/d
Uruguay	0%	3%	0%	0%	0%	0%
Venezuela	20%	0%	10%	0%	40%	0%

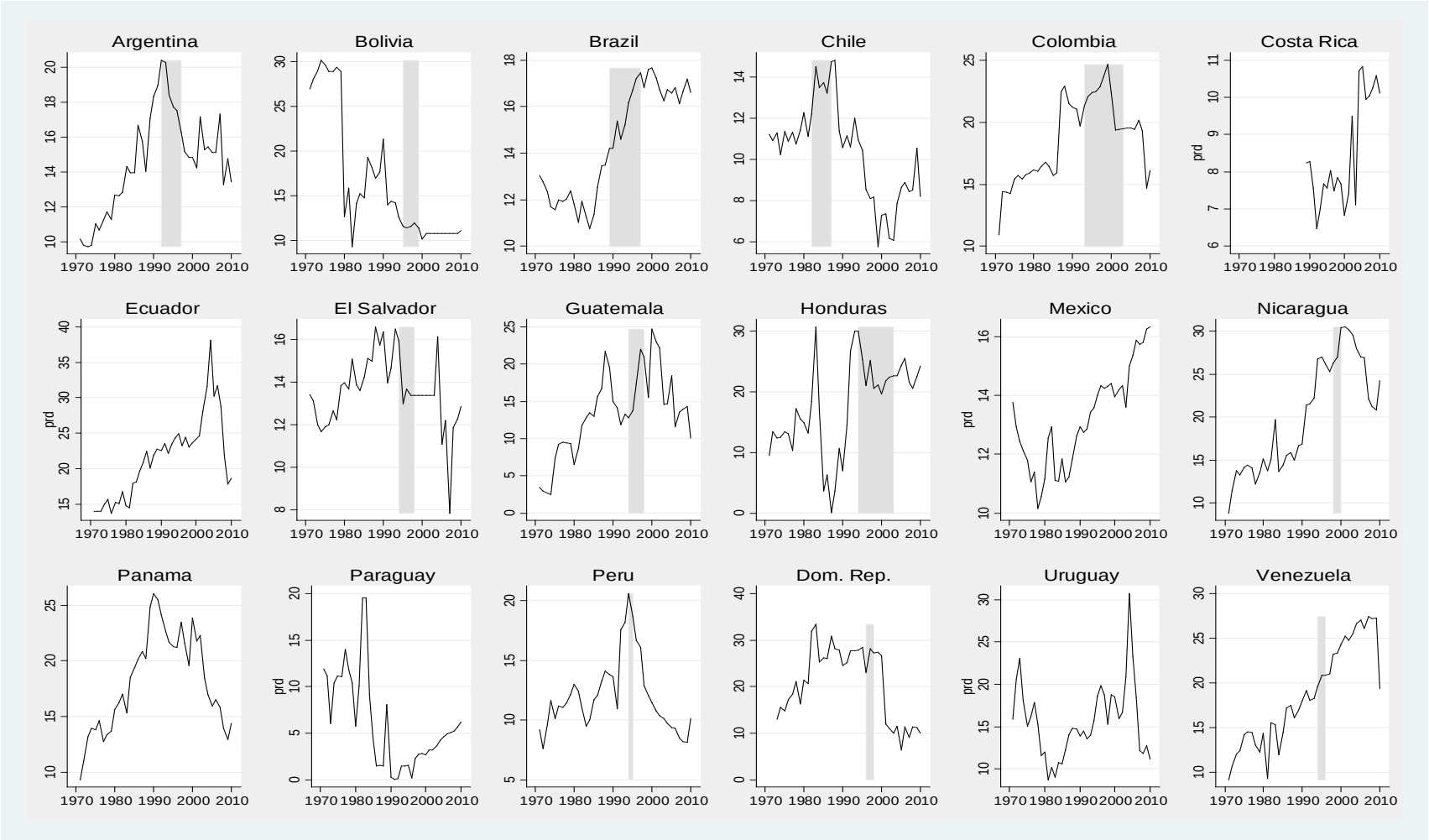
Source: Authors' elaboration with data of Espinasa (2001) and Table 2.
Notes: n/d = no data available.

