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How does the ownership of electricity distribution relate to energy poverty in Latin America and the Caribbean? [1]

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Abstract

This paper analyses the links between the ownership choices (i.e. public versus private) made by Latin and Central American countries for their electricity utilities and related basic social indicators at the expenditure quintile level (i.e. household access to electricity and energy poverty/affordability). From a multinomial logit model accounting for a wide range of controls, we find that energy poverty/affordability issues are more likely in countries with public operators but that these countries are also more likely to have better access rates. We also find that the creation of a separate regulatory agency is associated with better social outcomes when the operator is private than when it is public. These results have various interpretations, ranging from the illustration that better matching of ownership with other reforms is needed to get better social outcomes, to the possibility that the data reflects the effects of cream skimming by private operators preferring countries with lower poverty issues, leaving the socially challenging countries to public providers.

[1] This paper was produced as a background note for a larger study on the role of State-owned enterprises managed by the World Bank. We are grateful to María-Eugenia Sanin for sharing the household expenditure dataset with us. Most of the data cleaning work is her own, although we did some fine-tuning as well. We are also grateful to L. Andres at the World Bank for providing us with his data sets on the institutional characteristics of the region and to M. de Halleux and T. Serebrisky for numerous discussions on energy poverty in Latin America. Finally, we are grateful to T. Cordella and M. Vagliasindi for their detailed comments and specific suggestions on a previous version. Any mistake or misinterpretation is, however, our fault only and should not be attributed to anyone else.

1. Introduction

This paper produces quantitative evidence on the links between ownership (public vs. private) of electricity utilities and basic social indicators (i.e. access rates and affordability measures) associated with the delivery of electricity services in Latin America and the Caribbean (LAC) at the level of households separated into quintiles. The analysis is based on a dataset on household expenditures produced for 13 countries by Jimenez and Yepez-Garcia (2017). It covers close to 190,000 households classified in expenditure quintiles. This level of detail provides an opportunity to test the robustness of conclusions on the relevance of ownership for the poor usually reached by earlier econometric research for the average consumer.

We address three specific questions: (i) Do state-owned-enterprises (SOEs) in the sector affect access and affordability/energy poverty (*EP*) differently than private providers?, (ii) Does the differential effect depend on the income classes of households (i.e. are SOE better for the poorest)?, and (iii).Does the differential effect depend on other sector institutional characteristics, notably the creation of a separate regulatory agency?

We rely on a multinomial logit model to address these questions. The method allows the estimation of the probability that the household in any given quintile[2] has no access to electricity, or that it is energy-poor. Since the analysis controls for the main institutional characteristics of the sector as well as the ownership choice, it also reveals the relative role of ownership for different quintiles when compared to other policy decisions that could influence energy related social outcomes.

We find that being able to rely on household-level data refines significantly some of the conclusions reached by the earlier literature on the social effects of electricity reforms. The four main robust results can be summarized as follows. First, countries in which the main provider is an SOE are more likely to be associated with affordability/*EP* issues in the country, i.e. SOE are associated with countries in which there is higher *EP* on average. Second, countries in which SOEs are the main operators are worse for lower quintile than higher ones in terms of *EP* but better in terms of *access* (i.e. they are «regressive» in *EP* but "progressive" in *access*). Third, at the margin, the combination of an SRA with an SOE is correlated with increased *EP* as compared to the situation in which there is no SRA. In contrast, for private operators, the creation of an SRA is correlated with a further reduction in *EP*. Fourth, SOE are strongly correlated with reductions in access issues when the political orientation of the national government is left-leaning. This is not the case for *EP*.

To discuss the results in detail, the paper is structured as follows. First, we provide a brief survey of the evidence on impact of the reforms in the region on energy poverty related dimensions. Second, we describe the dataset used in the analysis by reviewing the different sources and construction of variables. Third, we highlight some descriptive statistics as motivation for the econometric analysis. Fourth, we explain in detail the model we use to perform our analysis. Next, we describe the different results. Finally, we explain the different limitations of our model from technical and policy perspectives. We conclude with suggestions for follow-up research.

[2] Throughout the paper, quintiles refer to quintiles of the per capita expenditure distribution. We assume it is a reasonable approximation of income quiintiles.

2. Brief survey of the literature on energy poverty in LAC

Access gaps have long been and still continue to be quite common in many parts of the world, including in some regions in LAC. In addition, energy poverty (i.e. lack of affordability) has become a global policy concern in particular since the 2008 global economic crisis, including in LAC. According to Foster and Witte (2020), only one-third of the 60 developed and developing countries they analyse as of 2015-16 manage to keep average electricity bills within 5% of household income. This seems to reflect efforts to improve cost recovery associated with the sector reforms of the 1990s as they report a correlation between affordability and limited capital cost-recovery as high as 0.8. As pointed out by Jasmab et al. (2017) and Bensch (2019) in their surveys of the global evidence on reform experience, these changes did not address the needs of the poor as effectively as expected. They argue that institutional choices, and in particular ownership choices have not made a difference to these policy concerns, including in LAC.

These surveys also reveal that, for LAC, there is actually very little *recent* analytical evidence on the extent to which institutional choices, and in particular ownership choices have made a difference on electricity access and EP.[3] Most of the peer reviewed evidence is based on data collected prior 2010, that is within 10-15 years of the adoption of institutional reforms which are known to erode over time as also hinted at by Jasmab et al. (2017). To our knowledge, Andres et al. (2008), Andres et al. (2013), Balza et al. (2013) and de Halleux et al. (2020) are the four main and most recent sources of cross-country analytical evidence on the social impact of the ownership and other institutional reforms specifically focused LAC.

The first three papers considered a comparable set of institutional changes (e.g., unbundling, privatization, regulation) and their impact on the region prior to 2010. They all confirm for LAC for the region the conclusions reached by Jasmab et al. (2017) and Bensch (2019) from their broader sample. Notably, with respect to the concern of this paper, they showed that privatization was not robustly associated with better access to service when compared to the performance achieved by SOEs. They also all argued that, as in other regions, regulatory and institutional quality can matter to the average social outcomes under either type of ownership.

De Halleux et al. (2020) updated the results relying on the latest data available (2018) on two poverty related indicators, access rates and a measure of affordability (based on a national proxy rather than on income class specific information). They considered an alternative less ambitious statistical approach than the econometric treatment adopted by the earlier papers. They focused instead on establishing Pearson and Spearman correlations between the main groups of reforms in the sector and measures and the two poverty related indicators characterizing the electricity sector in the region. Their conclusion was again consistent with earlier results. The fact that they rely on data almost 10 years more recent than the one used by the previous three papers provides that additional insight that little has changed since the conclusions produced by pre-2010 data.

Considered jointly, this evidence suggests that the impact of reforms at the average consumer level boiled down to a simple set of recurring insights. First, on average, reforms did not deliver on social goals as expected as measured by the outcome for an average

[3] The assessments of the impact of reforms at the region level have usually emphasized the impact on various measures of efficiency and on investment levels (as a proxy to improvements to access). Only in a few cases did they address specifically equity, fiscal and accountability goals supposedly expected to be delivered by the reforms as well.

consumer. Second, average social outcomes were sensitive to the composition of the reform packages. Changes in ownership alone had not been associated with significant improvements in terms of access and affordability. But the combination of reforms mattered. For instance, adding an autonomous regulatory capacity in LAC had been correlated with better access rates (often simply approximated by investment levels), although not necessarily with affordability based on the very aggregated approximate measure of affordability used by these various authors. The main value added of the following analysis is the assessments of the extent to which these conclusions apply equally to all income groups

3. Data sources and definitions

The impact of sectoral reforms in the region on access and affordability/*EP* measured at the income group level builds on the data base produced by Jimenez and Yepez-Garcia (2017) for their analysis of the determinants of household energy spending and energy budget shares. They produced a dataset covering 13 LAC countries at the level of expenditure quintiles rather than at the level of income.[4] The classification in expenditure quintiles within countries is made according to their per-capita household expenditures. We follow their lead in using this as a proxy of the distribution according to income and hence for the rest of the analysis, whenever we mention quintiles or we characterize households as being rich or poor, we build on that definition.

The details of the dataset are provided in Appendix A. They show that the dataset is a unique, harmonized collection of official household surveys and this is what allowed them to estimate reliable empirical Engel curves which provided detailed information on how much household socio-economic characteristics help understand expenditures on electricity.[5] These details are relevant for this paper as well. However, they did not control for the detailed sector characteristics and this is one of the main contributions of the analysis reported here. More specifically, we essentially combine their household-level data which reflect the demand side with institutional variables at the country level which reflect the supply side. This isolates the impact of ownership and other institutional characteristics usually decided as part of reform packages accounting for household specific characteristics at the level of quintiles.

The information on electricity expenditure provides the basis for the construction of our dependent variables to investigate access and *EP* of electricity services. First, if a household has stated that it does not spend anything on electricity, we consider that the household had no spending in electricity, which indicates a problem of access.[6] Second, besides access, this study aims at investigating the causes of a lack of affordability of electricity, entailing a situation of EP, a concept increasingly widely used that often leaves very broad margins of interpretation. There are indeed many different definitions of EP, which differ with respect to the data needed. Each of them has its own advantages and drawbacks (see for example Castaño-Rosa et al., 2019 and Thomson et al., 2019 for a critical review of the definitions). In this study we consider two main indicators of EP, basing

[4] The countries included in the dataset are the following: Bolivia, Brazil, Costa Rica, Dominican Republic, Ecuador, Guatemala, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, Peru and Uruguay.

[5] The authors have excluded the bottom 1% and top 1% of households at the expenditure level to reduce the presence of outliers. See Jimenez and Yepez-Garcia (2017) for a more detailed discussion on the dataset construction.

[6] This means either that the household did not consume electricity or that they own a generator. Other reasons for *zero-reporting* could be that (i) the responder did not recall the information at the time of the survey or (ii) there was an omitted response during the survey. Following Jimenez and Yepez-Garcia (2017), we assume that these other reasons are not systematic in the data.

our choice on the data availability (i.e. they are both based on household expenditures, by opposition for example to indicators based on appliance characteristics) and on the complementarity between the two measures.

In the first definition, a household is considered as energy-poor if it spends more than 10% of its total expenditure on electricity. This measure, hereafter called *EP-10,* is widely used, mainly because of its ease of computation and the simplicity of communication (Romero et al., 2018). In practice, this indicator is currently used in Ireland,[7] and has been the official energy poverty indicator in the UK from 2001 to 2013.[8] This indicator measures absolute energy poverty and the threshold do not depend on the country used. Therefore, to complement our analysis we consider a second indicator, *EP-2M*, which considers that a household is energy-poor if it spends more than twice the median of its country in its share of expenditures on electricity. This measure of energy poverty considers the relative position of a household compared to other households in the same country. Thresholds are therefore different for each country.

