**Institutional Governance and Performance in the Electricity Sector in Latin America and the Caribbean[[1]](#footnote-2)[[2]](#footnote-3)**

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# 1. Introduction

The 21st century started with a new wave of reforms in the electricity sector in Latin America and the Caribbean region (LAC). Reforms included changes in sector organization and regulation to increase the role of smart-grid technologies, distributed generation, and other technological innovations. As these changes are being rolled out, it seems useful to take stock of the outcomes of earlier governance reforms, as their performance outcomes define the baseline from which the new reform wave should be assessed. This assessment can also help policy makers determine which of the undelivered promises the new wave should include in its agenda.

This paper matches country-specific performance and governance characteristics in order to draw conclusions about the correlation between governance features and performance outcomes in the sector. The LAC region lends itself well to such an approach, because it is characterized by significant heterogeneity across countries in the degree to which institutional options were adopted. Countries differ in many dimensions, including whether they still have a vertically integrated service provider, created a separate regulator, rely massively on private capital, or opted for wholesale markets. Heterogeneity in governance is mirrored by heterogeneity in performance along the many dimensions that should drive outcomes.

The knowledge accumulated over the last 30 years suggests that governance affects performance, as Jasmab, Nepal, and Timilsina (2017) note in a survey of the impact of electricity reforms in developing countries. But the interaction between the two is complex. How much—and what kind of—governance matters is not clear.[[6]](#footnote-7) Part of the uncertainty on the sign and strength of the interaction is linked to the fact that many diagnostics focus on a single dimension of governance (e.g., privatization) and/or one performance outcome (e.g., investment). Such a focus can be misleading, because governance is best characterized as a package of institutions characteristics (e.g., market structure, regulation, other institutional dimensions), and outcomes are multiple.

This paper characterizes governance dimensions jointly and assesses their impact on various policy concerns. To do so, we develop a synthetic composite indicator that accounts for the multiple dimensions of governance of the sector and use it to understand the link between the various governance dimensions created and the outcomes of interest.

To identify the main governance and outcome dimensions to account for in LAC, we benefitted from earlier research on the impact of governance reforms in the region. Andres, Guasch, and Azumendi (2008); Andres, Schwartz, and Guasch (2013); and Balza, Jimenez, and Mercado (2013) provide some of the most encompassing recent assessments of the impact of reforms on performance in the region. They provide detailed characterizations of regulatory institutions as proxies for sector governance, using a smaller sample of countries than we study here.[[7]](#footnote-8) All three papers consider a similar range of governance changes (e.g., unbundling, privatization, regulation), but they do so individually. They largely confirm for LAC the conclusion reached by Jasmab, Nepal, and Timilsina (2017) in their summary of global experience. They find, for example, that privatization was associated with improvements in quality and efficiency in the region but not with better access to service. Their results also show that regulatory and institutional quality mattered to outcomes regardless of the level of private participation.

Accounting for the joint effects of all governance reforms, rather than assessing the effect of each of them individually, should yield a better appreciation of the complementarity of the main institutional changes countries adopt. Relying on a single indicator that synthesizes the diverse governance preferences at the country level should make it easier to get a sense of how far governments have moved away from the historical vertically integrated public monopoly that was the global norm in the electricity sector until the 1990s.

Beginning in the 1990s, many countries decide to change the governance of the sector. They typically focused on four dimensions: (a) market structure (unbundled or not), (b) opening to private sector participation, (c) the creation (or not) of a separate regulatory agency, and (d) the introduction of competition in the sector. For each country, these four dimensions can be translated into a single indicator “grading” governance on a scale of 0–100. Using this scale, it is possible to rank countries in terms of their level of adoption of the reforms typically considered desirable during the 1990s reform waves.[[8]](#footnote-9) We do this for 33 countries in LAC.

The synthetic indicator we create refines the indicator produced by the World Bank for 88 developing countries (including 14 in LAC) analyzed by Foster et al. (2017). That indicator synthesizes the four dimensions of power sector reform (the degree of unbundling, the existence of an autonomous regulatory entity, the entry of private management and capital, and the extent to which generators are allowed to compete to supply a monopoly utility and customers to negotiate their supply contracts).[[9]](#footnote-10) A major difference between the World Bank indicator and the one produced here is the approach used to weight the various dimensions. The World Bank assigns equal weights to all dimensions, ignoring the relevance of possible correlation across indicators, a major weakness noted by Polemis (2016). We use a weighting procedure that accounts for interactions among dimensions.

To use this indicator to produce policy insights, we combine the information provided by the governance choices made with the evidence on outcomes at the country level. First, we reinterpret the information provided by the 33 countries in the sample as data points in a continuous indicator of governance change that ranges from 0 to 100. Because for each synthetic governance observation, we have a matching performance outcome observed at the country level, we can correlate governance with a range of performance indicators, to test the extent to which the conclusions reached by earlier research on specific governance dimensions hold when the multidimensionality of governance is accounted for.

The rest of the paper is organized as follows. Section 2 presents the methodology. Section 3 discusses the results. Section 4 reports the correlation between the index of electricity reforms and the different aspects of quality of the service delivered. Section 5 summarizes the paper’s main conclusions.

# 2. Methodology for Creating the Index of Electricity Reforms

The development of the index can be described in four steps.

## ****Step 1: Identification of the Indicators****

Eight indicators capture the main dimensions typically discussed in the context of electricity reforms:

1. degree of competition in electricity transmission
2. degree of vertical integration (which reflects the range of integration over all industry functions)
3. participation of the private sector in generation, transmission, and distribution
4. existence of a separate regulatory entity
5. experience of the regulatory agency (approximated by the number of years it has been in place since its creation)
6. existence of a transmission system operator
7. existence of an independent system operator
8. existence of a wholesale market operator.

To structure the discussion in broad governance dimensions, we aggregate some of the indicators into four separate dimensions:

* market structure (i + ii)
* private sector participation (iii)
* regulatory autonomy and experience (iv + v)
* operational organization (vi + vii + viii).

## ****Step 2: Data Collection****

As in most policy diagnostics, data collection proved to be one of the most frustrating parts of the evaluation process. Even after almost 30 years of reforms in the region, it remains a challenge. There is still only limited comparability of information across countries, and most databases are either not open access and/or include only limited coverage of smaller economies. The international community still does not take measurement seriously enough.

The choice of indicators was limited by the availability of comparable data for a large number of economies. We opted to maximize the number of economies covered. We collected comparable data for 33 countries in LAC (including Puerto Rico but not Cuba because of lack of available information). Most of the data are for 2018, but some are for years as far back as 2015 (Table 1).

