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## Article

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## Privatization and the Role of Sub-national Governments in the Latin American Power Sector: A Plea for Less Subsidiarity?

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### ABSTRACT

In this paper, we explore the cross-national impact of privatization in the network industries on the access to network services. We focus on the assessment of the electricity sector in 20 Latin American countries and analyze the time series between 1985 and 2010. To control for the relevance of the subsidiarity (social commons) argument we assess the interaction between commodification and the role of the sub-national governments in the power sector. Privatization has a statistically significant positive effect on the level of electricity access. In the absence of federalism, privatization in the electricity sector has a greater impact on electrification than in the case with federalist government system. Federalism has a positive impact on the electricity access if electricity is generated and supplied mainly by the state-owned enterprises. Another interesting finding is the relationship between the degree of subsidiarity and electrification: A higher the degree of subsidiarity has a negative effect on the electrification. This could be a result of the increasing transaction costs and rent-seeking behavior in the decentralized settings. The study complements the existing literature by analyzing the privatization reform from the subsidiarity perspective.

**Keywords:** Privatization, Federalism, Subsidiarity, Power Sector, Latin America, Commodification

**JEL Classifications:** D40, E02, H13, H40, H70, L33, L43, L94

## 1. INTRODUCTION

Since the 1980s, public finance crisis and technological advances led to network industry reform, consisting in privatization, network unbundling and liberalization of the market entry. Latin America has been at the forefront of reforming the network industries in the context of a larger process of the state reforms. Problems in the power sector in most Latin American countries were emanating from the defaults on international loans and inability of the public supply to meet electricity demands (Wamukonya, 2003). Based on the findings of a comprehensive World Bank survey, privatization has been identified as the key remedy for the improvement of the electricity sector performance (World Bank, 1995). During the 1990s, the region attracted 55% of the whole privatization investments in developing countries (Chong and Benavides, 2007). The research question of the study is whether the privatization of electricity sector in Latin America and the presence of sub-national governments and municipalities have contributed to

the increasing level of access to service. The study refers to the access to service accounting for both the physical availability of a network connection and the financial affordability of consumption tariff. We expect privatization to have positive impact on firm productivity in the electricity generation and network expansion, eventually increasing access to service by meeting unsatisfied demand of network connections. However, at the household level privatization might have negative impact on the access to service through increasing consumption tariff. The reasons are the unsuitability of cross-subsidization<sup>1</sup> in competitive markets and the necessity of the tariff rebalancing, implying cost-reflecting price of service (Clarke and Wallsten, 2002, p. 4). Therefore, we expected sub-national governments and municipalities to matter in complementing the privatization reform through more efficient

1 Cross-subsidization is the praxis of charging higher prices to the low-cost and high-income consumers to subsidize high-cost and low-income consumers.

subsidization policy. The widespread belief that the establishment of an independent regulation is a sufficient condition to obtain positive distributional outcomes omits the key difference between the role of regulation and policymaking (Millán, 2007). The sound local knowledge of sub-national governments and municipalities is an essential component in economic growth policy and might help in easing the existing regulatory and policy gaps (Rodrik, 2004). The study investigates the research question using panel data for 20 Latin American countries in the period 1985–2010. We find statistically significant effect of privatization on the level of access to service. In the absence of federalism, privatization in the electricity sector has a greater impact on electrification than in the case with federal government system. Federalism has a positive impact on the electricity access if electricity generated and supplied by public enterprises. Another interesting finding is the relationship between the degree of federalism and the access to electricity: A higher degree of federalism has a negative impact on the electrification. This could be a result of the increasing transaction costs of more federalism or the proportionality of the size of the sub-national governments with their negotiation power with the private energy companies, regulation bodies and central governments. An alternative explanation is the utility maximization behavior of the local municipal interests represented by the subnational governments, trying to appropriate as much rents from the electrification activities as possible (Millán et al., 1987; Millán, 2007).