We sort households according to their access to electricity and according to the two definitions of EP, see Table 1 for a summary of the classification. Note that they are such that each household belongs exactly to one of the categories in each classification. These categories allow us to include households with no consumption into our analysis and therefore to have a sense of both the problem of access and the problem of *EP* at the same time. Households in the category "Others" are those able to access electricity services at an affordable cost.

Table 1: Definition of access and energy poverty

	Category 1: No access	Category 2: Others	Category 3: Energy poor
Classification 1: EP-10	SEE=0%	0%<SEE<10%	SEE>10%
Classification 2: EP-2M	SEE=0%	0%<SEE<2*(country median of SEE)	SEE>2*(country median of SEE)

Note: SEE: Share of household expenditures spent on electricity.

Besides household characteristics, we are interested in the influence of regulation and market structure on electricity expenditures. With respect to the market structure, we mainly focus on whether the electricity sector is under public ownership. Moreover, to control for the degree of liberalization (see e.g. Nagayama, 2009), we include a variable indicating whether there is a wholesale electric market (WEM) in the country. To account for the role of the regulatory framework, we include two variables. First, we account for whether there is a separate regulatory agency (SRA) in the country at the year of the survey. Second, we are interested in the type of price control. For simplicity of the analysis, we dichotomize this variable along the type of regulatory incentives: a country is considered to have a high-incentive pricing mechanism if it uses revenue cap, price cap or efficient company model methods. In contrast, low-incentive pricing mechanisms include rate of return and situations in which the price is exclusively determined by the government. The definition and source of each variable are presented in detail in Table 2.

[7] See Assist 2gether, Report on National and European measures addressing vulnerable consumers and energy poverty, EU (2018) 1–57. Available at https://www.assist2gether.eu/documenti/risultati/report_on_national_and_european_measures_addressing_vulnerable_consumers_and_energy_poverty.pdf

[8] See Romero et al. (2018).

All the variables are at the country-level and mainly come from two sources. First, Uperlainen and Yang (2019) provide a country-level panel database of market structure and reforms in the electric sector over the world. Second, Andres et al. (2008) provide a large database on the regulatory institutional of electricity in Latin America. The data from these two databases were complemented and updated to correspond to the countries and years included in the household surveys in Jiménez and Yépez-García (2017).

Finally, we include additional country-level control variables. The GDP per capita takes into account the level of development and the general economic conditions of the country. The variable accounting for the prices of electricity represents the average residential electricity prices at the country level and was retrieved from Olade-sieLAC. We also include the political orientation of the government of each of the countries at the year of the survey. Finally, a year trend controls for the year of survey in the cross-sectional household expenditure surveys.

Table 2: Definitions and sources of data

Variable name	Definition	Source
	Household level variables	
Share of electricity expenditures	% of total expenditures	Jimenez & Yepez-Garcia (2017)
Total electricity expenditures	Annual electricity expenditures (PPP USD)	Jimenez & Yepez-Garcia (2017)
Number of rooms	Number of rooms in the dwelling	Jimenez & Yepez-Garcia (2017)
Household head: man	Gender of the household head (= 1 if male, 0 if female)	Jimenez & Yepez-Garcia (2017)
Age of household head	In years	Jimenez & Yepez-Garcia (2017)
Household size	Number of household members	Jimenez & Yepez-Garcia (2017)
Urban area	Area (= 1 if urban, 0 if rural)	Jimenez & Yepez-Garcia (2017)
Property	= 1 if own the dwelling (= 0 if rented)	Jimenez & Yepez-Garcia (2017)
Education	From 1 = incomplete primary or less to 6 = university or higher	Jimenez & Yepez-Garcia (2017)
Quintile	1 to 5, based on per capita household expenditure within each country	Jimenez & Yepez-Garcia (2017)
	Country-level variables	
Residential price	Residential annual average price of electricity (USD/kWh), at the year of survey	Olade-sieLAC
SOE	= 1 if the enterprise is state-owned, at the year of survey (= 0 if not)	Uperlainen & Yang (2019), updated for Bolivia and Mexico
SRA	= 1 if there is a separate regulatory agency, at the year of survey (= 0 if not)	Uperlainen & Yang (2019), updated for Mexico
High Incentives	= 1 if there is a high incentive pricing system (= 1 if price cap, revenue cap or efficient company model; = 0 if rate of return or government based)	Andres et al. (2008), updated for Bolivia, Nicaragua and Paraguay
Wholesale Elec. Market	= 1 if there is a wholesale electricity market, at the year of survey (= 0 if not)	Uperlainen & Yang (2019), updated for Mexico
Political Orientation: Left	= 1 if the national government is left-wing, at the year of the survey	Authors' computation
GDP	GDP per capita (PPP, current international $), at the year of the survey	World Bank
Year	Year of the household-level survey	Jimenez & Yepez-Garcia (2017)

4. Descriptive statistics

In this subsection we describe the main trends observed in the sample. First, we review the electricity expenditure by quintile. Second, we focus on the main household characteristics. Finally, we highlight the main insights in terms of institutional characteristics.

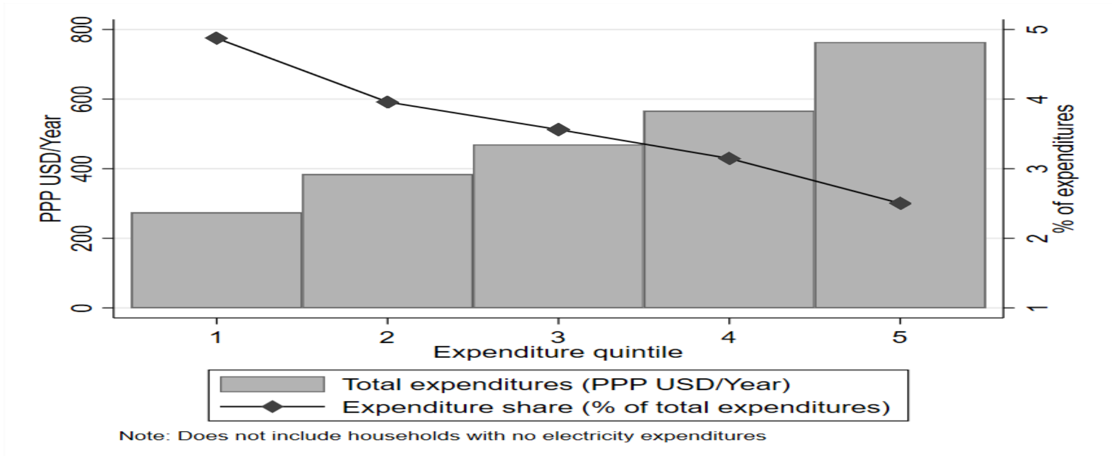
4.1. Electricity expenditure

Even though the total expenditure in electricity is increasing over the quintiles, the share of total expenditure that is allocated to electricity is decreasing over quintiles. This is represented in Figure 1. Across the 13 countries, the richest quintile of the population spends three times more than the poorest quintile. In contrast, however, on average the poorest quintile of the population spends almost 5% of their total expenditures on electricity while this is halved for the richest quintile.

Quintiles do not only differ by the average share of expenditures spent on electricity, as their distribution varies as well over the population, as shown in Appendix B. The variance of the expenditure share is larger among the poorest households. In particular, 25% of the households in the poorest quintile spend between 6% and 24% of their income on electricity. In contrast, among the richest, the higher quartile of share of expenditures ranges between 3% and 12%.

Finally, there also exists a large heterogeneity in the share of electricity expenditure across countries (see Appendix C for details). For example, in Ecuador households spend on average 2% of their budget on electricity, with little difference over quintiles. On the other hand, in Uruguay households spend on average 8% of their budget, with a large difference over quintiles: households in the lowest quintile spend an average of 12% compared to 4% for the richest. The last column also shows the median expenditure share in each country, which is the basis of the EP-2M measure. Again, there are important differences, with medians ranging from 1.59 in Ecuador to 6.49 in Uruguay. This paper precisely aims at understanding the institutional drivers behind these cross-countries differences.

Figure 1: Total expenditures in electricity and share of electricity expenditures, per quintiles

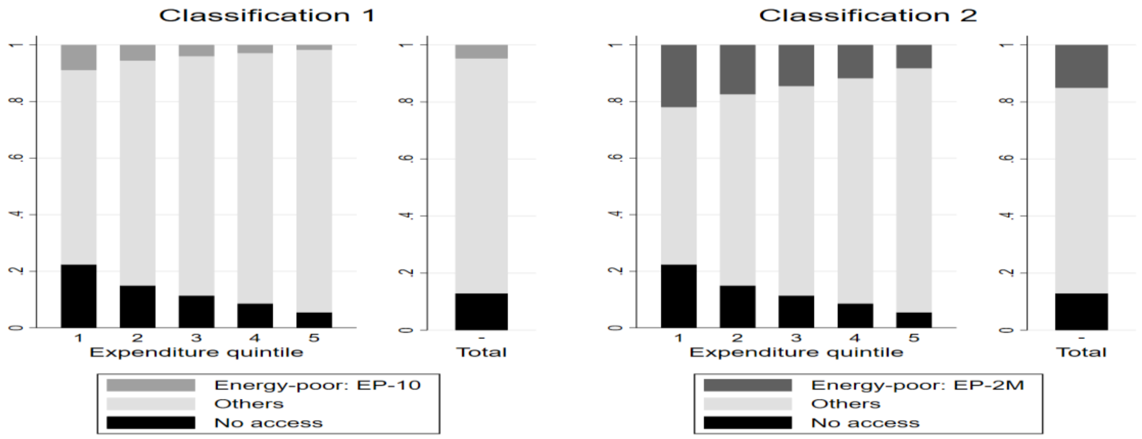


To have a sense of what these shares represent, we refer to the definitions of energy poverty as presented in the previous section. This also allows to include households with no expenditures in electricity to grasp both the issues of access and EP. Figure 2 represents the distribution of households according to access and energy poverty over the different quintiles. The figure shows that on average, 12% of the households do not have access to electricity in our sample; 4.7% of the total sample are energy-poor according to EP-10; and

15% according to EP-2M. Moreover, Figure 2 shows that the incidence of energy poverty falls over the quintiles, irrespectively of the measure that is used. The share of households that do not have access to electricity also falls over the quintiles but does not disappear for the richest quintile. Among the poorest quintile, more than 20% does not have access to electricity, 9% of the households are energy-poor according to the EP-10 measure and this rises up to 22% if we consider the relative measure of energy poverty, EP-2M.