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 1 Status of electricity reform in Latin America and the Caribbean, by economy | | | | | | | | | | |
|  | *Dimension* | | | | | | | | | |
|  | *Market structure* | | *Private sector participation* | | | *Regulatory autonomy and experience* | | *Operational organization* | | |
| *Economy* | *Level of competition* | *Level of unbundling* | *Separate* | | | *Sepa-*  *rate* | *Year of creation* | *Trans-mission system operator* | *Indepen-dent system operator* | *Wholesale market operator* |
| *Gene-ration* | *Gene-ration* | *Distri-bution* |
| Antigua and Barbuda | Monopoly | Vertically integrated | Yes | No | No | No | 1973 | No | No | No |
| Argentina | Retail market competition | Fully vertically unbundled | Yes | Yes | Yes | Yes | 1992 | No | Yes | Yes |
| Bahamas | Monopoly | Vertically integrated | Yes | Yes | Yes | Yes | 2009 | No | No | No |
| Barbados | Monopoly | Vertically integrated | Yes | Yes | Yes | Yes | 2001 | No | No | Yes |
| Belize | Retail market competition | Partially vertically unbundled | Yes | Yes | Yes | Yes | 1999 | No | No | No |
| Bolivia | Retail market competition | Fully vertically unbundled | Yes | Yes | Yes | Yes | 1994 | Yes | Yes | Yes |
| Brazil | Wholesale competition | Fully vertically unbundled | Yes | Yes | Yes | Yes | 1996 | Yes | Yes | Yes |
| Chile | Retail market competition | Fully vertically unbundled | Yes | Yes | Yes | Yes | 1978 | No | Yes | Yes |
| Colombia | Wholesale competition | Partially vertically unbundled | Yes | Yes | Yes | Yes | 1992 | No | Yes | Yes |
| Costa Rica | Monopoly | Vertically integrated | Yes | No | No | Yes | 1996 | No | No | Yes |
| Dominica | Retail market competition | Vertically integrated | Yes | Yes | Yes | Yes | 2006 | No | No | No |
| Dominican Republic | Wholesale competition | Fully vertically unbundled | Yes | No | No | Yes | 1998 | Yes | Yes | Yes |
| Ecuador | Wholesale competition | Fully vertically unbundled | Yes | No | No | Yes | 1998 | No | Yes | Yes |
| El Salvador, | Retail market competition | Fully vertically unbundled | Yes | No | Yes | Yes | 1997 | Yes | Yes | Yes |
| Guatemala | Wholesale competition | Fully vertically unbundled | Yes | Yes | Yes | No | 1996 | No | Yes | Yes |
| Guyana | Monopoly | Vertically integrated | Yes | No | No | Yes | 1999 | No | No | No |
| Grenada | Monopoly | Vertically integrated | Yes | Yes | Yes | No | - | No | No | No |
| Haiti | Retail market competition | Vertically integrated | Yes | Yes | Yes | No | - | No | No | No |
| Honduras | Retail market competition | Vertically integrated | Yes | No | No | Yes | 1995 | No | No | Yes |
| Jamaica | Retail market competition | Vertically integrated | Yes | Yes | Yes | Yes | 1995 | No | No | No |
| Mexico | Wholesale competition | Vertically integrated | Yes | No | No | Yes | 1995 | No | Yes | Yes |
| Nicaragua | Wholesale competition | Fully vertically unbundled | Yes | No | Yes | Yes | 1979 | No | No | Yes |
| Panama | Wholesale competition | Vertically integrated | Yes | No | Yes | Yes | 2006 | No | Yes | Yes |
| Paraguay | Monopoly | Vertically integrated | No | No | No | No | - | No | No | No |
| Peru | Wholesale competition | Fully vertically unbundled | Yes | Yes | Yes | Yes | 1996 | No | Yes | Yes |
| Puerto Rico | Retail market competition | Vertically integrated | Yes | Yes | Yes | Yes | 2014 | No | No | No |
| St. Kitts and Nevis | Monopoly | Vertically integrated | Yes | Yes | Yes | No | - | No | No | No |
| St. Lucia | Monopoly | Vertically integrated | Yes | Yes | Yes | Yes | 1964 | No | No | No |
| St. Vincent and the Grenadines | Monopoly | Vertically integrated | Yes | Yes | Yes | No | - | No | No | No |
| Suriname | Retail market competition | Fully vertically unbundled | Yes | No | Yes | No | - | Yes | Yes | Yes |
| Trinidad and Tobago | Retail market competition | Vertically integrated | Yes | No | No | Yes | 1966 | No | No | No |
| Uruguay | Retail market competition | Vertically integrated | Yes | No | No | Yes | 1997 | No | No | No |
| Venezuela, RB | Monopoly | Vertically integrated | No | No | No | No | 1992 | No | No | No |

## ****Step 3: Normalization of the Data to Produce a Synthetic Index****

The composite index is expressed as

, (1)

where *I* is the composite index; is the normalized variable; is the weight of the , , and .

The data reported in table 1 are raw; the variables have different measurement units and therefore cannot be aggregated. To eliminate the bias of scale in the calculation of the composite indicator, we standardize the raw data (table 2).

Before normalizing the data, we transform the indicators with qualitative values into quantitative ones:

* For the level of competition, monopoly, retail market competition, and wholesale market competition take the values of 0, 1, and 2, respectively.
* For the level of unbundling, vertically integrated, partially vertically unbundled, and fully vertically unbundled take the values of 0, 1, and 2, respectively.
* For the year of creation, we transformed the variable into , where is the new value of the indicator for country *c* and is the year of creation of the regulator for the country c. If the country does not have a regulator, the variable takes the value of 0.
* To eliminate the bias of scale and be able to read all variables in the same direction, we normalized the data using the max-min method, transforming each indicator *q* for city *c* as follows:

, (2)

where and are the minimum and maximum values of across all countries. The normalized indicator has values lying between 0 () and 1 ().

This approach has the advantage of being simple, but it has limitations. The range, for example, is sensitive to the choice of countries. If any country performs poorly on an indicator and/or another performs every well, the values will be distorted.

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| Table 2 Normalized values of electricity reforms in Latin America and the Caribbean, by economy (percent) | | | | | | | | |
|  | *Dimension* | | | | | | | |
|  | *Market structure* | | *Private sector participation* | *Regulatory autonomy and experience* | | *Operational organization* | | |
| *Economy* | *Level of competition* | *Level of unbundling* | *Separate energy regulator* | *Year of creation of regulator* | *Transmission system operator* | *Independent system operator* | *Wholesale market operator* |
| Antigua and Barbuda | 0 | 0 | 33.3 | 0 | 83.3 | 0 | 0 | 0 |
| Argentina | 50 | 100 | 100 | 100 | 48.1 | 0 | 100 | 100 |
| Bahamas, The | 0 | 0 | 100 | 100 | 16.7 | 0 | 0 | 0 |
| Barbados | 0 | 0 | 100 | 100 | 31.5 | 0 | 0 | 100 |
| Belize | 50 | 50 | 100 | 100 | 35.2 | 0 | 0 | 0 |
| Bolivia | 50 | 100 | 100 | 100 | 44.4 | 100 | 100 | 100 |
| Brazil | 100 | 100 | 100 | 100 | 40.7 | 100 | 100 | 100 |
| Chile | 50 | 100 | 100 | 100 | 74.1 | 0 | 100 | 100 |
| Colombia | 100 | 50 | 100 | 100 | 48.1 | 0 | 100 | 100 |
| Costa Rica | 0 | 0 | 33.3 | 100 | 40.7 | 0 | 0 | 100 |
| Dominica | 50 | 0 | 100 | 100 | 22.2 | 0 | 0 | 0 |
| Dominican Republic | 100 | 100 | 33.3 | 100 | 37.0 | 100 | 100 | 100 |
| Ecuador | 100 | 100 | 33.3 | 100 | 37.0 | 0 | 100 | 100 |
| El Salvador | 50 | 100 | 66.7 | 100 | 38.9 | 100 | 100 | 100 |
| Guatemala | 100 | 100 | 100 | 0 | 40.7 | 0 | 100 | 100 |
| Guyana | 0 | 0 | 33.3 | 100 | 35.2 | 0 | 0 | 0 |
| Grenada | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| Haiti | 50 | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| Honduras | 50 | 0 | 33.3 | 100 | 42.6 | 0 | 0 | 100 |
| Jamaica | 50 | 0 | 100 | 100 | 42.6 | 0 | 0 | 0 |
| Mexico | 100 | 0 | 33.3 | 100 | 42.6 | 0 | 100 | 100 |
| Nicaragua | 100 | 100 | 66.7 | 100 | 72.2 | 0 | 0 | 100 |
| Panama | 100 | 0 | 66.7 | 100 | 22.2 | 0 | 100 | 100 |
| Paraguay | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Peru | 100 | 100 | 100 | 100 | 40.7 | 0 | 100 | 100 |
| Puerto Rico | 50 | 0 | 100 | 100 | 7.4 | 0 | 0 | 0 |
| St. Kitts and Nevis | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| St. Lucia | 0 | 0 | 100 | 100 | 100 | 0 | 0 | 0 |
| St. Vincent and the Grenadines | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 |
| Suriname | 50 | 100 | 66.7 | 0 | 0 | 100 | 100 | 100 |
| Trinidad and Tobago | 50 | 0 | 33.3 | 100 | 96.3 | 0 | 0 | 0 |
| Uruguay | 50 | 0 | 33.3 | 100 | 38.9 | 0 | 0 | 0 |
| Venezuela, RB | 0 | 0 | 0 | 0 | 48.2 | 0 | 0 | 0 |

## ****Step 4: Creation of the Composite Index****

The most challenging part is to come up with the partial composite indicator at a given dimension level. It requires two steps: (a) a multivariate analysis to check correlations between indicators and thus redundancy and (b) a principal component analysis followed by a factor analysis to compute the weighting factor for each indicator considering its redundancy (for details, see Freudenberg 2003).