The study contributes to the existing literature by posing an original research question, analyzing the privatization reform from a subsidiarity perspective. The study has economic, political and developmental relevance. Particularly in the developing countries, network industry reform must promote dynamic efficiency, referring to sufficient and sustainable provision of service (Kim and Horn, 1999). Access to network electricity service might increase economic and employment opportunities among poor households, increasing their potential income and savings. According to McKenzie and Mookherjee the overall welfare gains from the new electricity connections skewed primarily towards the lowest class of income, since most of the new connections have been deployed among poor households (2002). In regards to the existing consumers, despite increasing consumption tariffs, the average welfare effect is still positive, driven mainly by the quality improvements (Andrés et al., 2008).

## 2. POWER LIBERALIZATION

It is during the 1970s that governments started to notice problematics arising from network industries being organized as vertically integrated state-owned monopoly or as heavily regulated privately owned monopoly. First, the quality of service was not keeping pace with technological advances. Second, due to asymmetric information, regulators were not able to identify the true production costs, hence failing in controlling prices (Shy, 2001). Third, decreasing public sector productivity and increasing fiscal debts pushed governments to rely on market dynamics. The public finance crisis combined with huge investment requirements and technological advancements in the power generation caused a vibrant discussion on the commodification of electricity over

liberalization of the electricity markets (Byrne and Mun, 2003). The public policy paradigm of network industry reform mainly consisted in three steps: Privatization; network unbundling and separation; and market liberalization (Florio, 2013). The first large-scale privatization program has been carried out by the Thatcher government in the UK, dismantled the monopoly of British telecom in 1984 and of British Gas in 1986. Following this trend, the process of reform followed in most European countries, Latin America and South Asia. West European countries have been able to generate the largest share of privatization revenues, which has been a response to a large-scale nationalization after the World War II. The main drivers have been the increasing financial inefficiency of state-owned enterprises, the development of financial markets and the required market reforms as prerequisite to enter the European Union. As an overall trend, West European governments have been reluctant in giving up the full control over the public utility in over 30% of the privatization contracts, maintaining control through voting rights and golden shares. Privatization in Eastern Europe has been particularly challenging given the economic reform towards market-based economic model. The reform reshaped financial market institutions and property rights, while trying to obtain social approval. Given the political history of Eastern European countries, crucial issues have been the definition of managerial compensation, the role of workers' councils in the enterprise, and the restitution of property rights previously nationalized between the 40s and the 60s. The privatization methods have been contradictory, differentiating between rapid and large-scale privatization and a softer approach. African countries have been rather slow and reluctant in embracing privatization, with public infrastructure and industrial/manufacturing sectors remaining under the state control. The reluctance is explained by weak institutional settings and a widespread public hostility, which might be justified by the scarce empirical evidences indicating rent seeking and increasing tariffs of service (Banks, 2006). Given the lacking institutional quality, privatization has not been perceived as the major instrument to incentive economic growth. Even if the argumentations of not privatizing state-owned enterprises are justifiable, the consequences are still costly. The power sector in the South Asia with a slow process of divestiture of state-owned enterprises has had increasing financial losses, covered by government's debt at high interest rate. Despite these poor performances, public support for privatization remains low, with large-scale public sector being perceived as an instrument to tackle income inequalities. Also in India, the privatization reform started in 1991 has been modest, consisting primarily in selling of minority shares of public enterprises. High political competition in the country has hindered the privatization reform (Roland, 2008).

### 2.1. Social Commons Argument

Liberalization of the power sector yielded diverging results in different countries. Commodification in Chile, England and Wales contributed significantly to the performance of the electricity sector. This, nevertheless, is not the case for all of the countries commoditizing power sector (Joskow, 2008). Brazil and California are the textbook cases where a severe electricity crisis emerged as a direct result of the electricity market liberalization. Privatization created an artificial scarcity of electricity resulting in high rocketing electricity prices (Byrne and Mun, 2003).