Note that in the two different classifications, the households with no access to electricity are identical. Only the definition of poverty varies across the two. Furthermore, although fewer households are considered poor under EP-10 than EP-2M, not all of these are considered as poor under EP-2M. Appendix D presents the details of the distribution of households according to the two classifications.

Figure 2: Access to electricity and energy poverty: distribution of households per quintiles.



Note: Classification 1: EP-10: a household is considered as energy-poor if it spends more than 10% of its total expenditures on electricity. Classification 2: EP-2M: a household is considered as energy-poor if the share of expenditures spent on electricity is higher than twice the country median.

Again, there is a large heterogeneity across the 13 countries in the sample. Appendix E presents the share of households that do not have access to electricity, by quintile and by country. In the whole sample, 13% of households do not have access to electricity, but the variation across countries is quite striking. In the Dominican Republic, this concerns 44% of households while it only concerns 0.2% of households in Costa Rica. As could be expected, the proportion of households without access to electricity falls with the rise in wealth. The inequality across quintiles however varies over the countries. For example, in Honduras, 80% of households in the first quintile do not have access, while this amounts to 7% in the last quintile. In contrast, in Mexico, the difference between the poorest and the richest is narrower, going from 10% to 5%.

The table in Appendix F presents the energy poverty rates by country and quintiles for the EP-10 measure. On average, 4.7% of households spend more than 10% of their expenditure on electricity. This ranges from very low figures such as 0.3% or 0.4% in Ecuador and Bolivia, to 20% in Uruguay and Jamaica. Ecuador and Bolivia are also the countries in which less than 1% of households in the first quintile are energy-poor. Conversely, the share of households that are energy-poor (EP-10) in the first quintile is quite high in Guatemala (12%), Brazil (14%), Jamaica (26%), and especially Uruguay (42%). In Jamaica, particularly, this figure stays quite high (10%) even for the richest quintiles of the population. For the majority of the countries, the share of households in EP-10 is decreasing over the expenditure quintile. It is however quite stable over the wealth distribution for the Dominican Republic, Ecuador and Paraguay. It can sometimes even be increasing for countries such as Honduras or Nicaragua. In other words, for these countries, the largest share of energy-poor is not found in the lowest quintiles. This can happen if the poorest have to ration their electricity consumption.

The figures for the relative measure of energy poverty are represented by the EP-2M measure in Appendix G. On average, this measure classifies more households as being poor: on average, 15% of the sample is considered to be poor with the EP-2M measure. The variation across countries is however lower than for the EP-10 measure of poverty. Every country has an average EP-2M between 10% and 20%. This means that there is more difference across countries in terms of absolute poverty (i.e. in the levels of the shares spent in electricity) than in terms of relative poverty (i.e. the inequality within a country). The particular case of Uruguay is quite striking in this perspective. In our sample, it is the country with the highest share of EP-10 but the lowest share of EP-2M. In other words, a lot of households spend a high share of their expenditures on electricity, but the inequality within the country is not as high as the other countries.[9] The countries with the highest relative energy poverty are Mexico, Nicaragua and Brazil. Table 3 summarizes all the detailed descriptive statistics of the various definitions related to household electricity expenditures we have presented in this section.

Table 3: Descriptive statistics – Electricity expenditures

Variable	N	Mean	Std. Dev.
Annual total expenditure (PP USD)	189,554	23439.18	638403.6
Annual expenditure in electricity (PP USD)	189,554	428.98	557.10
Share of electricity expenditure	189,554	3.1%	3.675
No electricity expenditure	189,554	0.129	0.335
EP-10	189,554	0.047	0.212
EP-2M	189,554	0.150	0.357

Notes: N: number of observations. EP-10: a household is considered as energy-poor if it spends more than 10% of its total expenditures on electricity. EP-2M: a household is considered as energy-poor if the share of expenditures spent on electricity is higher than twice the country median.

4.2. Household characteristics

Following the standard practice in the literature on this topic, we will control for many household characteristics in our analysis. We will rely on the usual socio-economic factors used to understand electricity expenditures decisions (see for instance Legendre and Ricci, 2015; Scarpellini et al., 2015; Jiménez and Yépez-García, 2017).

Table 4 presents the descriptive statistics of the household characteristics in our sample. On average, a household comprises 3.8 members, in a dwelling with 4 rooms. The majority of households are in urban areas and own the dwelling. Regarding the household head, 72% of them are men, with an average of 48 years old and the average education is 2.8 on a 1-6 scale.

[9] At least, as captured by the EP-2M measure.

Table 4: Descriptive statistics - household characteristics

Variable	N	Mean	Std. Dev.
Number of rooms	189,554	4.033	2.500
Gender of household head: Man=1	189,554	0.717	0.450
Age of household head	189,554	48.38	15.86
Household size	189,554	3.796	1.961
Area: Urban=1	189,554	0.725	0.447
Property	189,554	0.702	0.457
Education	189,554	2.849	1.316

Notes: N: number of observations

There are important differences in terms of access and electricity *EP* in rural and urban areas as can be seen in detail in. Appendix H. The share of households without access in rural areas is almost three times higher than that of urban areas (respectively 24% and 9% of households). The pattern goes in the other direction for energy poverty. The share of households that are energy-poor is more important in urban areas than rural ones. This is most striking with the EP-2M measure (16% in urban areas vs 12% in rural ones).

4.3. Institutional characteristics

Since the main purpose of the paper is to assess the extent to which ownership and other institutional decisions matter to social outcomes, we also collected information at the country level that will serve as a basis for the investigation of the institutional characteristics. In addition to ownership choice, we are interested in four categories of variables. The first relates to the regulation of the sector and includes both whether there is a separate regulatory agency, and the pricing control method used. The second, relates to the market structure and includes whether there is a wholesale electricity market. Third, we include information about politics, and in particular the political orientation of the government. Finally, we control for an additional set of variables: the price of residential electricity allows to disentangle the effect of institutional characteristics from the direct one of average prices on poverty; and the GDP per capita to control for the development level of each country. Table 5 summarizes all these variables for each country.

Only four countries in our sample have an SOE in the electricity sector, Costa Rica, Mexico, Paraguay, and Uruguay. Only two countries in our sample do not have a separate regulatory agency (SRA): Paraguay and Bolivia, which renationalized most of the sector in 2010 and 2012. The majority of the countries use a high-incentive pricing mechanism, are at least partially privatized, have a wholesale electricity market and have a left-wing national government. There is however some variation on how these variables are allocated across countries. There is also some variation in the residential electricity price and in the GDP per capita across countries. The price of electricity ranges between 0.08 (in Paraguay and Honduras) and 0.39 USD/kWh (in Jamaica).[10]

[10] Note that the correlation between the average residential price of electricity per kWh and GDP/capita is very low (0.03).

Table 5: Country-level data

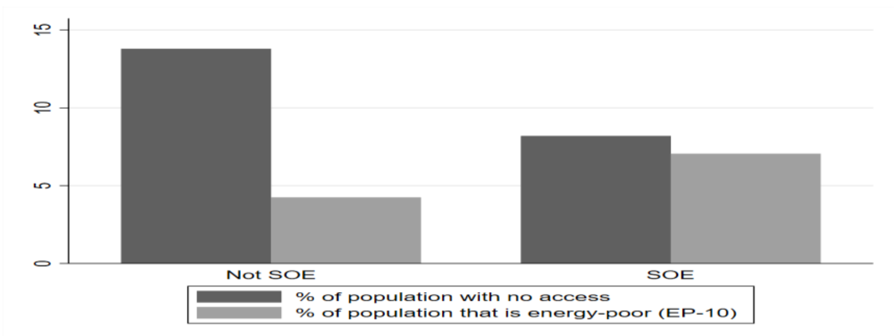
	SOE	SRA	High Incentive	WEM	Left-Gov	Price	GDP
Bolivia		[11]		X	x	0.09	6,593.2
Brazil		x	x	X	x	0.21	13,332.1
Costa Rica	x	x		x		0.18	14,445.9
Dominican Republic		x	x	x	x	0.16	9,853.2
Ecuador		x		x	x	0.09	9,883.6
Guatemala		x		x	x	0.17	6,458.3
Honduras		x	x			0.08	3,049.7
Jamaica		x	x		x	0.39	8,170.0
Mexico	x	x		x		0.09	18,046.0
Nicaragua		x	x	x	x	0.22	4,950.1
Paraguay	x					0.08	10,016.8
Peru		x	x	x	x	0.16	12,561.2
Uruguay	x	x	x		x	0.16	11,574.3

Note: SOE=State-owned enterprise; SRA= separate regulatory agency; High incentive= high incentive regulatory mechanism; WEM= Wholesale electricity market; Left-Gov= Left-oriented national government; Price=average national residential electricity prices.

4.4. Institutional characteristics and electricity expenditure

The joint look at the institutional country-level characteristics and the household-level electricity expenditures provides a number of policy relevant insights. For example, Figure 3 shows that on average, in countries with SOEs there are fewer people who do not have access to electricity but more that are energy-poor.[12] These sorts of simple averages are useful, but deserve a more robust assessment if a more precise sense of the relevance of institutional characteristics on access and *EP* is to be identified, even without trying to establish causality between institutional choices and social outcomes in the sector. The methodology and conceptual framework used for this analysis are presented in detail in the next section.

Figure 3: Access to electricity and energy poverty, by type of ownership



[11] Bolivia is an unusual case as it does have an agency responsible for regulation, the Authority of Fiscalisation and Social Control of Electricity responsible to regulate activities carried out by operators providing electricity services to guarantee the interests and rights of consumers and users but it didnot function as any of the other agencies in the region in terms of political independence for the year for which we are analyzing the region. We tested all the models under the assumpation that the agency was independently enough as well as under the assumption that there was no Independent assumption. It did not change the conclusions.

[12] The conclusions are the same if we look at EP-2M instead of EP-10.

5. Methods

The specific purpose of the paper is to answer three research questions:

1. Do SOEs in the electricity sector affect access and *EP* differently than private providers?
2. Does the differential effect of SOEs depend on the income classes of households?
3. Does the differential effect of SOEs depend on other institutional characteristics?