Once weighted, the indicators can be aggregated. The aggregate single score replicates the approach from the partial composite indicators computed for the dimensions (except for private sector participation, for which there is only one indicator). These composite indicators for each dimension are weighted (multivariate analysis followed by principal component analysis/factor analysis) and summed to develop the aggregate single score.

## Illustration of the approach

We illustrate the approach by focusing on the dimension *operational organization*, the indicators for which are transmission system operator, independent system operator, and wholesale market operator. We compute the correlations between the indicators within the dimension (Table 3). If they are low, it is unlikely that they share common determining factors. Values marked \* are significant at the 5 percent level; values marked \*\* are significant at the 2 percent level (Pearson correlation test). These levels of significance indicate that a relatively large number of common parameters should be influencing their values. For instance, the existence of a transmission system in a country is significantly correlated with the existence of an independent system operator and a wholesale market operator. Principal component analysis/factor analysis helps reduce redundancy.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 3 Correlation matrix of Operational Organization | | | |
|  | *Type of operator* | | |
| *Type of operator* | *Transmission system operator* | *Independent system operator* | *Wholesale market operator* |
| Transmission system operator | 1 |  |  |
| Independent system operator | 0.5\*\*\* | 1 |  |
| Wholesale market operator | 0.4\*\* | 0.8\*\*\* | 1 |

*Note*: Pearson correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

As the weights significantly affect the composite indicator value, they affect the results. The easiest option is the equal weighting method, which consists of computing the mean of all indicators. Giving all indicators equal weighting implies that there is no redundancy, however. Grouping variables with a high degree of correlation could cause certain performance features to be overestimated. A weighting set was therefore computed from the principal component analysis in order to reduce redundancy.

The principal component analysis transforms correlated indicators into a set of independent factors (principal components) while preserving the maximum proportion of the total variation in the dataset (Nardo et al. 2005). It reduces the overlapping information between two or more variables. Formally, the analysis takes Q variables and finds linear combination of them to produce components that are uncorrelated: \

…

(3)  
  
At this point there are still Q principal components—that is, as many components as there are variables. The weights (also called *factor loadings*) of the principal components applied to the variables are chosen so that the principal components satisfy three conditions:

* 1. They are uncorrelated/orthogonal.
  2. The first supports the maximum proportion of the variance, the second supports the maximum of the remaining variance, and so on, until the last of the principal components absorbs all of the remaining variance not accounted by the preceding components.
  3. (Nardo et al. 2005).

The eigenvalues of the indicators’ correlation matrix are the variances of the principal components. They provide information on the variability in the data.

The decision on how many principal components should be retained in the analysis without losing too much information depends on the criteria (“stopping rules”) selected. A criteria usually used to select and determine the number of components consists of (a) having associated eigenvalues larger than 1, (b) individually contributing more than 10 percent to the explanation of overall variance, and (c) cumulatively contributing more than 80 percent to the explanation of the overall variance (Nardo et al. 2005).

To illustrate the discussion, we present the results of a principal component analysis on the dimension *operational organization* (table 4). In light of the above analysis, the first two factors are retained. The PCA is conducted with the R software package FactoMineR.

|  |  |  |  |
| --- | --- | --- | --- |
| Table 4 Principal component analysis of Operational Organization | | | |
|  | *Principal component* | | |
| *Variable* | *1* | *2* | *3* |
| Variance | 2.2 | 0.6 | 0.2 |
| Percent of variance explained | 72.0 | 21.2 | 6.8 |
| Cumulative percent of variance explained | 72.0 | 93.2 | 100.0 |

After extraction of the first two principal components representing the data, we consider them as factors for the factor analysis (table 5). We then rotate the factor loadings, in order to minimize the number of individual indicators that have a high loading on the same factor (Nardo et al. 2005). Doig so simplifies the structure of the factors and makes their interpretation easier.

The most common rotational method is the Varimax rotation, which we adopt. It is an orthogonal rotation minimizing the number of variables with high loadings on each factor.

|  |  |  |
| --- | --- | --- |
| Table 5 Factor loadings of indicators of Operational Organization | | |
|  | *Factor* | |
| *Indicator* | *1* | *2* |
| Transmission system operator | 0.2 | 1.0 |
| Independent system operator | 0.9 | 0.3 |
| Wholesale market operator | 0.9 | 0.2 |

*Note*: Extraction method: principal components, Varimax rotation

The last step involves constructing the weighting coefficients for the factors loadings matrix after Varimax rotation “given that the square of factors depicts the proportion of the total unit variance of the indicator, which is explained by the factor” (Nardo et al. 2005). We use the method proposed by Nicoletti, Scarpetta, and Boyland (2000), in which each factor loading is squared, the factors with the highest value are selected, and the values are divided by the sum of the largest factor loadings. The weighting coefficients for each indicator reported in table 6 are the outcome of this procedure.

|  |  |
| --- | --- |
| Table 6 Weights for indicators of Operational Organization | |
| *Indicator* | *Weight* |
| Transmission system operator | 0.4 |
| Independent system operator | 0.3 |
| Wholesale market operator | 0.3 |

Based on the results reported in table 6, the composite index of *operational organization* can be reduced as follows:

(4)

Using this methodology, we create partial composite indicators for *Market structure* and *Regulatory autonomy and experience*. The results are reported in the appendixes. The final step involves producing a single indicator from these four dimensions for each country.

# 3. Discussion of the Results

Table 7 reports the correlations between dimensions. *Market structure* and *Operational organization* seem to be significantly correlated, as do *Market structure* and *Regulatory autonomy and experience*. An explanation of the first correlation can be that if there is competition in the market, it is more likely that the operation of electricity system will be unbundled (it will be more likely to have a stand alone transmission system operator, an independent system operator or a wholesale market operator )

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 7 Correlation matrix of dimensions of Electricity Reform | | | | |
|  | *Dimension* | | | |
| *Dimension* | *Market structure* | *Private sector participation* | *Regulatory autonomy and experience* | *Operational organization* |
| Market structure | 1.0 |  |  |  |
| Private sector participation | 0.2 | 1.0 |  |  |
| Regulatory autonomy and experience | 0.3\* | 0.0 | 1.0 |  |
| Operational organization | 0.8\*\*\* | 0.1 | 0.2 | 1.0 |

*Note*: Pearson correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

The principal component and factor analysis step identifies four factors for the aggregate single score. Only the first three seem to matter: They jointly explain 96 percent of the cumulative variance (see appendix, table 23). The others are hence ignored in the following steps.