In Brazil, for instance, commodification caused a 320% price increase for customers consuming less than 30kWh per month. Large customers, consuming more than 1100 kWh per month, nevertheless, did not experience any significant rise of the prices (Silva, 2000).

Energy commodification and technological advances opened the sector to community-based and lower-scale power plants, i.e., decentralization of electricity production. However, this led to the increasing market mergers and acquisitions, yielding increasing centralization of the electricity production (Byrne and Mun, 2003). Commodification, in the absence of regulation, could also have distributional effects since it is achieved at the expense of social objectives such as universal access to service (Cremer et al., 1998). The immediate implications are the refusal to provide electricity service, i.e., “cherry-picking” and “social dumping”, and the stop of the subsidization of the electricity tariffs (Guy et al., 1997).

Another important aspect of the power sector liberalization is the contradiction of the cost minimization and cornucopianism of the private power generation with the targets of sustainable environment, climate change and local health considerations in the regions where the private companies produce electricity from the fossil sources (Byrne and Mun, 2003). According to them, the economic logic of the liberalization has to be replaced by political discourse - a socio-political space, whereby “a vigorous public discourse would require that technology choice, investment commitment, social impacts, and ecological implications would all be routinely considered in an open access regime of ongoing evaluation” (Byrne et al., 2009). By relocating the power sector in the social commons the authors try to repeal the limitations of the marketplace approach by following a more holistic approach. This social commons concept implies more governable and responsive power sectors at the community and/or local level (Byrne and Mun, 2003), which is nothing but a pleading for subsidiarity principle in the power sector. In his farsighted analysis on the future of the power sector, Fuentes-Bracamontes also underscores the importance of the sub-national energy policy (2016). According to him, energy policy has no more to be regulated or stabilized only at the national level but in the first line on the “local” levels. He mentions federal, state, and municipal levels as the alternatives for the purely national governance in the times of changing power sector and underlying technologies (Fuentes-Bracamontes, 2016).

In contrast to most East Asian and African countries the half of the Latin American countries did have a strong element of social commons approach in the process of the liberalization of the power sector. This is rooted to the long lasting tradition of strong subnational governments in form of states, provinces, and/or municipalities. Hence, it seems to be theoretically interesting whether the active participation of the sub-national governments enhanced the performance of the electricity sector in terms of per capita electricity consumption.

## 2.2. Privatization of the Electricity Sector in Latin America

Latin America has been at the forefront in reforming network industries, with each country having its own reasons to proceed

with privatization. The reforms in the power sector were first initiated by Chile in the early 1980s (Dussan, 1996). Foreign debt crisis and fiscal deficit were only a part of a larger political legitimacy crisis, reflected in the collapse of administration apparatus and in high level of corruption (Lora, 2007). Starting from the middle 1980s, this multidimensional crisis created an environment for heavy and widespread process of state reform across Latin America. The process of reform created a large consensus to the implementation of neo-liberal economic policies able to stimulate competition. Since the late 1980s, sectoral economic policies aimed to redefine the role of the state in the economy, limiting its forms of intervention and removing barriers to private participation in the production activities. Public utilities had revealed financially inefficient with excess of public employment. Governments were eventually unable to sustain the required maintenance and expansion of the network, which resulted in poor public services in terms of access rate and quality in sectors such as electricity and telecommunication (Chong and Benavides, 2007; Lora, 2007). Privatization was expected to alleviate financial burdens and to create government revenues, while attracting private investments for the required utility performance improvements (Estache and Trujillo, 2013; Millán, 2007). Only during the 1990s, Latin America attracted 55% of the global privatization revenues among developing countries (about US\$361 billion), with public utilities and infrastructure sectors accounting for 75% of the whole amount (Chong and Benavides, 2007). Between 1990 and 1997 the majority of the electricity projects with private capital were implemented in Latin America (Izaguirre, 1998). 70% of these projects were the projects related to electricity generation. These projects were responsible for the major shift in the ownership structure of the Latin American electricity generation from public to private hands (Wamukonya, 2003). Table 1 shows the privatization revenues as percentage of GDP across Latin American countries in the decade 1990–2000, with Paraguay and Peru largely ahead the others. The privatization reform has adapted to country-specific economic and institutional settings. Governments have been responsible in defining selling methods and conditions, attributing weights to each political objective, while potentially extracting rents through political corruption and favoritisms (Estache and Trujillo, 2013; Murillo, 2002). The simplest selling contract refers to full divestiture of the incumbent state-owned operator, implying