From a technical point of view, we want to model whether a certain household has a problem of access to electricity or of *EP* as a function of its characteristics and the institutional framework of its country. In particular, we want to model the probability that a household falls into one of the following categories: [13]

- Category 1: The household has no access to electricity
- Category 2: Other (i.e. households can access electricity at an affordable cost)
- Category 3: The household is energy-poor

Let the probability that household *i* in country *c* falls into category *j* as:

$$\pi_{icj} = P(y = j) = F_j(X_i, X_c, \beta_i, \beta_c)$$

where X_i represents household characteristics, X_c country characteristics, β_i and β_c are the set of associated coefficients to estimate. We will estimate two models that will differ along their definition of categories: energy poverty is defined as EP-10 in model 1 and as EP-2M in model 2.[14]

The three outcome categories are non-ordered and all the covariates are specific to the household or to the country, not to the outcome categories. This setting is therefore appropriate to use a multinomial logit model (MLM, see Cameron and Trivedi, 2005, p. 500). This allows to estimate two sets of coefficients $\beta_{1|2}$ and $\beta_{3|2}$, representing respectively the effect of the regressors X on the probability that the household has no access to electricity, or that he is energy-poor, compared to the baseline option "other". From these coefficients, we will be able to estimate the marginal effects of the regressors to be able to interpret the magnitude of the effect of each of these regressors on the outcome categories.

In our setting, using an MLM instead of a linear OLS regression on the outcome "electricity expenditure shares" (as in Jiménez and Yépez-García, 2017), allows to overcome two main issues. First, it allows to include households that do not have access to electricity in the analysis and therefore to be able to consider both access and *EP* in the effects of institutional reforms. One reform could indeed have a positive impact on one of these two issues but a negative one on the other. Our methodology allows us to reveal such trade-offs. Second, it allows accounting for the non-linearity feature of electricity expenditure shares. In this setting, the most vulnerable population are the households that spend either nothing on electricity or that spend too much. By creating non-ordered categories, we can look at the two extremes of the underlying distribution of shares in a non-linear way.

Besides these advantages, the definitions we use must be interpreted with caution. Indeed, as the energy poverty definition is based on expenditures, we must bear in mind that

[13] See Table 1 for the exact definition of the categories in the context of this study.

[14] Mechanically, this also changes the definition of category 2, but category 1 remains unchanged.

such expenditures are the product of prices and quantities. Therefore, and though these indicators are widely used in practice and in theory, our results cannot specify whether the effect on expenditures is channelled through prices or quantities. For example, an increase in expenditure may be related to a rise in prices and a steady demand, which is detrimental to consumers. But another possible scenario is one where prices have fallen and as a reaction, part of the demand that was previously unmet because of rationing becomes now available to consumers, thus increasing quantities. Both scenarios imply an increasing expenditure, but interpreting the latter as detrimental to consumers is more problematic.

We deal with this issue by looking at the share of total expenditure on electricity and setting a threshold above which a household is considered to be in a situation of energy poverty. This strategy does not allow to completely overcoming the issue, as it entails three additional concerns. First, a household could be below the 10% expenditure in electricity threshold and still be rationing so as to be able to afford electricity services. Second, the thresholds are set arbitrarily, and one should be careful about their interpretation. Third, when the share of expenditure on electricity increases due to a certain hypothetical factor, mechanically, it implies that the share of expenditure on another good has decreased. Analysing these trade-offs is beyond the scope of this analysis, but we will keep this in mind when interpreting our results.

Finally, the covariates included in the analysis are those presented in the previous section. The errors are clustered at the country-area level. We also include a time trend that accounts for different years in which household surveys were conducted.

6. Results

This section describes the results obtained for the different specifications of the model. The first subsection reviews the results of the baseline model which are reported in full in Table 6. The second subsection presents the results of the analysis in which we add the interaction of SOE and income quintile. Third, we look at the institutional interactions between SOE and respectively SRA and political orientation. Finally, the last subsection checks the robustness of the results by conducting a sensitivity analysis towards the definition of the thresholds used in the definitions of EP.

6.1. Baseline model: households and institutions

Table 6 reports the results of the baseline model, namely the model studying the links between household and institutional factors and the odds of having no access to energy services or being energy-poor. As explained previously, we consider two different measures of energy poverty. First, model 1, as defined in Table 1, includes the EP-10 measure. In other words, a household is energy-poor if its expenditure in energy services is greater than 10% of its total expenditure. Second, model 2 considers the EP-2M measure, which determines a household as energy poor if its expenditure share on energy services is at least twice the median of the country.

Before analysing the main results, note that the coefficients in the tables represent the marginal effects at the mean of each regressor. As such, by way of example, the coefficient of the SOE variable indicates how much greater is the probability of having no access to energy services or being energy poor compared to the baseline category *other*, for a household living in a country where the electricity sector is publicly owned (SOE = 1) compared to a household in a country where the sector is at least partially privatized (SOE = 0). We therefore analyse the impact of the regressors on the probability of having no access or being energy poor, versus the baseline situation - i.e., the household is not energy poor and has access to energy services.

Table 6: Baseline results - Multinomial Logit Regression - Household and institutional characteristics - Marginal Effects

	Model 1: EP-10		Model 2: EP-2M	
	No access	Energy Poor (EP-10)	No access	Energy Poor (EP-2M)
Number of rooms	-0.026***	0.001***	-0.027***	0.008***
	(-5.99)	(4.18)	(-6.02)	(4.25)
Household head: man	-0.000	-0.004***	-0.000	-0.019***
	(-0.00)	(-4.79)	(-0.06)	(-5.90)
Age of household head	-0.001***	0.000***	-0.001***	0.002***
	(-2.92)	(3.24)	(-2.77)	(5.23)
Household size	-0.002	-0.007***	-0.002	-0.031***
	(-1.19)	(-7.57)	(-1.10)	(-15.03)
Urban area	-0.078***	0.010**	-0.079***	0.077***
	(-5.39)	(2.54)	(-5.41)	(8.54)
Property	-0.052***	0.002	-0.052***	0.016**
	(-3.66)	(1.39)	(-3.68)	(2.06)
Education	-0.011***	0.002**	-0.011***	0.013***
	(-3.46)	(2.39)	(-3.51)	(6.07)
Quintile 2	-0.033***	-0.055***	-0.025***	-0.131***
	(-3.73)	(-5.40)	(-2.99)	(-9.65)
Quintile 3	-0.051***	-0.072***	-0.042***	-0.192***
	(-4.02)	(-5.45)	(-3.41)	(-8.57)
Quintile 4	-0.065***	-0.080***	-0.056***	-0.235***
	(-4.71)	(-5.65)	(-4.20)	(-8.74)
Quintile 5	-0.081***	-0.087***	-0.073***	-0.277***
	(-5.21)	(-5.94)	(-4.87)	(-10.53)
SOE	-0.002	0.046***	-0.010	-0.019
	(-0.05)	(5.01)	(-0.24)	(-1.06)
SRA	0.057	0.027**	0.055	0.024
	(1.19)	(2.30)	(1.11)	(1.45)
High Incentives	0.040*	-0.001	0.042*	-0.009
	(1.75)	(-0.12)	(1.85)	(-0.83)
Wholesale Elec. Market	0.042	0.018*	0.052	0.070***
	(0.95)	(1.65)	(1.16)	(3.19)
Political orientation: Left	-0.034	-0.013	-0.043	-0.118***
	(-1.03)	(-1.59)	(-1.31)	(-8.51)
GDP	-0.000	-0.000***	-0.000	-0.000***
	(-1.42)	(-3.75)	(-1.38)	(-3.60)
Year	-0.008**	-0.004***	-0.008**	-0.001
	(-2.23)	(-4.33)	(-2.19)	(-0.72)
Residential price	0.015	0.278***	-0.013	0.118
	(0.09)	(5.43)	(-0.09)	(1.39)
N	189,554		189,554	
Pseudo R^2	0.169		0.120	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. t statistics in parentheses. The table presents the marginal effects. Errors clustered at the country-area level. N: number of observations. Model 1: Energy poor (EP-10): share of expenditures in electricity >10%. Model 2: Energy poor (EP-2M): share of expenditures in electricity > 2*median within country. Baseline category = others (i.e.: Model 1: 0% < share < 10%. Model 2: 0% < share < 2M).

The pseudo-R^2 suggests that our regressors are a better fit when the measure of energy poverty considered is EP-10 - i.e., 0.17 in model 1 versus 0.12 in model 2 -, though in both cases the goodness of fit remains outside the good fit interval - i.e., 0.2-0.4 -. Ideally, the pseudo-R^2 should be higher but note that our goal here is not to identify the drivers of energy poverty, but rather, to study how institutional factors associated with sector reforms relate to access and EP.

All the coefficients related to household characteristics seem important to explain access and *EP* of electricity services. The area of residence has a differentiated impact on access and poverty. Indeed, households in urban areas have an 8-percentage points (p.p.) lower probability of not having access to electricity services. Instead, urban households have a 1 to 8 p.p. higher probability of being energy poor. Not surprisingly, wealth quintiles also significantly affect the probabilities of not having access or being EP. Compared to the poorest households, the richest quintile increases their probability of access by 8 p.p. The likelihood of energy poverty also drastically decreases over wealth quintiles. There is no difference in access across households that are headed by a woman, however, on average, female-led households have a lower probability of energy poverty (around 0.4 p.p. to 1.9 p.p. lower, depending on the *EP*measure). Finally, the number of rooms, the age of the household head, and whether the household owns the dwelling are all significantly negatively associated with *no access* and positively with EP, although the magnitudes are quite small, except for the property of the dwelling which is associated with a 5 p.p. lower probability of no-access.

The results on the relevance of the institutional characteristics are more heterogeneous. First, Table shows that the ownership structure of the sector does not affect access to electricity. In terms of EP-10, however, the results show that a household that is in a country where the electricity sector is publicly owned is significantly associated with a 5 p.p. higher probability of being energy-poor. This result can be read in two ways. The first is that the public operators are less effective at addressing *EP*. An alternative is to consider that it reflects the fact that private operators are effective at cream skimming and less likely to take on mandates in which they need to cater to the needs of poor populations. Note however that the coefficient associated with EP-2M is negative and not significant. In other words, only the measure of absolute energy poverty is affected by the ownership structure, not the relative position of households compared to the country median.

Second, having a separate regulatory agency is not significantly associated with access to electricity services. Regarding EP, SRA is related to a 3 p.p. higher likelihood of being EP-10, the magnitude is similar for EP-2M although the coefficient is not significantly different from zero. In other words, having a separate regulatory agency operating in a country's electricity sector is not statistically significantly related to access rates to electricity services and is associated with a higher probability that a household of such a country is in a situation of energy poverty. This an important result since it was mainstreamed in Latin American and Caribbean countries to match the privatization of the different utilities' sectors with the introduction of a separate regulatory agency with the objective of looking out for the consumers' welfare in an environment in which the objective of companies supplying with the good or service is to maximize profits and the returns to investors.