Annex 3: Performance Indicators before (B) and after (A) Privatization

Degree of Private Participation	Countries	Final price for residential consumers (US$ Real/ KWh)		Percent of households with access to electricity		Electric power transmission and distribution losses *(% of output)*		Capacity generation per 1,000 habitants	
		B	A	B	A	B	A	B	A
Low	Venezuela	0.081	0.041	65	90	19	26	0.152	0.286
	Paraguay	0.177	0.064	80	95	12	15	0.282	0.433
	Mexico	0.093	0.075	75	97	2.3	9.1	0.269	0.466
	Costa Rica	0.092	0.078	86	98	15	18	0.407	0.687
	Ecuador	0.087	0.083	77	95	15	25	0.679	0.863
	Uruguay	0.136	0.181	45	91	7.2	4.1	0.581	1.358
Medium	Honduras	0.174	0.083	38	65	15	23	0.083	0.181
	Colombia	0.049	0.104	41	59	17	26	0.092	0.139
	Nicaragua	0.156	0.133	55	87	14	13	0.104	0.2
	Dom. Rep.	0.134	0.133	71	93	18	20	0.204	0.315
	El Salvador	0.105	0.138	64	84	18	19	0.287	0.461
	Panama	0.208	0.143	72	96	13	17	0.279	0.477
	Brazil	0.123	0.15	64	91	22	15	0.178	0.519
High	Argentina	0.128	0.068	81	95	14	15	0.457	0.731
	Bolivia	0.079	0.07	39	64	20	11	0.094	0.151
	Guatemala	0.168	0.103	70	93	12	9.4	0.288	0.58
	Peru	0.069	0.118	38	71	11	17	0.081	0.15
	Chile	0.129	0.147	44	68	12	11	0.173	0.231

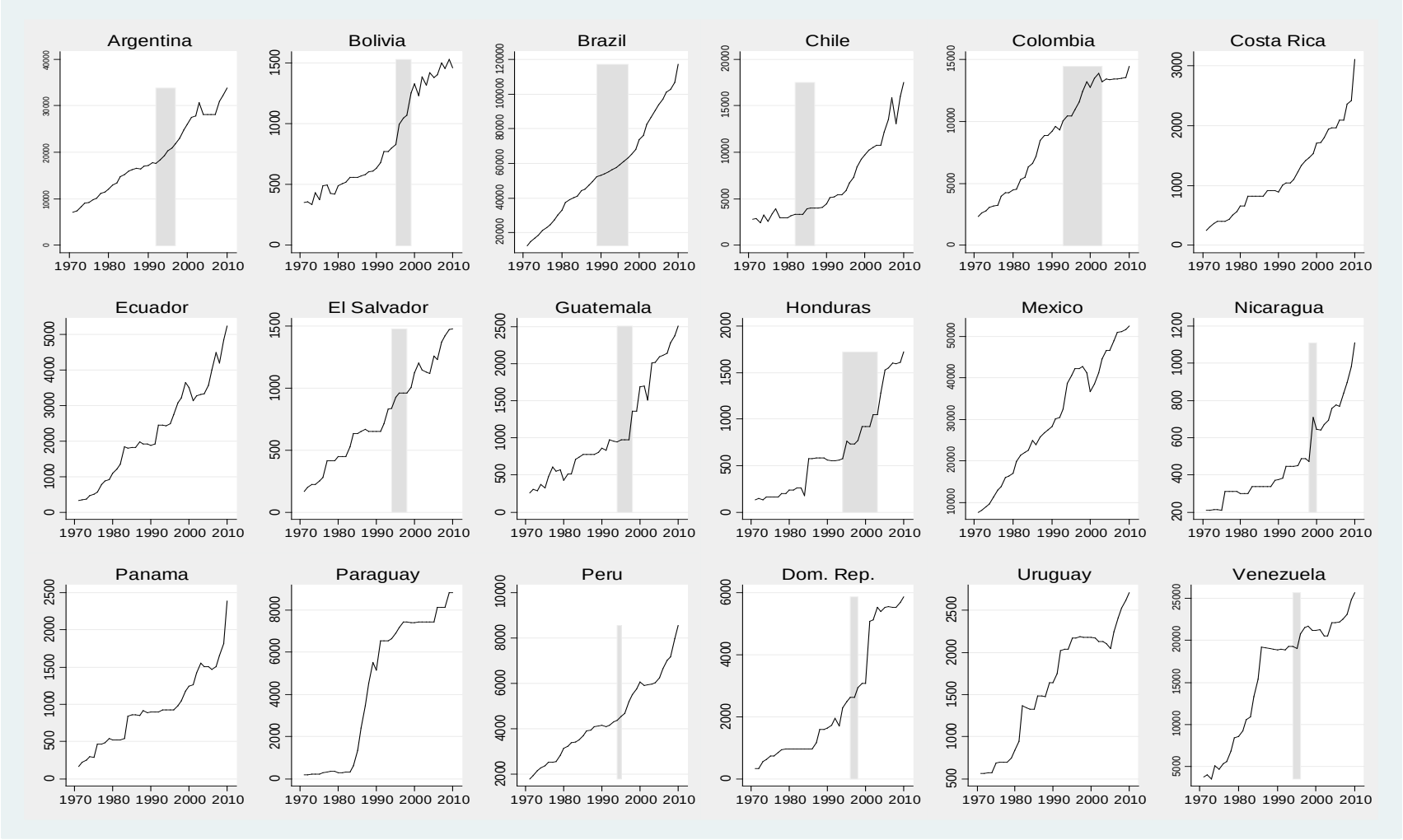
Source: Authors' calculations based on data from WDI, IEA, ECLAC, and OLADE.
Notes: B represents the average during the period 1971-t*, where t* is the average year of privatization in each country. A represents the average during t*-2010. In the case of countries without private investment, this study assumes the year 1997.