**Table 1: Privatization revenues as percentage of GDP in Latin America, 1990–2000**

Paraguay	16.00	Mexico	7.00
Peru	15.00	Jamaica	6.00
Panama	12.00	Trinidad and Tobago	6.00
Bolivia	12.00	Chile	4.00
Argentina	11.00	Colombia	3.00
Guyana	11.00	Honduras	3.00
Brazil	10.00	Nicaragua	3.00
El Salvador	10.00	Barbados	2.00
Belize	9.00	Ecuador	1.00
Guatemala	9.00	Costa rica	0.50
Venezuela, RB	8.00	Uruguay	0.00
Dominican Republic	8.00		

The calculations were made using constant 1999 US-dollars. Source: Chong and López-de-Silanes (2003)

government to give up the entire ownership and control of the utility. Full divestiture has been the most common approach in telecommunication and energy sectors across Latin America. A second approach refers to market capitalization, which allows governments to stimulate the development of capital markets (Estache and Trujillo, 2013). Other types of contract, such as concession and public offering of shares preserve a relationship between the government and the privatized utility, conducting to incentive distortions and unfair efficiency gains redistribution (Shleifer and Vishny, 1994).

### 2.3. Privatization and Access to Electricity Services

Despite the fact that network industries do not fulfill the assumptions of welfare economics theorem and competitive markets, privatization can have a positive impact on the efficiency of production through different channels (Megginson and Netter, 2001), which are congruent with institutional economics, ownership incentive effects, and agency and public choice theory (Boycko et al., 1996; Levy and Spiller, 1996; Niskanen, 1971; North, 1990). First, privatization would contribute to the efficiency of production where government's intervention has not been able to solve market failures. Second, private ownership better aligns incentives and defines clear objectives, reducing transaction costs. Government's inability to commit to a single objective is inconsistent with welfare efficiency maximization (Shleifer, 1998). Third, a major source of production inefficiency is the soft budget constraint and subsidy regime of the state-owned enterprises. Fourth, from a macroeconomic perspective, privatization revenues increase government budget and possibly government spending, eventually benefiting firms. At the microeconomic level, the impact of privatization on access to service differentiates between its impact on the affordability of consumption tariffs and on the availability of physical network connections. The affordability of consumption tariffs by households depends upon tariff level and structure imposed by the private operators. In turn, private operators would set tariff level accounting for market structure and sector regulation, with the latter imposing certain criteria in terms of price setting, level of required investments in network expansion, subsidy scheme and quality standards. While state-owned utility might set a tariff lower than the economic cost of provision because of public subsidization, private operators might be forced to increase tariff level so to achieve financial sustainability. Indeed, investment-oriented regulation requires cost-reflective pricing and tariff rebalancing, so that the private operators are able to maintain, modernize and expand the network (Baldwin et al., 2012). The expected increases in tariff level depends upon the pre-reform conditions and the political choice about efficiency gains redistribution (Estache Foster and Wodon, 2001, 2001). Concerning physical network connections, if it is true that private operators are likely to meet long-term unsatisfied demand of network connections, on the other hand private operators might have no incentives in serving unprofitable households, since the costs of providing a network connection is higher than the tariff paid (Estache et al., 2001; McKenzie and Mookherjee, 2002). The main causes are the cost-reflecting pricing and the economy of density, which create significant variations in the costs of network connection across different areas.