Third, having a high-incentive pricing mechanism - e.g., price cap or yardstick competition - is not significantly associated with energy poverty. It is, however, statistically significantly - at the 10% level - positively associated with *No access.* Indeed, our results show that energy sectors that are regulated through a high-incentive mechanism are associated with a 4 p.p. higher probability that a household has no access to energy services. It is interesting to check the extent to which these conclusions reconcile with the conclusions presented in Kopsakangas-Savolainen and Svento (2010). In their paper, the authors study the welfare effects of four different regulatory schemes, including fixed-price, rate-of-return (RoR), menu of cost-contingent contracts and simple menu of contracts. Their conclusion is that total welfare can be improved by switching from RoR to any other scheme but important differences in the welfare distribution between consumers and producers seem to appear. In our case, we find that high-incentive mechanisms are associated with higher probability of having no access than other mechanisms such as RoR. Their conclusion that switching from RoR to another mechanism - such as high-incentive ones – has important differences is distribution is thus not contradicted. We can therefore add to their conclusion that the distribution of welfare between producers and consumers is reinforced, since we find that the probability of having no access increases, and consumers seem to be getting the worst of it.

Fourth, having introduced a wholesale electricity market in the sector has a positive significant link with the probability of being EP, but no significant effect on the probability of having access to energy services. Having a wholesale electricity market is therefore associated with a higher risk of being energy poor, whether we consider EP-10: 2 p.p. increase at the 10% level of significance, or EP-2M: 7 p.p. increase at the 1% level.

Fifth, the political orientation of the government is considered. Having a left-oriented government seems to be related to higher odds of having access to electricity services, but the coefficients are not statistically significant. On the other hand, left-oriented governments significantly reduce the probability of EP-2M. Left-oriented governments are therefore associated with a lower probability of being energy poor, as measured by the relative measure of energy poverty but not the absolute one. In other words, left-oriented governments seem to be associated with reductions in the relative position of the households that spend the most, but not their absolute level of expenditure shares. Moreover, the political orientation of a government is not sufficient to address the issue of access to electricity, mainly inherent to rural areas in Latin American and Caribbean countries.

Finally, the average consumer price of electricity unsurprisingly shows a significant - at the 1% level - positive effect on the probability of being EP-10. A higher price is therefore related to a higher probability of a household being energy poor. EP-2M is not affected by electricity prices. This is not surprising because of the definition of both measures. EP-10 looks at the share of electricity expenditure in absolute terms. Prices therefore directly affect the expenditures. Conversely, EP-2M looks at households relative to the national median. Average prices are therefore expected to also influence the median and hence not the relative distribution around it. The results also show that there is no significant effect on access to electricity services. This could indeed be pointing out towards the fact that in rural areas, where the access problem is mostly present, the issue could be, rather than too expensive energy services that cannot be afforded by poorer households, a lack of appropriate infrastructure, which is not affected by prices.[15]

Table 6 also presents the coefficients of GDP and income quintiles - from the 2nd to the 5th as compared to the first, poorest, quintile. In terms of GDP, the results show a significant negative association with energy poverty - for both models 1 and 2 -, while in terms of income quintiles, the coefficients are significant - at the 1% level - and negative for

[15] We also tested including a dummy variable =1 if the country had a social tariff system in place to help poor consumers, and the results were unchanged.

both access and energy poverty, and decreasing as the quintiles increase. The interpretation is as follows: households in wealthier countries are associated with a lower probability of being energy poor, whereas, independently of the country, the probability of being energy poor or having no access to energy services decreases with the household's wealth.

To sum up, we find very similar results in terms of the links between household characteristics and energy poverty or access to energy services to the results obtained by Jiménez and Yépez-García (2017), with the exception of the size of the household. As it increases, the probability of being energy poor is lower, with no significant effect on access. We find the expected result in terms of prices: as prices increase, so does the probability of being energy poor but, again, there is no significant effect on access, which points towards an inadequate infrastructure provision in rural areas, where access is predominantly an issue, rather than an unaffordable service.

In terms of institutional factors, few seem to matter to access or EP. Ownership does not seem to make a difference. If anything, SOEs are associated with higher levels of EP, possibly reflecting cream skimming by private operators, leading SOEs to end up getting to deliver to all the consumers not attractive to these private operators. An SRA and a wholesale electricity market do not make a difference either to access. If anything, they were actually associated with higher levels of energy poverty in this sample.

The only institutional characteristics associated with effects on energy poverty and access rates are the political orientation of the government and the regulatory regime, although they do not have the same impacts across social indicators. A left-leaning national government will be associated with less energy poverty but does not affect the access rates to electricity services. In contrast, high-incentive pricing mechanisms are associated with lower access rates, and no clear effect on energy poverty.

Note that the results we have presented are correlations and, given the structure of our data, do not imply causality by any means. For example, in this context, if countries with a high rate of energy poverty are those troubling to attract the private sector, we would not be able to disentangle this mechanism from energy poverty being a consequence of ownership structure. In other words, not only we cannot ensure causality, but if there is causality in the link between SOEs and access and EP, we cannot pin down the direction of the effect with this study.

Moreover, as explained in section 5, the expenditure on electricity is the result of the product of prices and quantity. Our results show a significant positive sign of the SOE coefficient on energy poverty. Therefore, if the relation was a causal one, the questions we could be asking ourselves would be: does having an SOE increase the average consumer price? Does it induce consumers to increase their consumption of electricity? Does it imply new infrastructure entailing a transfer of households from having no access to a situation of energy poverty? In the following sections we deepen the analysis with the objective of better understanding the mechanisms and reliability of these results, but we are constrained by the data in making any causal claims.

This first analysis was able to provide some insight on the link between the ownership structure and access and *EP* of electric services. The next sessions will investigate whether the differential effect of SOEs compared to private providers depends on the wealth of the households and on other institutional characteristics.[16]

[16] We performed different robustness checks by including the following variables in the regression, one a time: Doing Business Indicators, Ethnic Fractionalization, Average High Temperature in January in the Capital, Settler Mortality, and

6.2. Quintile analysis

The main objective of this section is to study the extent to which SOEs relate in different ways to the energy situation of households of distinct income quintiles. As explained above, in addition to the baseline's model household and institutional controls, we introduce the interaction between the income quintiles and the SOE variable. The results for the coefficient of interest are presented in Table 7.

Table 2: Difference between SOE and private provider - Quintile analysis - Marginal effects

	Model 1: EP-10		Model 2: EP-2M	
	No access	Energy Poor (EP-10)	No access	Energy Poor (EP-2M)
SOE	-0.002	0.089***	-0.005	-0.020
	(-0.05)	(2.70)	(-0.11)	(-1.20)
SOE*Quintile 2	0.055***	-0.123***	0.035*	-0.007
	(2.82)	(-2.94)	(1.86)	(-0.20)
SOE*Quintile 3	0.075***	-0.202***	0.049**	-0.013
	(2.97)	(-2.79)	(2.12)	(-0.25)
SOE*Quintile 4	0.081***	-0.238***	0.053**	0.002
	(2.72)	(-2.76)	(1.98)	(0.04)
SOE*Quintile 5	0.083***	-0.268***	0.055**	0.008
	(2.67)	(-3.02)	(2.02)	(0.13)
N	189,554		189,554	
Pseudo-R^2	0.170		0.121	
Household Variables	Yes		Yes	
Institutional Variables	Yes		Yes	
Quintile Dummies	Yes		Yes	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. t statistics in parentheses. The table presents the marginal effects. Errors clustered at the country-area level. N: number of observations. Household and institutional variables are those presented in the baseline model. Model 1: Energy poor (EP-10): share of expenditures in electricity >10%. Model 2: Energy poor (EP-2M): share of expenditures in electricity > 2*median within country. Baseline category = others (i.e.: Model 1: 0% < share < 10%. Model 2: 0% < share < 2M). Baseline category for the quintile interactions: Private provider and Quintile 1.

The coefficient shown for SOE is the marginal effect of having an SOE compared to having a private provider, for households in the first quintile. For instance, the interaction between SOE and quintile 2 describes the difference in the marginal effect on access or energy poverty of having an electricity sector that is publicly owned for a household in the 2nd quintile compared to a household in the 1st quintile.

There are a couple of remarks worth making. First, the results with respect to access are consistent across the 2 models. Indeed, both models show that ownership does not matter to access for the poorest, i.e., by the households in the first quintile. Furthermore, compared to

Polity5. The same results hold for all the regressions except for Polity5. This is due to the fact that Polity5 is highly and positively correlated with High Incentive, and including it creates a problem of multicollinearity.

the poorest quintile, the relative effect of SOEs compared to private providers is significantly positive for “no access” for higher quintiles, and increasingly so. This points towards private providers benefitting the richest and SOEs being more likely to improve access for the poorest compared to households in the richer higher quintiles.

Second, the results for *EP* seem to be sensitive to the definition used in the model. Indeed, a household in a country where the electricity sector is publicly owned is associated with a higher probability of EP-10 in the poorest quintile but may be linked with lower odds of being energy poor for households in quintiles 2 and higher. The results seem to suggest that SOEs could be protecting less well the poorest in affording electricity services but much more effectively the other income classes than private provider, and increasingly so.

Third, for EP-2M, the relative measure of energy poverty, there does not seem to be a differentiated effect of SOE across quintiles. It therefore seems that ownership could be linked to a larger extent to the absolute share of expenditure in electricity, but has no significant link with the distribution of these shares within a country.

To sum up, SOEs are associated with higher access by the poorest quintile than by the households in the higher quintiles when compared to private operators. Bu they are also associated with higher affordability problems for the poorest which can be interpreted as a lack of competence or, in contrast, as a reflection of the cream skimming issue raised earlier. Finally, in terms of the pseudo-R^2, this model is also a slightly better fit than the baseline model, suggesting that indeed the distributional effect matters in this model.

6.3. Institutional interactions

The previous subsections showed that institutional characteristics in the energy sector are closely related to the odds of being in a situation of energy poverty or having no access to energy services. In this subsection, we look at how the ownership structure interacts with other institutional variables in their association with access and EP. The results are reported in Table 8 and 9.

Table 8: Interaction between SRA and SOE – Marginal effects

	Model 1: EP-10		Model 2: EP-2M	
	No access	Energy Poor (EP-10)	No access	Energy Poor (EP-2M)
SOE	0.002	0.097***	0.000	-0.013
	(0.06)	(2.94)	(0.00)	(-0.90)
SRA	0.067***	0.019***	0.067***	0.028
	(4.75)	(3.09)	(4.74)	(1.56)
SRA*SOE	-0.140	0.062***	-0.149	-0.030
	(-1.54)	(2.67)	(-1.56)	(-1.33)
N	189,554		189,554	
Pseudo-R²	0.172		0.123	
Household Variables	Yes		Yes	
Institutional Variables	Yes		Yes	
Quintile Dummies	Yes		Yes	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. t statistics in parentheses. The table presents the marginal effects. Errors clustered at the country-area level. N: number of observations. Household and institutional variables are those presented in the baseline model. Model 1: Energy poor (EP-10): share of expenditures in electricity >10%. Model 2: Energy poor (EP-2M): share of expenditures in electricity > 2*median within country. Baseline category = others (i.e.: Model 1: 0% < share < 10%. Model 2: 0% < share < 2M).