Annex 4: Electricity Power Transmission and Distribution Losses *(as percentage of output)*



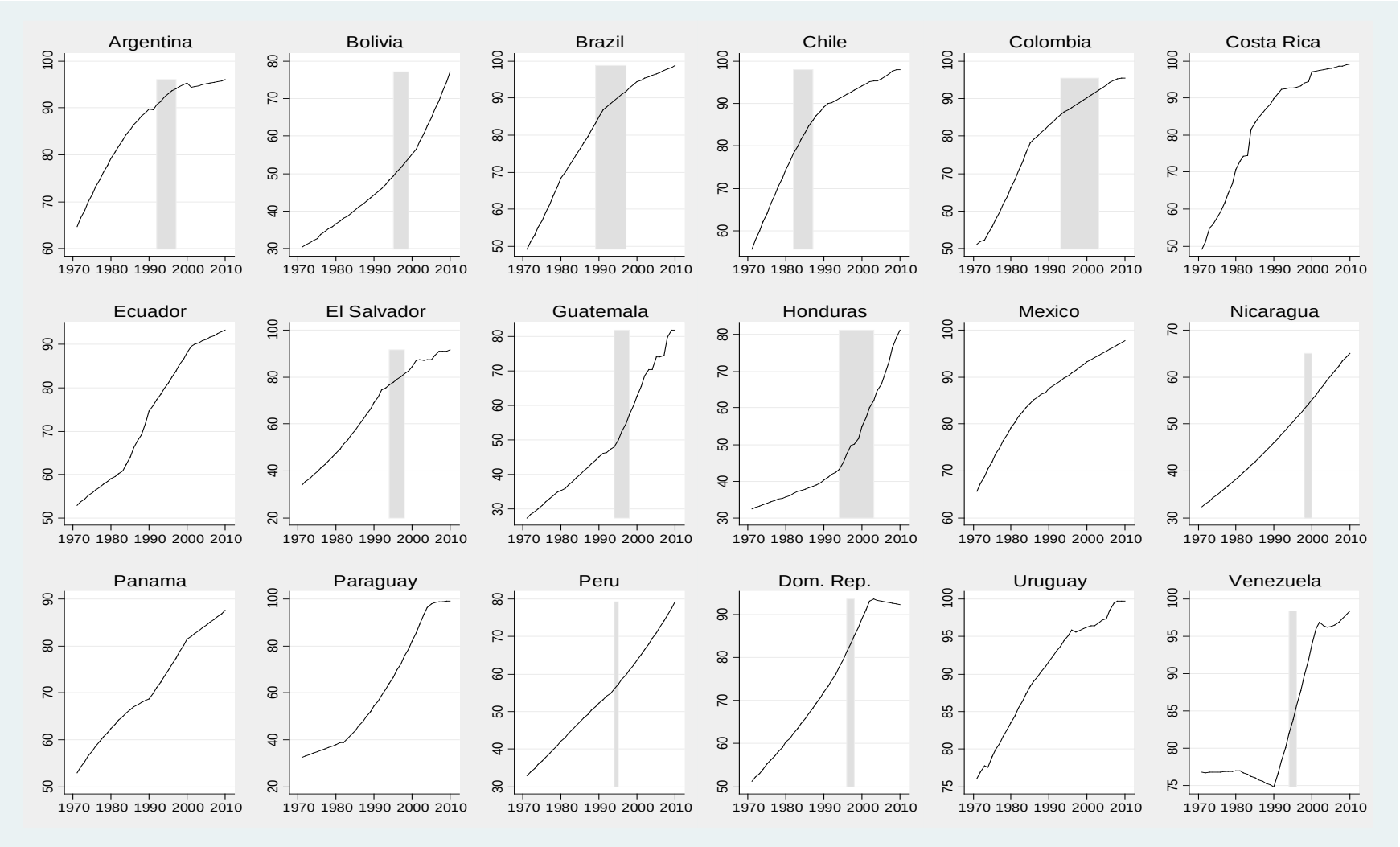
Source: Authors' elaboration based on information from OLADE. Gray area indicates the period between the year that privatization started and the year in which it reached 50 percent.