## 3. FEDERALIST GOVERNMENT STRUCTURE

The recent World Bank discourse on the good governance moved from the concept of "minimal" state intervention in the markets towards more functional concepts of "effective" and "un-intrusive" state (World Bank, 1997). The discourse aims at a redefinition of power concentration within the state, advocating greater decentralization of power in policymaking and public service provision for a more responsive state intervention (World Bank, 1997). The concept of "un-intrusive" state reverses the enormous expansion of the size and scope of the state (Wagle and Dixit, 2007), i.e., praising subsidiarity and/or federalist government structures.

Despite the fact that the role of federalist government structure in the outcome of the privatization was insufficiently addressed in the economic literature, it seems to be unambiguous that privatization process like any other political change is shaped by the features of the political system. The role of the sharing of power of the national (central) government with the entities such as states and provinces, i.e., federalism has to be considered as a possible indicator in the success of the privatization. Especially in the Latin American context, the issue of power sharing plays a decisive role in the process of privatization where the half of the states/provinces have authority over taxes, spending and legislation. Given that privatization reform shifted the objective of universal access to service to private operators through legislation, taxation and subsidies (Florio, 2013; Newbery, 1997), sub-national governments and municipalities play a decisive role in its achievement. Indeed, privatization reform has reshaped the market structure of network industries, leading to obstacle in implementing within-firm cross-subsidization (Clarke and Wallsten, 2002). Hence, government's intervention is still required to maximize the number of access to service by implementing a non-distortionary, inexpensive and competitively neutral subsidization policy (Clarke and Wallsten, 2002). Therefore, the well-functioning system of sub-national governments and municipalities appears to be a well-designed instrument in addressing situations where the critical issue is the low level of access to service (Lora, 2007). Especially in the context of the Latin America, it has to be emphasized that federal state governments and municipalities play the decisive role in the process of the regulation of the power sector. Due to the constitutions of the federalist Latin American states the federal bodies play a way higher role in the process of the privatization than the national bodies (Bouille et al., 2001; Kucinski, 1995; Zhang et al., 2008).

According to the principle of subsidiarity, centralized regulation should perform exclusively tasks that cannot be performed at a local level. For example, centralized regulation must coordinate with sub-national governments in organizing auctioning bids for service provision by private operators (Ugaz and Waddams, 2003). The intuition is that sub-national governments are relatively efficient in implementing demand-driven subsidization policy, minimizing targeting errors and financial inefficiency to not-elected recipients. Subsidizing the demand-side has three advantages (Ugaz and Waddams, 2003). First, it does not distort competition. Second, it allows pricing to reflect the scarcity of

the resources. Third, it supports the access to service among vulnerable demographic groups, such as children or disadvantaged. In support of the hypothesis is the statement made in (Rodrik, 2004): “Successful reforms are those that package sound economic principles around local capabilities, constraints and opportunities. Since these local circumstances vary, so do the reforms that work. An immediate implication is that growth strategies require considerable local knowledge.” Demand-driven subsidization policy could partly solve the well-known regulatory inability to redistribute privatization efficiency gains in Latin America fairly. Millán (2007) pointed out how Latin American governments have for too long been convinced that the key component of successful network industry reform was the establishment of a quality and independent regulator, forgetting the essential difference between the role of regulation and policymaking. The idea of sub-national authorities as key component of network industry reform comes from the water sector experience, characterized by a large number of isolated and heterogeneous firms, and from the Chilean experience of subsidization. The Chilean rural electrification program required central government to allocate financial resources to regional and local authorities to finance and subsidize network expansion or alternative electricity sources. For telecommunication, the Chilean government established a telecommunication development fund which enabled a demand-driven subsidization of the consumers. The regulatory challenges and policy gaps in promoting access to service indicate the essential role of the local knowledge (Foster et al., 2000; Estache, 2005).