Table 8 shows first that the results of the baseline model did not provide a full picture. The baseline model suggested that SOE and SRA coefficients were statistically significantly associated with EP-10, both positively, but not with EP-2M or access. However, adding their interaction to the model, Table 8 shows that the results slightly differ. SRA is now also significantly positively associated with No Access. The only difference in terms of SOE is related to the magnitude of the effect, as it is now twice as big: a state-owned electricity sector is associated with a 9.7 p.p. higher probability of being energy-poor (EP-10). In terms of the interaction between the variables, the results confirm that the interaction between SOE and SRA matters. Indeed, compared to a country without an SOE and without an SRA, having an SRA in a state-owned electricity sector is associated with a 6.2 p.p. higher probability of falling in the EP-10 category.

Thus, there is evidence that the role played by SRA depends on the ownership structure of the sector: i.e. both SOE and SRA are associated with higher levels of EP, and their interaction further increases EP. Conversely, in countries with private participation, adding an SRA further reduces energy poverty.

Table 9 highlights relevance of political preferences for the social outcomes in the sector. First, it shows that left-oriented governments with private participation – i.e. the SOE dummy is set to 0– are significantly associated with a higher probability of not having access to electricity. Second, in countries with left-oriented governments, having a SOE instead of private participation is strongly correlated with an increase in access to electricity – i.e., a decrease in the probability of falling into the no access category. Third, countries with an SOE and a right-wing government are also associated with higher access to electricity – i.e., lower probability of no access –, but the magnitude is almost 10 times smaller than the association for SOE and left-oriented governments. And finally, the interaction between the ownership structure and the political orientation does not seem to significantly matter for energy poverty. But, if anything, left-wing governments are associated with lower EP-2M, and the impact of SOE on energy poverty now depends on its definition, i.e. it is significantly positive when looking at EP-10 but significantly negative when looking at EP-2M.

Table 9: Interaction between the political orientation of the government and SOE - Marginal effects

	Model 1: EP-10		Model 2: EP-2M	
	No access	Energy Poor (EP-10)	No access	Energy Poor (EP-2M)
SOE	-0.039***	0.104*	-0.040***	-0.034**
	(-5.32)	(1.68)	(-5.65)	(-2.45)
Political Orientation: Left	0.051***	-0.022	0.050***	-0.069*
	(8.47)	(-0.64)	(8.68)	(-1.70)
SOE*Left	-0.319***	-0.009	-0.336***	-0.117
	(-5.53)	(-0.10)	(-5.54)	(-1.57)
N	189,554		189,554	
Pseudo-R²	0.180		0.129	
Household Variables	Yes		Yes	
Institutional Variables	Yes		Yes	
Quintile Dummies	Yes		Yes	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. t statistics in parentheses. The table presents the marginal effects. Errors clustered at the country-area level. N: number of observations. Household and institutional variables are those presented in the baseline model. Model 1: Energy poor (EP-10): share of expenditures in electricity >10%. Model 2: Energy poor (EP-2M): share of expenditures in electricity > 2*median within country. Baseline category = others (i.e.: Model 1: 0% < share < 10%. Model 2: 0% < share < 2M).

Summing up, there are a couple of remarks worth making. First, interactions seem to play an important role in the analysis of the links between institutional reforms and energy poverty: , the goodness-of-fit is slightly increased in each of the interactions with respect to the baseline model, and there are differences relatively to the coefficients derived in the baseline model. Second, the results confirm that, though the baseline model is a good starting point, a deeper analysis is necessary to appropriately understand how energy poverty reconciles with SOEs and sectoral reforms in general. For instance, the baseline model suggests that the marginal impact of SOEs on access rates is, on average, not different to the one private providers have. Third, however, controlling for the interaction with the political orientation, the marginal impact on access rates of an SOEs in countries is stronger when the government when the government is left-wing government. And finally, the negative effect of SOEs on *EP* is worsened by the presence of a SRA hinting at the possibility that the mandate assigned to an SRA may not be the right one, in contrast to what is observed when an SRA is matched with a private operator.

6.4. Sensitivity analysis to threshold definition

In this subsection we study the robustness of our results by modifying the threshold of both of our *EP* measures, namely EP-10 and EP-2M. Regarding EP-10, Appendix J shows the results obtained when the threshold is decreased and increased to 5% and 15% respectively. Modifying this threshold is not only interesting in terms of the robustness of the results of our main models but it also seems to be a necessary step in order to study the differences in the measuring of energy poverty across countries. Indeed, countries such as Italy, for instance, consider a household to be energy poor if its expenditure in electricity services is equal to or greater than 5% of income.

There are a couple of comments worth making: first, the sign, magnitude and significance of the marginal effects of our variables on the probability of having no access to energy services is rather invariable to the changes in the measuring of energy poverty. Second, the sign, and to a lower extent the significance, of the marginal effect of our variables on the probability of being energy poor is invariable to the threshold used. This result increases the robustness of the findings derived in our main models.

Third, there is a difference, however, in terms of the size of the marginal effects of the variables on energy poverty. Indeed, the marginal effects of institutional variables increase in magnitude when we consider EP-5, and they decrease in magnitude when considering EP-15. Note that the share of the population in a situation of energy poverty increases when we consider the 5% threshold, and decreases when we consider the 15% threshold, which makes the difference in magnitudes of marginal effects coherent: indeed, when the threshold is decreased from 10 to 5%, it is more likely to be in the category of being energy poor, and therefore the marginal effect of each variable increases. The opposite holds in terms of the 15% threshold. Since the definition is more restrictive, the marginal effects on the probability of being it are lower. Finally, the analysis is applicable to EP-2M. The table is shown in Appendix K and the conclusions are consistent with those of EP-10

Summing up, the only difference when accounting for variations in the threshold (10% or twice the median) for measuring *EP* is in the magnitude of the marginal effects, which relates to how one threshold or the other modifies the probability of falling into the energy poverty category, but the sign and significance of the effect are invariable, which reflects the robustness of the results obtained in our main models.

7. Concluding remarks

The results point to three broad observations relevant to policy decisions. They also suggest that there are some limitations to the policy insights revealed by the simple correlations estimated from this specific data sample. These limitations have their own policy implications.

The first main observation is that the ownership structure of the electricity sector is generally likely to matter to social indicators in the electricity sector as already identified by earlier research based on more aggregated data. But there are differences across social indicators which suggest that public and private operators may have different perspectives on the poverty related issues and different margins to deal with them. More precisely, our baseline model shows that, although having an SOE in the electricity sector is not significantly associated with access, it is significantly positively correlated with one of our *EP* measures. In other words, a household living in a country where the electricity sector is state-owned has a higher probability of not being able to afford electricity services

The second main observation refines some of the previous result. In particular it shows that different quintiles are impacted differently by the institutional choices on some dimensions. For instance, while the ownership structure does not determine the access to electricity for the poorest, for countries with an SOE, the probability of access is lower for higher quintiles. In contrast, in terms of *EP*, countries with SOEs are found to be associated with higher affordability issues for the poorest and fewer such issues for the richest quintiles when compared to countries with private operators.

The last main observation illustrated by the simple modelling exercise conducted in this paper is that ownership should not be assessed in isolation. For instance, it seems that the association between ownership and access or *EP* depends on whether there exists a separate regulatory agency in the sector. This result serves as a reminder that ignoring the interactions between institutional characteristics of a sector may lead to the wrong social diagnostics , worse yet, the wrong recommendations. Reforms are usually thought through as packages but too often excessively mutli-dimensional standardized packages. Spending some time rethinking the match of institutional choices with local constraints and preferences could lead to better social outcomes. The fact that SRAs do less well in countries in which the operators are public should not be anecdotal and, indeed, deserves more scrutiny.

It may also reflect the fact that the choice of regulation that SRAs are expected to enforce, including the design of tariffs and the margin to rely on price discrimination may be too standardized in the region. Different ownership choices may demand different regulatory choices. Pricing and subsidies targeting may have to be designed differently according to the ownership context because the ownership choices are also linked to differences in the ability to subsidize. There may be a case for more precise regulation deserves at least some consideration if there is a desire to improve social outcomes.

These last comments already hint at the need for cautiousness in the interpretation of the three main observations. It is crucial to keep in mind that they reflect correlations and have no claim to causality between policy or institutional characteristics and social outcomes. In particular, the results produced by our simple modelling should not be used to draw linear policy conclusions on the relative social effectiveness of the two main ownership options, for instance. Some readers may interpret them as illustrations that private operators are doing better at addressing social concerns. This would be misleading. These same results could also be consistent with a much more subtle characterization of the markets, including the possibility of cream-skimming by private investors. The result could indeed simply reflect a self-selection bias in the sample.

If countries with a high rate of energy poverty are those finding it difficult to attract the private sector, it would result in a sample in which the private actors are only present when social indicators are not a source of concern. The theoretical literature has long suggested that cream-skimming can be a serious possibility in the context of infrastructure reforms to explain this type of biases.[17] There is also a long record of selection biases in the evidence on which types of countries get to attract private funding in infrastructure.[18] It thus seems reasonable to consider the possibility that the correlations identified in this paper can simply result from a cream skimming problem in the region. It would explain why SOEs continue to the main providers for a large share of the poor households of the regions and why private operators are more active where social performance indicators tend to be better.

Two-way causality in this sample is thus a possibility which would be consistent with the correlations we analyse. It would also point to the possibility that some key control variables that would reflect differences in risk perceptions, in price regulation design or in service obligations to the poor that influence the selection biases have been omitted from the discussion so far. This deserves follow up work to be able to test the relative strength of the various possible interpretations. This would be best tested with access to panel data, either on a continental scale or at a specific country level. But this analysis should be covered by follow up work since this dataset offers very limited scope to deliver a clear test.

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[17] See Auriol et al. (2021)

[18] Hammamiet al. (2006) providing evidence of cream-skimming by showing that PPPs tend to be more common in large, stable, wealthier and developed markets. The idea is that it allows for a faster cost recovery. It also explains why PPPs tend to focus on affluent urban areas when not constrainted by regulatory obligations.