Once the factor loadings for each dimension have been measured, the weights to be used in the aggregation can be computed. Table 8 reports them, along with final aggregate scores.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 8 Aggregate and dimension scores for Electricity Reform in Latin America and the Caribbean, by economy (percent) | | | | | |
|  | *Final aggregate score* | *Partial reform dimension specific scores* | | | |
|  | *Market structure* | *Private sector participation* | *Regulatory autonomy and experience* | *Operational organization* |
| *Economy* | *0.23* | *0.27* | *0.26* | *0.24* |
| Antigua and Barbuda | 19.8 | 0 | 33.3 | 42.0 | 0.0 |
| Argentina | 78.6 | 75.0 | 100 | 74.0 | 63.6 |
| Bahamas, The | 41.6 | 0 | 100 | 58.0 | 0 |
| Barbados | 52.1 | 0 | 100 | 66.0 | 34.2 |
| Belize | 55.7 | 50.0 | 100 | 68.0 | 0 |
| Bolivia | 87.0 | 75.0 | 100 | 72.0 | 100 |
| Brazil | 92.2 | 100 | 100 | 70.0 | 100 |
| Chile | 81.9 | 75.0 | 100 | 87.0 | 63.6 |
| Colombia | 78.6 | 75.0 | 100 | 74.0 | 63.6 |
| Costa Rica | 35.4 | 0 | 33.3 | 70.0 | 34.2 |
| Dominica | 48.1 | 25.0 | 100 | 61.0 | 0 |
| Dominican Republic | 74.3 | 100 | 33.3 | 69.0 | 100.0 |
| Ecuador | 65.3 | 100 | 33.3 | 69.0 | 63.6 |
| El Salvador | 77.4 | 75.0 | 66.7 | 69.0 | 100 |
| Guatemala | 70.3 | 100 | 100 | 20.0 | 63.6 |
| Guyana | 26.5 | 0 | 33.3 | 68.0 | 0 |
| Grenada | 26.5 | 0 | 100 | 0 | 0 |
| Haiti | 32.3 | 25.0 | 100 | 0 | 0 |
| Honduras | 41.4 | 25.0 | 33.3 | 71.0 | 34.2 |
| Jamaica | 50.7 | 25.0 | 100 | 71.0 | 0 |
| Mexico | 54.4 | 50.0 | 33.3 | 71.0 | 63.6 |
| Nicaragua | 71.4 | 100 | 66.7 | 86.0 | 34.2 |
| Panama | 60.6 | 50.0 | 66.7 | 61.0 | 63.6 |
| Paraguay | 0 | 0 | 0 | 0 | 0 |
| Peru | 83.3 | 100 | 100 | 70.0 | 63.6 |
| Puerto Rico | 46.3 | 25.0 | 100 | 54.0 | 0 |
| St. Kitts and Nevis | 26.5 | 0 | 100 | 0 | 0 |
| St. Lucia | 52.5 | 0 | 100 | 100 | 0 |
| St. Vincent and the Grenadines | 26.5 | 0 | 100 | 0 | 0 |
| Suriname | 59.4 | 25.0 | 33.3 | 98.0 | 0 |
| Trinidad and Tobago | 40.1 | 25.0 | 33.3 | 69.0 | 0 |
| Uruguay | 32.5 | 0 | 0 | 24.0 | 0 |
| Venezuela, RB | 6.2 | 0 | 0 | 24 | 0 |
| Average | 51.4 | 41.7 | 71.7 | 54.9 | 34.7 |
| Standard deviation | 0.24 | 0.39 | 0.34 | 0.31 | 0.38 |
| Maximum value | 92.2 | 100 | 100 | 100 | 100 |
| Minimum value | 0 | 0 | 0 | 0 | 0 |

The average aggregate figure (51.4) indicates that many countries have not followed the reform wave. The most popular reform was the opening to private capital, with an average score of 71.7. The least widespread reform is the change in the operational organization of the sector, with an average score of 34.7. The standard deviations around the mean are similar for all reforms.

The aggregate scores reveal Paraguay as an outlier; it did not implement any of the reforms assessed in this diagnostic. Brazil performed best, with a score of 91 percent, followed by Bolivia, Chile, and Peru, all of which scored above 80 percent.

Almost all countries (94 percent) had private sector participation in their electricity industry. Other reforms were less widespread. A third of the countries scored 0 on market structure, about a quarter had not created a separate regulatory agency, and almost half had not restructured the operational side of the sector (that is, they had no separate transmission system operator , independent system operator, or wholesale market operator).

Half of the Caribbean countries analyzed (7 of 14) lag the other countries in the region, suggesting that size matters, as Foster et al. (2017) note. Some differences in policy and political preferences are unrelated to size, however.

# Are Reforms Correlated with Outcomes?

Are reforms linked to enhancements in the performance of the electricity sector? To investigate the question, we focus on four dimensions of quality:

* + - Access, as measured by the percentage of the population with access to electricity (World Bank 2016a)
    - Technical quality, as measured by the annual duration and frequency of outages per customer, the reliability of supply and the transparency of the tariff index, and energy losses in distribution (World Bank 2017a)
    - Process quality, as measured by the number of procedures for getting electricity, the number of days for getting electricity, mechanisms for monitoring outages, mechanisms for restoring outages, financial deterrents aimed at limiting outages, and communication of tariff changes (World Bank 2017a)
    - Affordability, as measured by the cost of electricity as a percentage of per capita Gross National Income (World Bank 2017a).

Table 9 reports the results.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 9 Performance of electricity sector in Latin America and the Caribbean, by economy | | | | | | | | | | | |
|  | *Access* | *Technical quality* | | | *Process quality* | | | | | | *Affordability* |
| *Economy* | *Percent of population with electricity access* | *Total duration and frequency of outages per customer a year* | *Reliability of supply and transparency of tariff index* | *Energy losses in distribution and transmission as a percent of output* | *Mechanisms for monitoring outages* | *Mechanisms for restoring outages* | *Financial deterrents aimed at limiting outages* | *Communication of tariff changes* | *Procedures to get service* | *Time to get service* | *Cost of electricity as percent of GNI per capita* |
| Antigua and Barbuda | 97.3 | 1 | 5 | 24.0 | 1 | 1 | 1 | 1 | 4 | 42 | 115 |
| Argentina | 100 | 0 | 5 | 16.0 | 1 | 1 | 1 | 1 | 6 | 92 | 24 |
| Bahamas | 100 | 0 | 0 | 12.0 | 1 | 1 | 0 | 1 | 5 | 67 | 124 |
| Barbados | 100 | 0 | 0 | 6.0 | 1 | 1 | 1 | 1 | 8 | 88 | 64 |
| Belize | 92.2 | 0 | 4 | 12.0 | 1 | 1 | 0 | 1 | 5 | 66 | 318 |
| Bolivia | 93.0 | 1 | 6 | 14.0 | 1 | 1 | 1 | 1 | 8 | 42 | 689 |
| Brazil | 100 | 0.5a | 5.4 | 16.0 | 1 | 1 | 1 | 1 | 4 | 64 | 54 |
| Chile | 100 | 2 | 6 | 9.0 | 1 | 1 | 1 | 0 | 5 | 43 | 68 |
| Colombia | 99.0 | 1 | 6 | 20.0 | 1 | 1 | 1 | 1 | 5 | 106 | 542 |
| Costa Rica | 100 | 3 | 8 | 10.0 | 1 | 1 | 1 | 1 | 5 | 45 | 168 |
| Dominica | 100 | 3 | 7 | 8.2 | 1 | 1 | 0 | 1 | 5 | 61 | 466 |
| Dominican Republic | 100 | 0 | 4 | 34.0 | 1 | 1 | 0 | 1 | 7 | 67 | 249 |
| Ecuador | 99.9 | 2 | 7 | 19.0 | 1 | 1 | 1 | 1 | 7 | 74 | 636 |
| El Salvador | 98.6 | 1 | 8 | 12.0 | 1 | 1 | 1 | 1 | 4 | 88 | 883 |
| Guatemala | 92.3 | 1 | 4 | 7.7 | 1 | 1 | 0 | 1 | 5 | 38 | 188 |
| Guyana | 91.8 | 2 | 7 | 14.0 | 1 | 1 | 1 | 1 | 5 | 44 | 551 |
| Grenada | 84.2 | 0 | 4 | 33.0 | 1 | 0 | 1 | 1 | 8 | 82 | 442 |
| Haiti | 38.7 | 0 | 0 | 56.0 | 0 | 0 | 0 | 1 | 4 | 60 | 3522 |
| Honduras | 87.6 | 0 | 0 | 25.0 | 0 | 1 | 0 | 1 | 7 | 39 | 791 |
| Jamaica | 98.2 | 2 | 7 | 24.0 | 1 | 1 | 1 | 1 | 7 | 95 | 237 |
| Mexico | 100 | 3 | 7 | 17.0 | 1 | 1 | 0 | 1 | 6.8 | 100 | 314 |
| Nicaragua | 81.8 | 0 | 4 | 32.0 | 1 | 1 | 0 | 1 | 6 | 55 | 856 |
| Panama | 93.4 | 3 | 8 | 13.0 | 1 | 1 | 1 | 1 | 5 | 35 | 17 |
| Paraguay | 98.4 | 0 | 2 | 32.0 | 0 | 1 | 0 | 1 | 5 | 67 | 162 |
| Peru | 94.8 | 1 | 6 | 7.0 | 1 | 1 | 1 | 1 | 5 | 67 | 350 |
| Puerto Rico | 100 | 1 | 4 | 13.8 | 1 | 1 | 0 | 1 | 5 | 32 | 228 |
| St. Kitts and Nevis | 100 | 0 | 0 | 17.8 | 0 | 0 | 0 | 0 | 4 | 18 | 239 |
| St. Lucia | 97.8 | 3 | 7 | 9.3 | 1 | 1 | 0 | 1 | 6 | 26 | 83 |
| St. Vincent and the Grenadines | 100 | 0 | 0 | 7.4 | 1 | 0 | 0 | 1 | 3 | 52 | 52 |
| Suriname | 87.2 | 0 | 0 | 8.0 | 1 | 1 | 0 | 1 | 4 | 113 | 634 |
| Trinidad and Tobago | 100 | 1 | 6 | 6.0 | 1 | 1 | 1 | 1 | 4 | 61 | 212 |
| Uruguay | 100 | 1 | 6 | 19.0 | 1 | 1 | 1 | 1 | 5 | 48 | 11 |
| Venezuela, RB | 99.6 | 0 | 0 | 32.0 | 0 | 0 | 0 | 0 | 6 | 208 | 16713 |