#### 4. ESTIMATION STRATEGY

In this section, we address whether the degree of federalism matters for the outcome of privatization measured in the access to the electricity in Latin America. To this end, we estimate a specification following the general approach in Balza et al. (2013). The major difference between our estimation and the specification in Balza et al. (2013) is the presence of the federalism-variables in our estimation. In addition, we did not include the autonomous regulator variable in our specification due to the fact that in 15 countries in the database the process of privatization relied on autonomous agencies and in the 5 of them (Chile, Colombia, Guatemala, Paraguay and Venezuela) on the independent consultancy and blueprints of the multilateral agencies (Wamukonya, 2003). Thus, it is not plausible to assume that the countries without autonomous regulation agency in the process of privatization would differ from the countries relying on the consultancy of the supranational or independent consultancy bodies. Hence, the resulting specification is:

$$\ln Y_{it} = B_0 + B_1 * PRIV_{it} + B_2 * FED_{it} + B_3 * PRIV_{it} * FED_{it} + X'_{it} B + d(i) + u_{it}$$

With  $i$  referring to country and  $t$  to time.  $Y$  is the dependent variable to proxy access to service and it is introduced as natural logarithm.  $PRIV$  represents the explanatory variable of privatization, while  $FED$  is the indicator of sub-national governments or federalism.

$PRIV * FED$  refers to the interaction term between the indicators of privatization and sub-national governments, so to capture the complementary effects.  $X$  is the vector of control variables.  $d(i)$  represents country fixed effects, different across countries but constant across years, while  $u$  represents the errors term. As already mentioned above, the research question of the study is tested using panel data for 20 Latin American countries for the period 1985–2010. Since we do not have the privatization data for all the years in the data set, the panel data is unbalanced.

Concerning the interpretation of the results, in econometric models with interaction terms the coefficients do not reflect the total average impact of interest, rather a conditional effect. In our model, the privatization coefficient reports the impact of privatization in the absence of federalist government system, while the federalism indicator indicates the impact of federalism in the absence of privatization. Eventually, the interaction coefficient shows the changes in the privatization impact between having or not having a federalist government system.

#### 4.1. Methodological Limitations

Previous surveys have raised the issue of endogeneity in the privatization studies (Arin and Ulubaşoglu, 2009; Gupta et al., 2008, Roland, 2008). Particularly, it is possible that the utility performance shows a problem of causality with the choice of privatize, with poorly performing utilities likely to be privatized earlier and in larger extent than better performing firms. IV-variables are the commonly used remedies to deal with the issue of reverse causality. However, it is hard to identify a proper instrument and collect reliable data in case of network industries (Jamash et al., 2005). Despite these considerations, endogeneity does not raise an econometric problem and can be ignored when analyzing electricity sectors in Latin America given the large extent of privatization reform (Andrés et al. 2008). Country-fixed effects might also capture most of the country-specific propensity to reform as well as the country-specific constitutional, legal, economic, and political aspects (Cubbin and Stern, 2006). Endogeneity due to reverse causality could also be raised by per capita income (PCI) in the long run, since increasing PCI might result from increasing access to service (Zhang et al., 2008). However, because of the relatively high initial coverage rate in Latin American electricity sectors, the increasing electricity consumption might have been directed mostly towards ‘consumptive’ use of energy by households rather than towards ‘productive’ use of energy, which were more likely to receive the required amount of electricity supply prior to privatization. Hence, the increasing electricity consumption has not been directed towards new income generating activities.