Annex 5: Installed Capacity for Electricity Generations *(KW)*



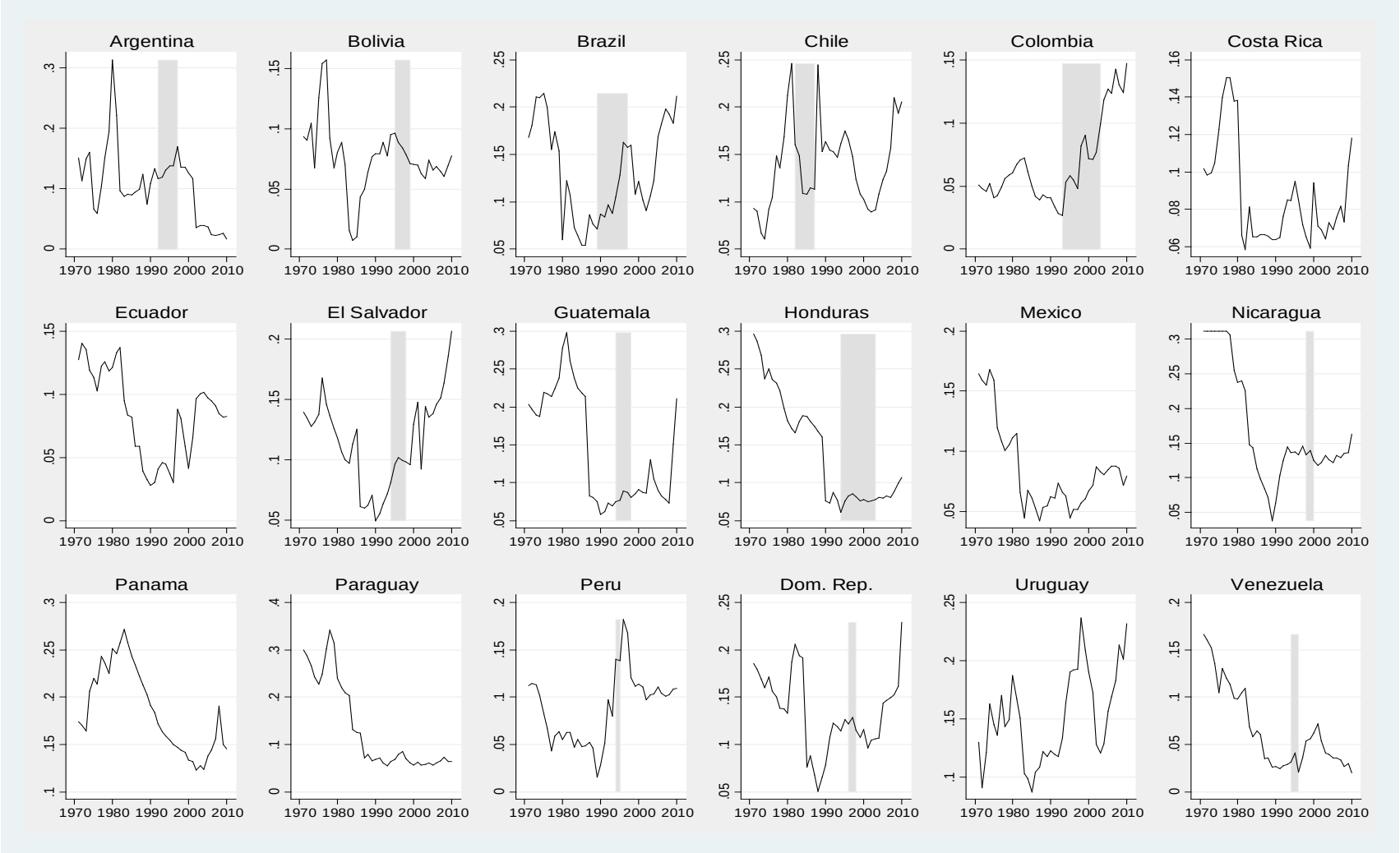
Source: Authors' elaboration based on information from OLADE. Gray area indicates the period between the year that privatization started and the year in which it reached 50 percent.