*Note*: a. Average of Rio de Janeiro (1) and São Paulo (0).

The data for the 11 performance indicators are then normalized using the max-min procedure, except for indicators that are inversely proportional to quality. For those cases, we adapt the formula in order to link the indicator value positively with quality (an increase in the value will increase the quality character). Indicators inversely proportional to quality are adapted with the following equation:

, (5)

where is the normalized indicator *q* of type “less is better.” We then create the aggregate indicators *Technical quality* and *Process quality* (*Access* and *Affordability* arecharacterized only by one indicator and therefore do not require a aggregate index) following the same methodology used to create the synthetic governance index (see appendix B). Table 10 provides the normalized values of the performance indicators. Table 11 presents the final scores of the various dimensions of quality.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table 10 Normalized values of performance indicators in Latin America and the Caribbean, by economy (max-min method results) (percent) | | | | | | | | | | | |
|  | *Access* | *Technical quality* | | | *Process quality* | | | | | | *Affordability* |
| *Economy* | *Percent of population with electricity access* | *Total duration and frequency of outages per customer a year* | *Reliability of supply and transparency of tariff index* | *Energy losses in distribution and transmission as a percent of output* | *Mechanisms for monitoring outages* | *Mechanisms for restoring outages* | *Financial deterrents aimed at limiting outages* | *Communication of tariff changes* | *Procedures to get service* | *Time to get service* | *Cost of electricity as percent of GNI per capita* |
| Antigua and Barbuda | 95.6 | 66.7 | 62.5 | 64.0 | 100 | 100 | 100 | 100 | 80 | 87.4 | 99.4 |
| Argentina | 100 | 100 | 62.5 | 80.0 | 100 | 100 | 100 | 100 | 40 | 61.0 | 99.9 |
| Bahamas | 100 | 100 | 0 | 88.0 | 100 | 100 | 0 | 100 | 60 | 74.2 | 99.3 |
| Barbados | 100 | 100 | 0 | 100 | 100 | 100 | 100 | 100 | 0 | 63.2 | 99.7 |
| Belize | 87.3 | 100 | 50.0 | 88.0 | 100 | 100 | 0 | 100 | 60 | 74.7 | 98.2 |
| Bolivia | 88.6 | 66.7 | 75.0 | 84.0 | 100 | 100 | 100 | 100 | 0 | 87.4 | 95.9 |
| Brazil | 100 | 83.3 | 67.5 | 80.0 | 100 | 100 | 100 | 100 | 80 | 75.6 | 99.7 |
| Chile | 100 | 33.3 | 75.0 | 94.0 | 100 | 100 | 100 | 0 | 60 | 86.8 | 99.7 |
| Colombia | 98.4 | 66.7 | 75.0 | 72.0 | 100 | 100 | 100 | 100 | 60 | 53.7 | 96.8 |
| Costa Rica | 100 | 0 | 100 | 92.0 | 100 | 100 | 100 | 100 | 60 | 85.8 | 99.1 |
| Dominica | 100 | 0 | 87.5 | 95.6 | 100 | 100 | 0 | 100 | 60 | 77.4 | 97.3 |
| Dominican Republic | 100 | 100 | 50.0 | 44.0 | 100 | 100 | 0 | 100 | 20 | 74.2 | 98.6 |
| Ecuador | 99.8 | 33.3 | 87.5 | 74.0 | 100 | 100 | 100 | 100 | 20 | 70.5 | 96.3 |
| El Salvador | 97.7 | 66.7 | 100 | 88.0 | 100 | 100 | 100 | 100 | 80 | 63.2 | 94.8 |
| Guatemala | 87.4 | 66.7 | 50.0 | 96.6 | 100 | 100 | 0 | 100 | 60 | 89.5 | 98.9 |
| Guyana | 86.6 | 33.33 | 87.5 | 84.0 | 100 | 100 | 100 | 100 | 60 | 86.3 | 96.8 |
| Grenada | 74.2 | 100 | 50.0 | 46.0 | 100 | 0 | 100 | 100 | 0 | 66.3 | 97.4 |
| Haiti | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 100 | 80 | 77.9 | 79.0 |
| Honduras | 79.8 | 100 | 0 | 62.0 | 0 | 100 | 0 | 100 | 20 | 88.9 | 95.3 |
| Jamaica | 97.1 | 33.3 | 87.5 | 64.0 | 100 | 100 | 100 | 100 | 20 | 59.5 | 98.6 |
| Mexico | 100 | 0 | 87.5 | 78.0 | 100 | 100 | 0 | 100 | 24 | 56.6 | 98.2 |
| Nicaragua | 70.3 | 100 | 50.0 | 48.0 | 100 | 100 | 0 | 100 | 40 | 80.5 | 94.9 |
| Panama | 89.3 | 0 | 100 | 86.0 | 100 | 100 | 100 | 100 | 60 | 91.0 | 100 |
| Paraguay | 97.4 | 100 | 25.0 | 48.0 | 0 | 100 | 0 | 100 | 60 | 74.2 | 99.1 |
| Peru | 91.5 | 66.7 | 75.0 | 98.0 | 100 | 100 | 100 | 100 | 60 | 74.2 | 98.0 |
| Puerto Rico | 100 | 66.7 | 50.0 | 84.4 | 100 | 100 | 0 | 100 | 60 | 92.6 | 98.7 |
| St. Kitts and Nevis | 100 | 100 | 0 | 76.4 | 0 | 0 | 0 | 0 | 80 | 100 | 98.6 |
| St. Lucia | 96.4 | 0 | 87.5 | 93.4 | 100 | 100 | 0 | 100 | 40 | 95.8 | 99.6 |
| St. Vincent and the Grenadines | 100 | 100 | 0 | 97.2 | 100 | 0 | 0 | 100 | 100 | 82.1 | 99.7 |
| Suriname | 79.1 | 100 | 0 | 96.0 | 100 | 100 | 0 | 100 | 80 | 50.0 | 96.3 |
| Trinidad and Tobago | 100 | 66.7 | 75.0 | 100 | 100 | 100 | 100 | 100 | 80 | 77.4 | 98.8 |
| Uruguay | 100 | 66.7 | 75.0 | 74.0 | 100 | 100 | 100 | 100 | 60 | 84.2 | 100 |
| Venezuela, RB | 99.3 | 100 | 0 | 48.0 | 0 | 0 | 0 | 0 | 40 | 0 | 0 |