#### 5. DATA

In investigating the level of access to network service, literature often rely on coverage rate or output indicator. Coverage rate indicates the number of households with a network connection or the number of network connections per 100 inhabitants. Output indicator indicates instead the level of aggregate output of service. Given the definition of access to service used in this study, accounting for both the physical availability of a network

connection and the affordability of consumption tariffs, the output might be a more proper indicator in capturing both dimensions. The most common output indicators to proxy access to electricity service refer to the electricity generation capacity or per capita electricity consumption. However, the limitations are multiple. The increasing production or consumption might be captured by existing consumers, hence overestimating the actual level of access to service. Contrarily, at constant level of per capita consumption together with demand-management policies (for example economic efficiency) or decreasing level of distributional losses, the indicator would underestimate the increase in the actual level of access to service. The data on the electric power consumption (kWh per capita) are compiled by the International Energy Agency (IEA), it refers to electricity consumption per capita (kWh). It is defined as the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power plants (OECD/IEA, 2014).

The data on the years of privatization reforms and the percentage of private ownership in the electricity generation is provided in Balza et al. (2013) and its updating in Millán (2007), based on the information from Ministries' and Regulators' reports, and Economic Commission for Latin America and the Caribbean (ECLAC). The data is available for the year 2001, 2006, and 2010. Because of the limited availability of privatization data the study assumes constant values for missing observations (years) and full effectiveness of the reform, without accounting for transitional period.

In investigating the role of sub-national governments and municipalities, the study decides for an indicator referring to the presence of political and fiscal federalism. It reports whether the

country states/provinces/municipalities have an authority over taxing, spending, or legislation related to privatization in the power sector. It is constructed as a dummy variable, taking value 1 if any of these three categories is present, and it is time constant for each country. It is taken from the database of political institutions 2015 (Cruz et al., 2016) and is available for 12 countries for each year, resulting in 305 observations. Having fiscal or political federalism might indicate a higher level of effectiveness and competence in the local governance, however increasing transaction costs. A limitation of the indicator is the missing information about the quality of sub-national governance.

We further investigate the degree of federalism by an indicator referring to the number of municipalities divided by the total population of the country, hence deriving the degree of decentralization. The data on the number of municipalities are taken from Rosales and Carmona (2008).

A set of control variables have been included. GDP per capita (constant US dollar in natural logarithms) and Poverty Headcount Ratio at \$1.90 a day (2011, PPP) (% of population) are taken from the world development indicators (WDI) 2016 and are proxies for individual demand of public services, then inducing higher level of investment in production capacity. Population density (natural logarithms of people per sq. km of land area) is also taken from the WDI and is a proxy for the cost of service provision (World Bank, 2016). According to the concept of economy of density, high population density decrease the cost of service provision, requiring lower investments in network expansion. Index of economic and political freedom is introduced to capture political and institutional factors. The index of economic freedom is a 10-point index developed by the Fraser Institute, indicating

**Table 2: Description of the dependent and independent variables**

Variable	Description/transformation	Source
Electric power consumption (kWh per capita)	Natural logarithms of the electric power consumption per capita	International Energy Agency (IEA)
Privatization (PRIV)	Percentage of private ownership in electricity generation	Ministries' and Regulator's reports and ECLAC
Federalism	Dummy variable, differentiating between Latin American countries with and without sub-national units (states, provinces or municipalities) having an authority over taxing, spending, or legislating related to the process of the privatization in the electricity generation and/or distribution	Database of Political Institutions (Cruz, Keefer & Scartascni, 2016)
Size of municipal unit	Number of the municipalities divided by the total population	Rosales and Carmona, 2008
Population density	Natural logarithms of people per sq. km of land area	World Development Indicators, 2016
PCI	Natural logarithm of GDP per capita (constant USD)	World Development Indicators, 2016
Poverty headcount ratio	Poverty headcount ratio at \$1.90 a day (2011 PPP) (percentage of population)	World Development Indicators, 2016
Economic freedom	10-point index indicating increasing economic freedom as the index increases	The Fraser Institute, 2017
Polity	7-point index indicating decreasing political rights as the index increases	Freedom House, 2016

IEA: International Energy Agency, ECLAC: Economic Commission for Latin America and the Caribbean, PCI: Per capita income