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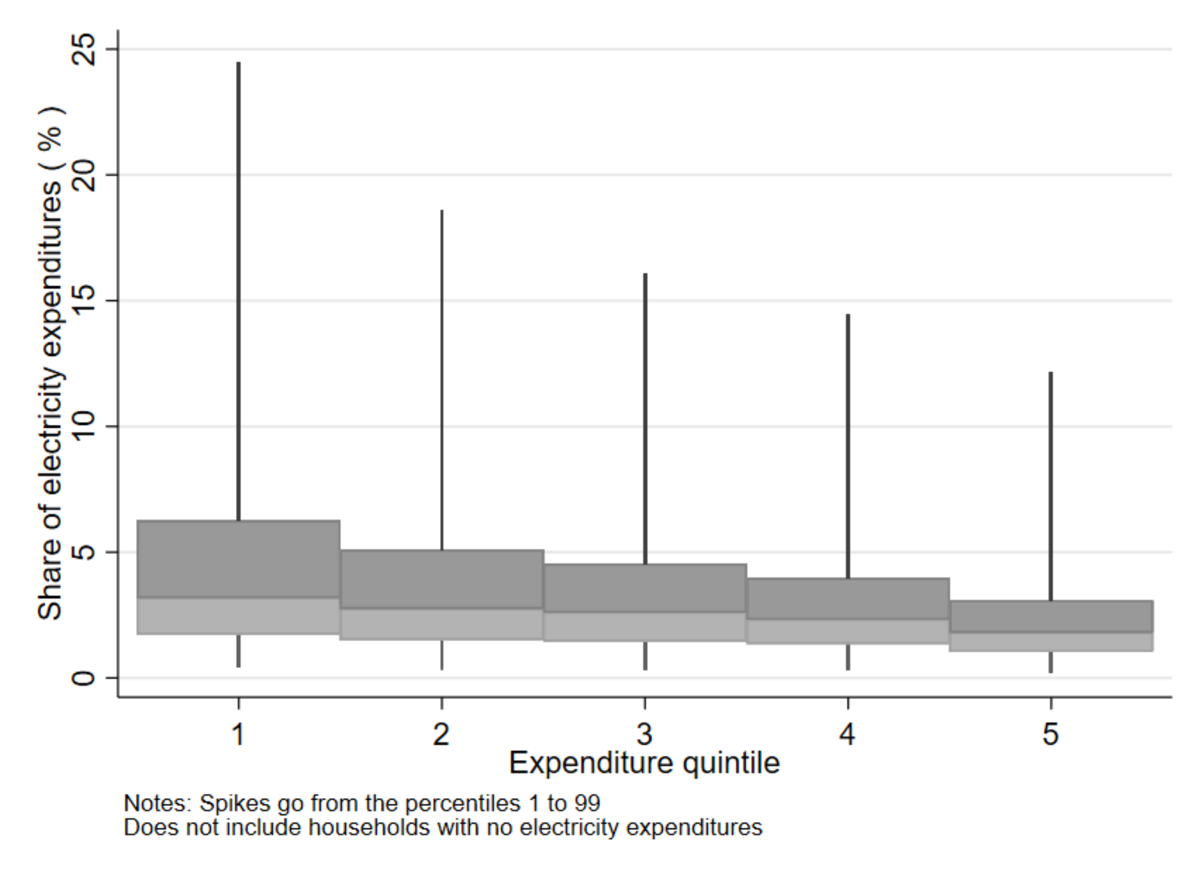
9. Appendix

Appendix A: Source of the data from Jimenez & Yepez Garcia (2017) by country

Countries	Survey Name	Year
Bolivia	Encuesta de Hogares	2013
Brazil	Pesquisa de Orçamentos Familiares	2008/2009
Costa Rica	Encuesta Nacional de Ingresos y Gastos	2013
Dominican Republic	Encuesta Nacional de Ingresos y Gastos de los Hogares	2007
Ecuador	Encuesta Nacional de Ingresos y Gastos de los Hogares Urbanos y Rurales	2011/2012
Guatemala	Encuesta Nacional de Ingresos y Gastos Familiares	2009/2010
Honduras	Encuesta Nacional de Condiciones de Vida	2004
Jamaica	Jamaica Survey of Living Conditions	2012
Mexico	Encuesta Nacional de Ingreso-Gasto de los Hogares	2014
Nicaragua	Encuesta Nacional de Hogares sobre Medición de Nivel de Vida	2014
Paraguay	Encuesta de Ingresos y Gastos y de Condiciones de Vida	2011/2012
Peru	Encuesta Nacional de Hogares sobre Condiciones de Vida y Pobreza	2014
Uruguay	Encuesta Nacional de Gastos e Ingresos de los Hogares	2005/2006

Source: Jimenez & Yepez Garcia (2017)

Appendix B: Distribution of share of electricity expenditures, across quintiles



Appendix C: Average share of electricity expenditure share, by country and quintiles

	Expenditure quintile					**Total**	
	1	2	3	4	5	**Average**	**Median**
Bolivia	2.09	2.03	2.12	2.11	1.88	**2.04**	**1.67**
Brazil	6.06	4.76	4.09	3.39	2.38	**4.31**	**3.20**
Costa Rica	5.24	3.87	3.24	2.50	1.69	**3.00**	**2.42**
Dominican Republic	4.41	4.04	3.47	3.40	2.98	**3.62**	**2.59**
Ecuador	2.35	2.18	2.03	1.92	1.56	**1.98**	**1.59**
Guatemala	7.13	5.42	5.15	4.79	3.83	**5.13**	**3.98**
Honduras	4.57	3.91	3.86	3.54	3.36	**3.65**	**2.57**
Jamaica	10.31	8.52	7.91	6.89	5.43	**7.73**	**6.09**
Mexico	4.31	3.65	3.20	2.98	2.26	**3.27**	**2.20**
Nicaragua	4.15	4.20	4.02	3.93	3.77	**3.99**	**2.73**
Paraguay	2.54	2.77	3.10	3.19	3.00	**2.93**	**2.26**
Peru	3.76	2.74	2.76	2.68	2.41	**2.91**	**2.24**
Uruguay	11.62	9.28	7.67	6.12	4.46	**7.66**	**6.49**
Total	**4.87**	**3.96**	**3.56**	**3.15**	**2.50**	**3.60**	**2.74**

Note: Does not include household with no electricity expenditures

Appendix D: Distribution of households according to the two definitions of energy poverty.

		Classification 2			
		No access	Others	Energy-poor (EP-2M)	**Total**
Classification 1	No access	24,391	0	0	**24,391**
	Others	0	135,611	20,624	**156,235**
	Energy-poor (EP-10)	0	1,056	7,872	**8,928**
	Total	**24,391**	**136,667**	**28,496**	**189,554**

Note: Classification 1: EP-10: a household is considered as energy-poor if it spends more than 10% of its total expenditures on electricity. Classification 2: EP-2M: a household is considered as energy-poor if the share of expenditures spent on electricity is higher than twice the country median.

Appendix E: Share of households with no electricity expenditures, by quintile and by country

	Expenditure quintile					**Total**
	1	2	3	4	5	
Bolivia	6.52	2.74	1.53	1.80	1.69	**2.65**
Brazil	16.15	10.94	8.65	6.07	3.78	**9.91**
Costa Rica	0.62	0.23	0.42	0.00	0.00	**0.20**
Dominican Republic	59.58	50.82	42.79	36.23	24.28	**44.39**
Ecuador	22.07	16.98	12.88	9.16	5.32	**12.93**
Guatemala	34.60	20.53	14.05	9.92	5.66	**17.06**
Honduras	80.11	43.42	21.39	14.34	7.08	**28.97**
Jamaica	32.22	19.00	13.34	10.68	7.33	**16.81**
Mexico	9.91	9.81	8.65	7.17	5.10	**8.13**
Nicaragua	33.82	19.92	18.09	15.18	10.19	**18.23**
Paraguay	16.31	16.61	13.60	11.05	9.05	**13.31**
Peru	25.15	12.16	8.10	6.24	5.23	**12.87**
Uruguay	17.69	9.16	6.66	3.92	1.39	**7.74**
Total	**22.39**	**14.93**	**11.38**	**8.56**	**5.48**	12.87

Appendix F: Share of households that are energy-poor according to EP-10, by quintile and by country

	Expenditure quintile					**Total**
	1	2	3	4	5	
Bolivia	0.87	0.35	0.33	0.26	0.48	**0.44**
Brazil	14.08	7.39	4.19	2.63	0.86	**6.67**
Costa Rica	4.98	1.39	1.04	0.52	0.44	**1.32**
Dominican Republic	2.75	3.43	2.52	2.90	2.19	**2.78**
Ecuador	0.39	0.26	0.15	0.26	0.26	**0.26**
Guatemala	11.81	8.05	8.28	6.76	3.85	**7.79**
Honduras	2.00	3.57	5.72	3.66	3.51	**3.77**
Jamaica	25.83	23.18	21.23	16.62	9.50	**19.58**
Mexico	6.83	4.60	3.47	3.83	2.34	**4.21**
Nicaragua	4.16	5.25	5.37	5.75	6.68	**5.55**
Paraguay	2.03	0.86	2.66	2.04	2.00	**1.92**
Peru	3.88	1.39	1.23	0.78	0.55	**1.81**
Uruguay	42.20	32.49	18.28	8.74	3.08	**20.91**
Total	**8.86**	**5.52**	**3.94**	**2.85**	**1.70**	4.71

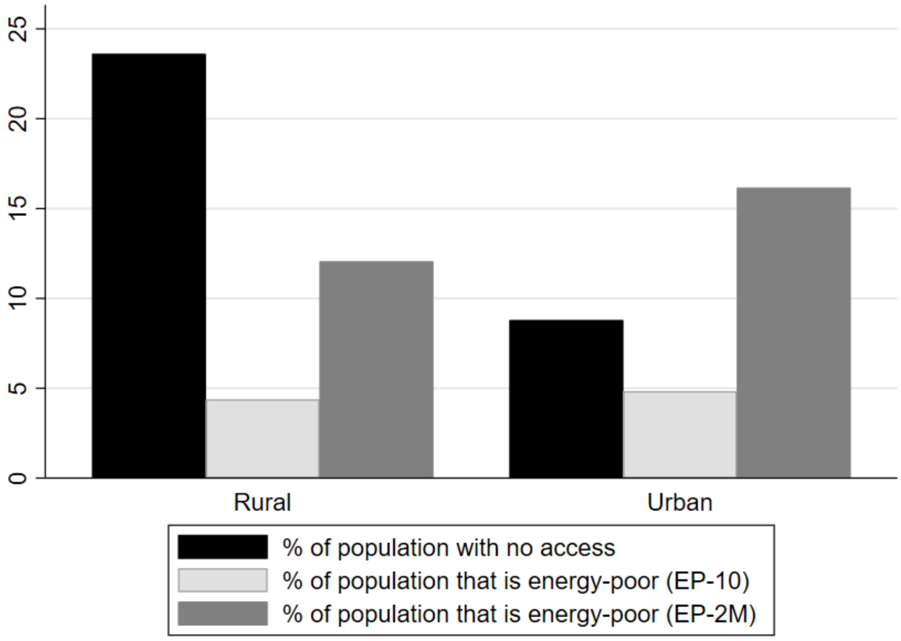
EP-10: a household is considered as energy-poor if it spends more than 10% of its total expenditures on electricity.