Table 11 reveals that the region performs well on average in terms of access and affordability, with average scores 91.3 percent and 94.6 percent, respectively. It performs much less well on service and technical quality, where the averages are 70.4 percent and 66.3 percent, respectively. For all indicators, the standard deviation is large, because of the presence of outliers such as Haiti (for access rate and technical quality) and the República Bolivariana de Venezuela (for affordability and service quality).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 11 Scores on dimensions of performance in the electricity sector in Latin America and the Caribbean, by economy (percent) | | | | |
|  | *Dimension* | | | |
| *Economy* | *Access* | *Technical quality* | *Process quality* | *Affordability* |
| Antigua and Barbuda | 95.7 | 64.3 | 93.2 | 99.4 |
| Argentina | 100.0 | 80.4 | 79.4 | 99.9 |
| Bahamas, The | 100.0 | 62.8 | 67.1 | 99.3 |
| Barbados | 100.0 | 67.2 | 71.5 | 99.7 |
| Belize | 87.3 | 79.2 | 67.3 | 98.2 |
| Bolivia | 88.6 | 75.7 | 76.5 | 95.9 |
| Brazil | 100.0 | 76.9 | 90.7 | 99.7 |
| Chile | 100.0 | 69.1 | 72.5 | 99.7 |
| Colombia | 98.4 | 71.3 | 82.0 | 96.8 |
| Costa Rica | 100.0 | 66.3 | 88.7 | 99.1 |
| Dominica | 100.0 | 63.5 | 67.8 | 97.3 |
| Dominican Republic | 100.0 | 63.2 | 58.8 | 98.6 |
| Ecuador | 99.8 | 65.9 | 77.2 | 96.3 |
| El Salvador | 97.7 | 85.4 | 88.2 | 94.8 |
| Guatemala | 87.4 | 72.1 | 70.3 | 98.9 |
| Guyana | 86.6 | 69.6 | 88.8 | 96.8 |
| Grenada | 74.2 | 63.9 | 60.0 | 97.4 |
| Haiti | 0.0 | 30.8 | 49.3 | 79.0 |
| Honduras | 79.8 | 53.3 | 51.3 | 95.3 |
| Jamaica | 97.1 | 62.3 | 74.9 | 98.6 |
| Mexico | 100.0 | 57.1 | 56.0 | 98.2 |
| Nicaragua | 70.3 | 64.6 | 64.3 | 94.9 |
| Panama | 89.3 | 64.1 | 89.8 | 99.9 |
| Paraguay | 97.4 | 56.4 | 56.5 | 99.1 |
| Peru | 91.5 | 80.8 | 86.3 | 98.0 |
| Puerto Rico | 100.0 | 67.6 | 71.0 | 98.7 |
| St. Kitts and Nevis | 100.0 | 58.6 | 37.5 | 98.6 |
| St. Lucia | 96.4 | 62.7 | 67.5 | 99.6 |
| St. Vincent and the Grenadines | 100.0 | 66.1 | 64.9 | 99.7 |
| Suriname | 79.1 | 65.7 | 66.3 | 96.3 |
| Trinidad and Tobago | 100.0 | 81.5 | 91.1 | 98.8 |
| Uruguay | 100.0 | 72.1 | 88.4 | 100 |
| Venezuela, RB | 99.3 | 48.2 | 8.3 | 0 |
| Average | 91.4 | 66.3 | 70.4 | 94.6 |
| Standard deviation | 0.18 | 0.11 | 0.18 | 0.17 |
| Maximum value | 100 | 85.4 | 93.2 | 100 |
| Minimum value | 0 | 30.8 | 8.3 | 0 |

Table 12 reports the correlations among the four performance measures. The Pearson correlation is usually used to assess the linear relationship between two continuous variables. As we normalized all indicators, we are de facto relying on continuous variables. Pearson assumes that the variables are normally distributed and linear. The Spearman correlation coefficient provides insights on the ranked values for each variable. It measures the monotonic relationship of the variables (meaning that the variables might tend to move in the same direction but not necessarily at a constant rate) and does not make assumptions about the distribution of the data. The two measures usually yield similar results unless the data are not normally distributed or significant nonlinearities characterize them.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table 12 Correlation matrix of dimensions of performance | | | | |
|  | *Dimension* | | | |
| *Measure* | *Access* | *Technical quality* | *Process quality* | *Affordability* |
| *Pearson* |  |  |  |  |
| Access | 1 |  |  |  |
| Technical quality | 0.6\*\*\* | 1 |  |  |
| Process quality | 0.2 | 0.7\*\*\* | 1 |  |
| Affordability | 0.1 | 0.4\*\* | 0.7\*\*\* | 1 |
|  |  |  |  |  |
| *Spearman* |  |  |  |  |
| Access | 1 |  |  |  |
| Technical quality | 0.1 | 1 |  |  |
| Process quality | 0.2 | 0.7\*\*\* | 1 |  |
| Affordability | 0.5\*\*\* | 0.2 | 0.4\*\* | 1 |

*Note*: Pearson and Spearman correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

This analysis provides a number of insights for policy:

* Access and affordability are nonlinearly correlated. This finding is not unexpected, given the complexity of tariff structures in many countries in the region and the widespread mistargeting of subsidies.
* Access and affordability are both positively and statistically significantly linearly correlated with technical quality. This finding suggests that the poor are likely to benefit from improved technical efficiency in the region.
* Affordability is positively correlated with process quality. This finding suggests that improvements in the way service caters to users are likely to have strong social payoffs.
* The strongest correlation is between the two quality dimensions. This finding, together with the social payoffs to quality improvements, points to the importance of measuring technical quality as rigorously as possible as part of the regulatory supervision of the sector.

To assess the relationship between governance and performance, we assess their correlations using both the Pearson and Spearman measures. We do so for the synthetic governance index as well as for each of its main components. To complement the assessment, we report include the results of a very basic ordinary least square linear regressions (figure 1) between the overall reform score and each performance dimension.

The results of the Pearson and Spearman tests lead to two main conclusions (table 13). First, there is no correlation between the reform index and access or affordability. Second, there is some correlation with quality variables. The Pearson correlation shows a positive correlation with both technical and process quality. The Spearman correlation is significant only for technical quality. The difference may reflect the presence of outliers, which leads the Pearson correlation to be higher than the Spearman correlation.

|  |  |  |
| --- | --- | --- |
| **Table 13 Correlation between aggregate reform index and performance outcomes** | | |
|  | *Reform aggregate index* | |
| *Performance outcome* | *Pearson correlation* | *Spearman correlation* |
| Access | 0.1 | 0.0 |
| Technical quality | 0.6\*\*\* | 0.5\*\*\* |
| Process quality | 0.4\*\* | 0.3\* |
| Affordability | 0.3\*\* | 0.0 |

*Note*: Pearson and Spearman correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

The results in Table 13 largely confirm the conclusions reached by Andres, Schwartz, and Guasch (2013) and Balza, Jimenez, and Mercado (2013) from their reading of various partial assessments. To make the comparison more precise, it may be useful to see how strong the correlation is with each of the four individual governance dimensions analyzed separately in earlier research. None of the Pearson correlations is statistically significant, suggesting that the links between performance and these partial governance dimensions are unlikely to be simply linear. Table 14 reports the results for the Spearman correlations.