**Table 3: Specifications include fixed effects and random effects panel estimations and correct for heteroscedasticity and autocorrelation**

Dependent variable: Natural log of electric power consumption (kWh per capita) from 1985 to 2010							
Independent variables	Robust-FE (1)	Robust-FE (2)	Robust-RE (3)	Robust-RE (4)	Robust-RE (5)	Robust-RE (6)	Robust-RE (7)
Privatization	0.821*** (0.118)	0.299*** (0.0927)	0.635*** (0.112)	0.554*** (0.0678)	0.517*** (0.0573)	0.492*** (0.0519)	0.679*** (0.0458)
PCI		1.225*** (0.119)	1.072*** (0.104)	1.052*** (0.0969)	0.993*** (0.0937)	0.909*** (0.119)	
Federalism# PRIV			-0.568*** (0.169)	-0.546*** (0.158)	-0.495*** (0.173)	-0.531*** (0.158)	-0.548*** (0.194)
Federalismdummy			0.308 (0.216)	0.478** (0.208)	0.274 (0.170)	0.378** (0.184)	1.054*** (0.268)
Population density				0.219*** (0.0641)			
Degree of federalism/ decentralization					-0.377** (0.161)	-0.418*** (0.155)	-1.115*** (0.141)
Economic freedom						0.0364* (0.0189)	-0.0152 (0.0494)
Politiy							-0.0502** (0.0236)
Poverty headcount ratio							-0.00979*** (0.00314)
Constant	6.678*** (0.0318)	-3.500*** (1.000)	-2.460*** (0.883)	-3.229*** (0.784)	-5.757*** (1.546)	-5.725*** (1.464)	-5.024*** (1.556)
Observations	480	480	305	305	286	286	157
R <sup>2</sup>	0.419	0.734	0.861	0.899	0.875	0.864	0.451
Number of country ID	20	20	12	12	11	11	11

Robust standard errors in parentheses. \*\*\*P<0.01, \*\*P<0.05, \*P<0.1

increasing economic freedom as the index increases. It accounts for five areas: The size of government, legal structure and security of property rights, access to sound money, freedom to trade internationally and regulation of credit, labour and business. The index of political freedom is a 7-point index developed by freedom house, indicating decreasing political rights as the index increases. It accounts for the features of the electoral process, political pluralism and participation, and functioning of government. The following Table 2 summarizes the dependent and independent variables used in the study.

## 6. RESULTS

Table 3 reports the panel estimation results of the study. Privatization has a positive and significant impact on the level of access to electricity services in each model specification. 1% increase in the share of the private ownership in electricity generation causes at least 0.299 and maximum 0.821% increase in the electricity consumption per capita. In estimation equation (7), for example, using robust random effects panel data, in the absence of federalist government system 1% increase in electricity privatization increases access to electricity service by 0.679%, while decreasing its impact to 0.131% in the presence of federalist government system. In the scenario of public electricity generation and supply, federalist government system has a positive and significant impact on the electrification. Another interesting crosscutting finding in the estimation equations (5), (6) and (7) is

the relationship between the degree of subsidiarity and electricity consumption, whereby we use the size of the municipality as a proxy for the degree of subsidiarity: The higher the degree of subsidiarity as the size of the municipal unit the worse is the access to electricity services. This finding corroborates the observation in Millán (2007), which shows rather descriptively that with the increasing number and negotiation power of the sub-national government entities in the process of the power sector liberalization lead to substantial increase of the transaction costs at least in Brazil, Colombia and El Salvador. Population density in contrast, has a statistically significant positive impact on the access to the electricity services (eq. (4)). Higher level of Economic Freedom (eq. (6)) and more political rights (eq. (7)) also correspond with a higher access to the electricity services. Poverty headcount ratio has a statistically significant negative impact on the electricity consumption. Nevertheless, due to the small value of the coefficient (-0.009) it has a lower impact on the average consumption than the other variables in the specifications.

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