Annex 6: Percentage of Household with Access to Electricity



Source: Authors' elaboration based on information from OLADE. Gray area indicates the period between the year that privatization started and the year in which it reached 50 percent.

Annex 7: End-user Residential Electricity Prices *(real US$ / KWh)*



Source: Authors' elaboration based on information from OLADE. Gray area indicates the period between the year that privatization started and the year in which it reached 50 percent.

Annex 8: Specification Tests

Tests \ Outcome	Capacity		Losses		Coverage		Prices	
	Stats	*P-value*	*Stats*	*P-value*	*P-value*	*Stats*	*P-value*	*P-value*
Heteroskedasticity: Modified Wald Test for groupwise Heteroskedasticity*	107.89	0.000	1470.27	0.000	668.38	107.89	697.76	0.000
Serial correlation: Wooldridge test for autocorrelation in panel data	20.532	0.000	124.099	0.000	1489.62	0.000	97.011	0.000
Unit root test: IM-Pesaran-Shin W statistic**	-1.726	0.0422	-2.0161	0.0219	-2.0149	0.0220	-3.6899	0.0001
Cross-sectional dependence: Pesaran CD test	12.784	0.000	6.546	0.000	12.516	0.000	0.642	0.5210

Source: Authors' elaboration.
Notes: * Estimated in a fixed effect regression model; **includes trends and removes cross sectional means.

Annex 9: Electricity Performance Regressions *(continued from table 4)*

Explanatory variables	Ln(capacity)	Ln(elect. losses)	Ln(coverage)	Ln(price)
Privatization dummy$_{t-1}$	0.0741**	-0.00770**	0.00554	0.00483
	(0.0222)	(0.00242)	(0.00349)	(0.00407)
Regulatory index$_{t-2}$	0.0613**	0.00186*	0.00777**	-0.00421**
	(0.00900)	(0.00104)	(0.00159)	(0.00104)
Ln(GDP per capita, constant 2000 PPP)	0.666**	-0.00957*	0.0620**	0.0755**
	(0.0492)	(0.00548)	(0.00885)	(0.00791)
Ln(electricity from fossil fuels)	-0.0488**	0.00280**	-0.00206*	0.00512**
	(0.00905)	(0.00136)	(0.00108)	(0.00149)
ln(petroleum prices)	0.0387*	-0.00165	0.00669*	0.00170
	(0.0202)	(0.00143)	(0.00351)	(0.00179)
Overall institutional index	0.0141**	0.000357**	0.00114**	-0.00185**
	(0.00149)	(0.000153)	(0.000250)	(0.000270)
Obs. per country	38	38	38	38
Number of countries	18	18	18	18
Total observation	684	684	684	684

Source: Authors' elaboration.
Notes: Standard errors in parentheses * p<0.10 ** p<0.05; all specifications contain country-fixed effects.