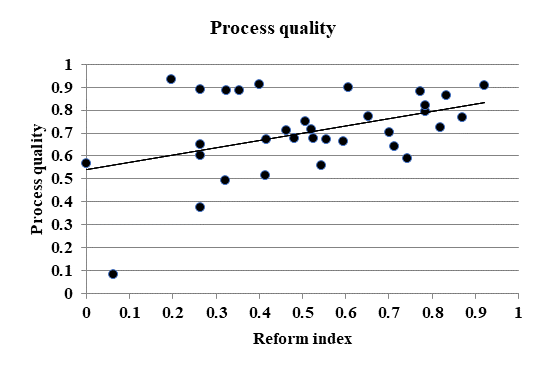
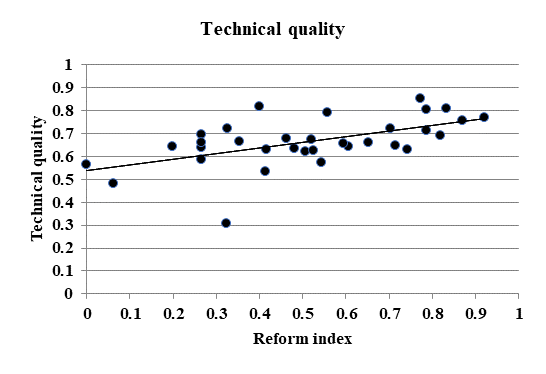
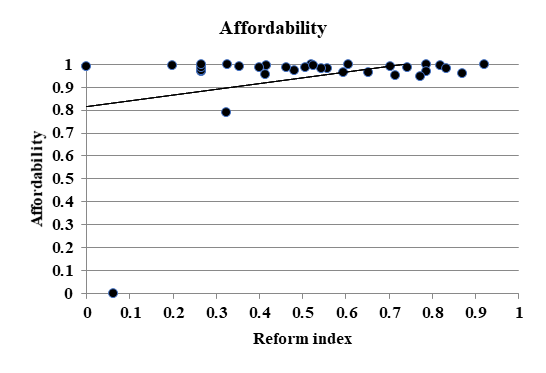
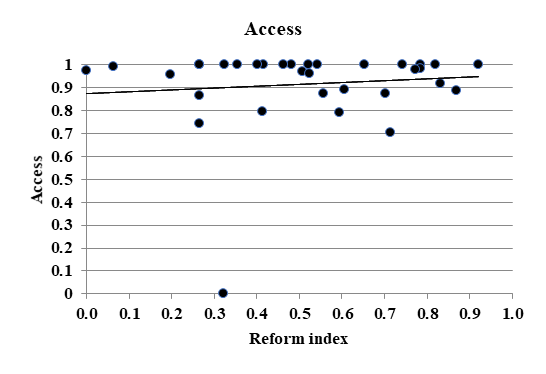
|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 14 Correlation matrix between dimensions of Electricity Reforms and Performance** | | | | |
|  | *Dimension of electricity reform* | | | |
| *Measure of performance* | *Market structure* | *Private sector participation* | *Regulatory autonomy and experience* | *Operational organization* |
| Access | –0.1 | 0.0 | 0.2 | 0.0 |
| Technical quality | 0.4\*\*\* | 0.2 | 0.3\*\* | 0.4\*\* |
| Process quality | 0.2 | 0.0 | 0.4\*\* | 0.2 |
| Affordability | –0.2 | 0.2 | 0.1 | –0.1 |

*Note*: Pearson correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

Table 14 highlights the fact that governance affects technical quality and to a lesser extent process quality. None of the partial dimensions defining the overall governance index has any impact on access and affordability. The creation of a separate regulatory agency is uncorrelated with either variable—a surprising result in a region in which social concerns should be part of the agenda relevant for sector regulators. The only partial dimension without any effect on any of the performance dimensions is private sector participation. This finding reinforces a recurring message that private participation alone will not lead to significant improvements. For the aggregate index, the correlation with performance is higher than the correlation for any of the partial governance indicators, suggesting that reform packages may be more effective than individual changes.

Figure 1 illustrates the much larger dispersion for the two quality measures compared with the access and affordability measures. The simple linear regressions confirm the earlier results on the stronger correlation between the governance and quality variables than between governance and access or affordability. The higher a country is on the governance scale, the more likely performance is to be positive.

Figure 1 Correlation between reform index and selected measures of performance in the electricity sector in Latin America and the Caribbean



# 4. Conclusion

This paper provides a baseline snapshot of the state of the governance of the electricity sector in LAC and four outcome dimensions that should be of interest to policymakers. Although it is based on analysis of a small dataset—and does not therefore present results that are the output of econometric analysis—it provides useful insights.

The analysis confirms that governance matters to outcomes but that changes to governance in LAC’s electricity sector did not have the desired impact on key social performance dimensions: The overall measure of governance is not correlated with either access or affordability. In contrast, the higher the governance index, the higher the quality measures. Social payoffs are achieved only indirectly, as quality is positively correlated with better access and affordability. This finding confirms earlier results that suggest that the failure to develop regulatory capacity to explicitly address social concerns is one of the weak spots of the first wave of governance reforms in the region.

The results also provide insights on the baseline from which the new wave of reforms is starting. Simply building on the inherited governance characteristics of the earlier reforms is not enough. Changes are needed. One of the most important ones may be the need to recognize that a given reform may have different results in different countries. One size does not fit all; the reforms most likely to reach the desired policy goals are those designed to deal most explicitly with the institutional weaknesses and limitations of a particular country (for a survey, see Estache 2018).

A better matching of reforms adopted with local institutional constraints is not enough. Governance options needs to be broadened to account for other regional specificities. Procurement has been a weak spot in the region, as the Lava Jato corruption scheme in Brazil revealed. A review of procurement should be part of any governance assessment, including in the electricity sector.

It would also make sense to account more explicitly for the growing role of less formal institutions in the sector, which have been effective at mitigating some of the weaknesses of formal actors. The region has benefited from an increased role for consumer associations, cooperatives, nongovernmental organizations, and other civil society actors. Any of these actors could have made a difference in the social outcomes observed. Many are likely to be able to have an impact in the implementation and monitoring of the new wave of reforms aiming at greening the sector— but there is not yet systematic monitoring of their role.

This paper represents one more step in the much-needed effort to identify the full set of factors most likely to deliver improvements in the electricity sector. The first wave of reforms failed to fully deliver on the social agenda. Progress on the social agenda has been important in LAC (at least measured by progress in access) but it was probably the result of policy decisions rather than the output of sector regulatory/governance reforms. More also needs to be done to improve service quality. A much more detailed diagnostic would help policy makers improve the results of reform efforts.

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# Appendix A Aggregate Indicator of Electricity Reforms

|  |  |  |
| --- | --- | --- |
| Table A.1 Correlation matrix of Market Structure dimension | | |
|  | *Indicator* | |
| *Indicator* | *Level of competition* | *Level of unbundling* |
| Level of competition | 1.0 |  |
| Level of unbundling | 0.6\*\*\* | 1.0 |

*Note*: Pearson correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

|  |  |  |
| --- | --- | --- |
| Table A.2 Principal component analysis of Market Structure dimension | | |
|  | *Principal component* | |
| *Variable* | *1* | *2* |
| Variance | 1.6 | 0.4 |
| Percent of variance explained | 80.3 | 19.7 |
| Cumulative percent of variance explained | 80.3 | 100.0 |

|  |  |
| --- | --- |
| Table A.3 Factor loadings of indicators of Market Structure dimension | |
| *Indicator* | *Factor* |
| Level of competition | 0.9 |
| Level of unbundling | 0.9 |

*Note*: Extraction method: principal components, Varimax rotation.

|  |  |
| --- | --- |
| Table A.4 Weights for indicators of Market Structure dimension | |
| *Indicator* | *Weight* |
| Level of competition | 0.5 |
| Level of unbundling | 0.5 |

|  |  |  |
| --- | --- | --- |
| Table A.5 Correlation matrix of regulatory autonomy and experience dimension | | |
|  | *Indicator* | |
| *Indicator* | *Separate energy regulator* | *Year of creation of regulator* |
| Separate energy regulator | 1.0 |  |
| Year of creation of regulator | 0.4\*\* | 1.0 |

*Note*: Pearson correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

|  |  |  |
| --- | --- | --- |
| Table A.6 Principal component analysis of Regulatory autonomy and experience dimension | | |
|  | *Principal component* | |
| *Variable* | 1 | *2* |
| Variance | 1.4 | 0.6 |
| Percent of variance explained | 71.0 | 29.0 |
| Cumulative percent of variance explained | 71.0 | 100.0 |

|  |  |  |
| --- | --- | --- |
| Table A.7 Factor loadings of indicators of Regulatory autonomy and experience dimension | | |
|  | *Factor* | |
| *Indicator* | *1* | *2* |
| Separate energy regulator | 0.8 | –0.5 |
| Year of creation of regulator | 0.8 | 0.5 |