Appendix G: Share of households that are energy-poor according to EP-2M, by quintile and by country

	Expenditure quintile					**Total**
	1	2	3	4	5	
Bolivia	12.31	13.39	15.54	14.07	11.88	**13.49**
Brazil	29.64	22.10	14.97	9.01	3.53	**17.59**
Costa Rica	45.17	25.23	14.41	5.69	3.20	**15.13**
Dominican Republic	11.25	11.49	10.14	11.42	10.25	**10.95**
Ecuador	15.70	15.02	13.53	11.83	8.01	**12.66**
Guatemala	18.38	13.43	13.65	12.27	7.93	**13.19**
Honduras	5.22	12.22	18.99	16.42	15.60	**14.32**
Jamaica	19.53	14.58	14.30	9.04	5.05	**12.74**
Mexico	28.72	22.00	17.68	16.84	11.88	**19.42**
Nicaragua	14.61	17.45	16.99	16.98	18.76	**17.14**
Paraguay	12.58	14.89	15.94	16.85	14.32	**14.91**
Peru	17.99	13.15	13.39	12.01	8.63	**13.58**
Uruguay	25.52	15.55	7.54	2.78	0.95	**10.46**
Total	**21.96**	**17.42**	**14.51**	**11.77**	**8.22**	**15.03**

EP-2M: a household is considered as energy-poor if the share of expenditures spent on electricity is higher than twice the country median.

Appendix H: Access and energy poverty, by urban and rural areas



Note: EP-10: share of expenditures in electricity >10%. EP-2M: share of expenditures in electricity > 2*median within country.

Appendix J: Sensitivity analysis to EP-10 threshold – Marginal Effects

	Model 1: Baseline (10%)		5% threshold		15% threshold	
	No access	EP-10	No access	EP-5	No access	EP-15
Number of rooms	-0.026***	0.001***	-0.028***	0.008***	-0.026***	0.000***
	(-5.99)	(4.18)	(-6.00)	(3.73)	(-5.97)	(3.30)
Household head: man	-0.000	-0.004***	-0.001	-0.017***	0.000	-0.001***
	(-0.00)	(-4.79)	(-0.11)	(-6.14)	(0.06)	(-4.47)
Age of household head	-0.001***	0.000***	-0.001***	0.002***	-0.001***	0.000**
	(-2.92)	(3.24)	(-2.62)	(4.41)	(-3.13)	(2.54)
Household size	-0.002	-0.007***	-0.003	-0.030***	-0.002	-0.002***
	(-1.19)	(-7.57)	(-1.44)	(-9.28)	(-0.90)	(-6.66)
Urban area	-0.078***	0.010**	-0.080***	0.068***	-0.078***	0.002*
	(-5.39)	(2.54)	(-5.41)	(3.62)	(-5.43)	(1.80)
Property	-0.052***	0.002	-0.055***	0.018*	-0.051***	0.001
	(-3.66)	(1.39)	(-3.69)	(1.89)	(-3.65)	(1.01)
Education	-0.011***	0.002**	-0.011***	0.013***	-0.011***	0.000
	(-3.46)	(2.39)	(-3.30)	(4.16)	(-3.53)	(1.40)
Quintile 2	-0.033***	-0.055***	-0.030***	-0.116***	-0.032***	-0.022***
	(-3.73)	(-5.40)	(-3.26)	(-8.31)	(-3.78)	(-5.50)
Quintile 3	-0.051***	-0.072***	-0.049***	-0.177***	-0.049***	-0.027***
	(-4.02)	(-5.45)	(-3.67)	(-9.56)	(-4.02)	(-5.56)
Quintile 4	-0.065***	-0.080***	-0.066***	-0.227***	-0.062***	-0.029***
	(-4.71)	(-5.65)	(-4.47)	(-8.68)	(-4.70)	(-5.75)
Quintile 5	-0.081***	-0.087***	-0.086***	-0.279***	-0.078***	-0.031***
	(-5.21)	(-5.94)	(-5.19)	(-9.30)	(-5.16)	(-5.93)
SOE	-0.002	0.046***	0.015	0.245***	-0.008	0.012***
	(-0.05)	(5.01)	(0.34)	(6.22)	(-0.19)	(4.21)
SRA	0.057	0.027**	0.064	0.101**	0.054	0.008**
	(1.19)	(2.30)	(1.33)	(2.44)	(1.13)	(2.19)
High Incentives	0.040*	-0.001	0.041*	-0.003	0.040*	-0.000
	(1.75)	(-0.12)	(1.71)	(-0.07)	(1.79)	(-0.12)
Wholesale Elec. Market	0.042	0.018*	0.027	0.049	0.046	0.005*
	(0.95)	(1.65)	(0.59)	(0.93)	(1.05)	(1.66)
Political orientation: Left	-0.034	-0.013	-0.016	-0.006	-0.037	-0.006**
	(-1.03)	(-1.59)	(-0.46)	(-0.19)	(-1.17)	(-2.48)
GDP	-0.000	-0.000***	-0.000	-0.000***	-0.000	-0.000***
	(-1.42)	(-3.75)	(-1.45)	(-3.60)	(-1.35)	(-3.61)
Year	-0.008**	-0.004***	-0.009**	-0.018***	-0.008**	-0.001***
	(-2.23)	(-4.33)	(-2.29)	(-3.81)	(-2.18)	(-4.17)
Residential price	0.015	0.278***	0.032	1.299***	-0.002	0.078***
	(0.09)	(5.43)	(0.20)	(5.21)	(-0.02)	(5.32)
N	189,554		189,554		189,554	
Pseudo-R^2	0.169		0.177		0.160	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. t statistics in parentheses. The table presents the marginal effects. Errors clustered at the country-area level. N: number of observations. Model 1: Energy poor (EP-10): share of expenditures in electricity >10%. EP-5: share of expenditures in electricity >5%. EP-15: share of expenditures in electricity >15%. Baseline category = others (i.e.: 0% < share < *5, 10 or 15* %).

Appendix K: Sensitivity analysis to EP-2M threshold – Marginal Effects

	Model 1: Baseline (2M)		1.5M threshold		2.5M threshold	
	No access	EP-2M	No access	EP-1.5M	No access	EP-2.5M
Number of rooms	-0.027***	0.008***	-0.027***	0.016***	-0.026***	0.004***
	(-6.02)	(4.25)	(-6.04)	(3.60)	(-6.01)	(4.30)
Household head: man	-0.000	-0.019***	-0.000	-0.028***	-0.000	-0.012***
	(-0.06)	(-5.90)	(-0.06)	(-7.73)	(-0.03)	(-5.08)
Age of household head	-0.001***	0.002***	-0.001***	0.003***	-0.001***	0.001***
	(-2.77)	(5.23)	(-2.78)	(6.26)	(-2.81)	(4.70)
Household size	-0.002	-0.031***	-0.002	-0.044***	-0.002	-0.021***
	(-1.10)	(-15.03)	(-0.98)	(-16.85)	(-1.10)	(-15.03)
Urban area	-0.079***	0.077***	-0.080***	0.123***	-0.078***	0.047***
	(-5.41)	(8.54)	(-5.41)	(9.91)	(-5.41)	(7.72)
Property	-0.052***	0.016**	-0.053***	0.023**	-0.052***	0.012**
	(-3.68)	(2.06)	(-3.70)	(2.24)	(-3.67)	(2.39)
Education	-0.011***	0.013***	-0.012***	0.023***	-0.011***	0.008***
	(-3.51)	(6.07)	(-3.53)	(8.21)	(-3.52)	(5.05)
Quintile 2	-0.025***	-0.131***	-0.023***	-0.140***	-0.027***	-0.113***
	(-2.99)	(-9.65)	(-2.76)	(-13.03)	(-3.18)	(-7.46)
Quintile 3	-0.042***	-0.192***	-0.039***	-0.215***	-0.044***	-0.150***
	(-3.41)	(-8.57)	(-3.18)	(-12.50)	(-3.59)	(-7.35)
Quintile 4	-0.056***	-0.235***	-0.054***	-0.290***	-0.058***	-0.175***
	(-4.20)	(-8.74)	(-3.97)	(-11.54)	(-4.36)	(-7.72)
Quintile 5	-0.073***	-0.277***	-0.072***	-0.376***	-0.074***	-0.198***
	(-4.87)	(-10.53)	(-4.76)	(-14.42)	(-4.96)	(-9.02)
SOE	-0.010	-0.019	-0.010	-0.017	-0.010	-0.013
	(-0.24)	(-1.06)	(-0.24)	(-0.74)	(-0.24)	(-0.98)
SRA	0.055	0.024	0.055	0.037	0.055	0.015
	(1.11)	(1.45)	(1.11)	(1.38)	(1.12)	(1.49)
High Incentives	0.042*	-0.009	0.043*	-0.025	0.042*	0.002
	(1.85)	(-0.83)	(1.84)	(-1.51)	(1.85)	(0.26)
Wholesale Elec. Market	0.052	0.070***	0.052	0.058*	0.052	0.058***
	(1.16)	(3.19)	(1.15)	(1.94)	(1.16)	(3.61)
Political orientation: Left	-0.043	-0.118***	-0.042	-0.125***	-0.043	-0.092***
	(-1.31)	(-8.51)	(-1.27)	(-6.24)	(-1.32)	(-9.68)
GDP	-0.000	-0.000***	-0.000	-0.000***	-0.000	-0.000***
	(-1.38)	(-3.60)	(-1.37)	(-4.28)	(-1.38)	(-3.26)
Year	-0.008**	-0.001	-0.008**	0.001	-0.008**	-0.001
	(-2.19)	(-0.72)	(-2.19)	(0.40)	(-2.19)	(-0.89)
Residential price	-0.013	0.118	-0.013	0.091	-0.014	0.094
	(-0.09)	(1.39)	(-0.09)	(0.66)	(-0.09)	(1.61)
N	189,554		189,554		189,554	
Pseudo-R^2	0.120		0.112		0.129	

* p < 0.1, ** p < 0.05, *** p < 0.01. t statistics in parentheses. The table presents the marginal effects. Errors clustered at the country-area level. N: number of observations. Model 1: Energy poor (EP-2M): share of expenditures in electricity > 2*median within country. EP-1.5M: share of expenditures in electricity > 1.5*median within country. EP-2.5M: share of expenditures in electricity > 2.5*median within country. Baseline category = others (i.e.: 0% < share < *1.5, 2 or 2.5* * Median).