*Note*: Extraction method: principal components, Varimax rotation.

|  |  |
| --- | --- |
| Table A.8 Weights for indicators of Regulatory autonomy and experience dimension | |
| *Indicator* | *Weight* |
| Separate energy regulator | 0.5 |
| Year of creation of regulator | 0.5 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table A.9 Principal component analysis of aggregate index of Electricity Reforms | | | | |
|  | *Principal component* | | | |
| *Variable* | 1 | 2 | 3 | 4 |
| Variance | 2.0 | 1.0 | 0.8 | 0.2 |
| Percent of variance explained | 49.6 | 25.1 | 20.8 | 4.4 |
| Cumulative percent of variance explained | 49.6 | 74.7 | 95.6 | 100.0 |

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| Table A.10 Factor loadings of dimensions of aggregate index of Electricity Reforms | | | |
|  | *Factor* | | |
| *Indicator* | *1* | *2* | *3* |
| Market structure | 0.9 | 0.1 | 0.2 |
| Regulatory autonomy and experience | 0.1 | 0.0 | 1.0 |
| Operational organization | 1.0 | 0.0 | 0.1 |
| Private sector participation | 0.1 | 1.0 | 0.0 |

*Note*: Extraction method: principal components, Varimax rotation.

|  |  |
| --- | --- |
| Table A.11 Weights of dimensions of aggregate index of Electricity Reforms | |
| *Dimension* | *Weight* |
| Market structure | 0.2 |
| Regulatory autonomy and experience | 0.3 |
| Operational organization | 0.2 |
| Private sector participation | 0.3 |

# Appendix B Aggregate Performance Indicators

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| --- | --- | --- | --- |
| Table B.1 Correlation matrix of Technical Quality dimension | | | |
|  | *Indicator* | | |
| *Indicator* | *Total duration and frequency of outages per customer a year* | *Reliability of supply and transparency of tariff index* | *Energy losses in distribution/ transmission as a percent of output* |
| Total duration and frequency of outages per customer a year | 1.0 |  |  |
| Reliability of supply and transparency of tariff index | –0.8\*\*\* | 1.0 |  |
| Energy losses in distribution/transmission as a percent of output | –0.4\*\* | 0.3\* | 1.0 |

*Note*: Pearson correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

|  |  |  |  |
| --- | --- | --- | --- |
| Table B.2 Principal component analysis of Technical Quality dimension | | | |
|  | *Principal component* | | |
| *Variable* | *1* | *2* | *3* |
| Variance | 2.0 | 0.8 | 0.2 |
| Percent of variance explained | 66.7 | 26.1 | 7.2 |
| Cumulative percent of variance explained | 66.7 | 92.8 | 100.0 |

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| --- | --- | --- |
| Table B.3 Factor loadings of indicators of Technical Quality | | |
|  | *RC* | |
| *Indicator* | *1* | *2* |
| Total duration and frequency of outages per customer a year | –0.9 | –0.2 |
| Reliability of supply and transparency of tariff index | 0.9 | 0.1 |
| Energy losses in distribution/transmission as a percent of output | 0.2 | 1.0 |

*Note*: Extraction method: principal components, Varimax rotation.

|  |  |
| --- | --- |
| Table B.4 Weights for indicators of Technical Quality | |
| *Indicator* | *Weight* |
| Total duration and frequency of outages per customer a year | 0.3 |
| Reliability of supply and transparency of tariff index | 0.3 |
| Energy losses in distribution/transmission as a percent of output | 0.4 |

## 

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| --- | --- | --- | --- | --- | --- | --- |
| Table B.5 Correlation matrix of Process Quality dimension | | | | | | |
|  | *Dimension* | | | | | |
| *Dimension* | *Mechanisms for monitoring outages* | *Mechanisms for restoring outages* | *Financial deterrents aimed at limiting outages* | *Communication of tariff changes* | *Procedures for getting electricity* | *Time for getting electricity* |
| Mechanisms for monitoring outages | 1.0 |  |  |  |  |  |
| Mechanisms for restoring outages | 0.5\*\*\* | 1.0 |  |  |  |  |
| Financial deterrents aimed at limiting outages | 0.4\*\* | 0.3 | 1.0 |  |  |  |
| Communication of tariff changes | 0.5\*\*\* | 0.5\*\*\* | 0.1 | 1.0 |  |  |
| Procedures for getting electricity | –0.1 | –0.1 | –0.1 | –0.1 | 1.0 |  |
| Time for getting electricity | 0.1 | 0.2 | 0.0 | 0.2 | 0.2 | 1.0 |

*Note*: Pearson correlation matrix. Significance level: \* = 10 percent, \*\* = 5 percent, \*\*\* = 1 percent.

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| --- | --- | --- | --- | --- | --- | --- |
| Table B.6 Principal component analysis of Process Quality dimension | | | | | | |
|  | *Principal component* | | | | | |
| *Variable* | *1* | *2* | *3* | *4* | *5* | *6* |
| Variance | 2.3 | 1.2 | 0.9 | 0.7 | 0.5 | 0.4 |
| Percent of variance explained | 37.7 | 20.5 | 15.0 | 11.6 | 8.6 | 6.6 |
| Cumulative percent of variance explained | 37.7 | 58.2 | 73.2 | 84.8 | 93.4 | 100.0 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Table B.7 Factor loadings of indicators of Process Quality dimension | | | | |
|  | *Factor* | | | |
| *Indicator* | *1* | *2* | *3* | *4* |
| Mechanisms for monitoring outages | 0.7 | 0.5 | 0.1 | 0.0 |
| Mechanisms for restoring outages | 0.7 | 0.2 | –0.1 | 0.2 |
| Financial deterrents aimed at limiting outages | 0.1 | 0.9 | –0.1 | 0.0 |
| Communication of tariff changes | 0.9 | –0.1 | 0.0 | 0.1 |
| Procedures for getting electricity | –0.1 | –0.1 | 1.0 | 0.1 |
| Time for getting electricity | 0.1 | 0.0 | 0.1 | 1.0 |

*Note*: Extraction method: principal components, Varimax rotation.

|  |  |
| --- | --- |
| Table B.8 Weights for indicators of Process Quality dimension | |
| *Indicator* | *Weight* |
| Mechanisms for monitoring outages | 0.1 |
| Mechanisms for restoring outages | 0.1 |
| Financial deterrents aimed at limiting outages | 0.2 |
| Communication of tariff changes | 0.2 |
| Procedures for getting electricity | 0.2 |
| Time for getting electricity | 0.2 |

1. This document is a product of the research program developed for the preparation of the Inter-American Development Bank 2020 flagship report *Infrastructure Services in Latin America*. All of the background papers of the research program are available at www.iadb.org/infrastructureservices. [↑](#footnote-ref-2)
2. The authors are grateful for discussions and comments from Salvador Bertomeu-Sanchez, Richard Schlirf, and Fransesc Trillas. Any mistakes or misinterpretations are the sole responsibility of the authors and should not be attributed to any of the institutions with which they are affiliated. [↑](#footnote-ref-3)
3. ECARES, Université Libre de Bruxelles [↑](#footnote-ref-4)
4. ECARES, Université Libre de Bruxelles [↑](#footnote-ref-5)
5. Inter-American Development Bank [↑](#footnote-ref-6)
6. Bensch et al. (2016) draw a similar conclusion in their own survey. [↑](#footnote-ref-7)
7. Andres, Schwartz, and Guasch (2013) focus on electricity distribution, working with data at the firm level in 26 countries for the 1995–2005 period. Balza, Jimenez, and Mercado (2013) work with sector-level data at the country level. Their study covers 18 countries for the 1971–2010 period. [↑](#footnote-ref-8)
8. This exercise says nothing about the desirability of these reforms. [↑](#footnote-ref-9)
9. Foster et al. (2017) then use the indicators to measure the extent to which the reform choices were influenced by country characteristics, such as geography, income group, power system size, and political economy, but do not look at outcomes. [↑](#footnote-ref-10)