The determinants of electricity constraints by firms in developing countries

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Abstract

We employ survey data for 108 developing countries over the period 2006-2017 and estimate an ordered probit model to determine the firm and country characteristics that affect the probability that a firm is energy poor—i.e., the firm will report that electricity is an obstacle to the firm's operations. We find that firms that experienced power outages and firms in the manufacturing industry are more likely to be energy poor. In contrast, majority-owned government firms and older firms are less likely to be energy poor. The gender of the firm owner and the size of the firm are not correlated with firm energy poverty. Among firms that experienced power outages, firm energy poverty increases with the frequency as well as the duration of outages. We also find that firms that operate in countries with weak institutions and in countries where residents have limited access to electricity are more likely to be energy poor.

JEL Classification: D22, O12, L20

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1 Introduction

Data from the World Bank Enterprise Survey (WBES) indicate that many firms in developing countries cite electricity as the major obstacle or one of the top constraints that impede their business. Specifically, data from the WBES for 108 developing countries from 2006-2017 show that about 14% of firms reported that electricity was the most important obstacle they face in their operations (Graph 1). This makes electricity the second most important constraint, the first being access to finance which was selected by 15% of the firms surveyed. The data also suggest that electricity is more of a problem in South Asia and Sub-Sahara Africa (SSA) regions: about 24% of firms in South Asia and 25% of firms in SSA reported that electricity is the top obstacle to the growth of their business (Table 1). Furthermore, about 46% of firms in SSA and 41% of firms in South Asia reported that electricity was a major or severe obstacle to their business (Table 3). Indeed, the fact that electricity ranks higher than political instability and access to finance in these regions, which happens to be the poorest regions is quite surprising, and it clearly suggest that electricity insecurity or energy poverty among firms is an important issue that requires further investigation. More importantly, to the extent that firms are the engines of growth in developing countries, it is important to understand the factors that inhibit firm performance. Yet the literature on firm energy poverty is scant. Specifically, with the exception of a few, most of the studies on firm energy poverty have focused on the impact of electricity outages on firm productivity, and, the results are mixed. For example some studies find a large adverse effect (e.g. Hardy and McCasland, 2021; Busani, 2013; Abeberese et al. 2021), others studies find a small and significant effect (e.g., Grainger and Zhang, 2017) and others find no significant relationship between the frequency of outages and firm productivity (e.g., Scott et. al. 2014). While this line of research is important, it has limited policy implications in that it provides no guidance as to which firms are energy constrained. For policy purposes, it is crucial for policy makers to be able to identify energy poor firms so that they can craft targeted policies. For example,

it will be misguided if a government provides assistance to large firms when electricity is a constraint for small firms and not large enterprises.

This paper tackles the firm energy poverty problem from a different angle. The paper employs data from the WBES for 108 developing countries over the period 2006-2017. We define a firm as energy poor if the firm reports that electricity is an obstacle to the firm's operations and we estimate an ordered probit model to determine the firm and country characteristics that affect the probability that a firm is energy poor. We find that firms that experienced power outages and firms in the manufacturing industry are more likely to be energy poor. In contrast, majority-owned government firms and older firms are less likely to be energy poor. The gender of the firm owner and the size of the firm are not correlated with firm energy poverty. Among firms that experienced power outages, firm energy poverty increases with the frequency as well as the duration of outages. We also find that firms that operate in countries with weak institutions and in countries where residents have limited access to electricity are more likely to be energy poor.

The paper makes at least five contributions to the literature. First, to the best of our knowledge, it is the first study to conduct an empirical analysis of the determinants of firm energy poverty. Second, the paper examines the extent to which a country's institutions affect firm energy poverty. Thus, in this sense, the paper contributes to the extensive literature that analyze the link between a country's institutional quality and the performance or investment decisions of firms that operate in the country (Asiedu and Freeman, 2009; Asiedu and Lien, 2011).[1]

Third, the paper contributes to the electricity-binding constraint literature, which has generally focused on whether electricity supply is a binding constraint to economic growth in developing countries (McCulloch and Zileviciute, 2017).[2] It is important to note that there

[1] Asiedu and Freeman (2009) examine the impact of corruption on firm investment and Asiedu and Lien (2011) analyze how democracy in host countries affect the amount of foreign direct investment a country receives.

[2] Authors provide an extensive review of the literature that analyzes whether electricity is a binding constraint to economic growth in developing countries.

are many ways by which electricity can affect a firm's performance. Electricity insecurity can take the form of high electricity cost, the amount of time it takes to obtain an electricity connection, bribe payments firms have to make in order to obtain service, voltage fluctuations and unpredictable, frequent and long power outages, to mention a few. As noted in the binding constraint literature, it is important to determine whether a constraint is binding before allocating resources to remove or relax the constraint. This paper focuses on the most common source of electricity insecurity, i.e., power outages. Indeed, our data suggests that electricity outages is very costly to firms—resulting in about 8% loss of sales for the entire sample and about 10% for countries in SSA and South Asia. We examine whether power outages is a binding constraint by testing whether firms that have experienced an outage are more likely to be energy poor. We also test whether the frequency and the duration of outages increases the probability of firm energy poverty.

Fourth, the paper also contributes to the thin literature on energy and women entrepreneurship. Maestre and Pueyo (2019) conduct an extensive review of the literature on the productive use of electricity and note on page 170 that "Gender considerations have broadly escaped the debate on how electricity impacts enterprises. The energy and gender literature has instead focused mainly on the household realm, where women suffer heavily the burden of energy poverty." The authors argue that women entrepreneurs face different challenges than men in how they utilize electricity as well as the benefits they derive from electricity, suggesting that there may be differences in the constraints faced by male and female-owned enterprises. Clearly, this issue has important policy implications, and therefore requires further investigation. Specifically, if female-owned enterprises are more energy constrained than male-owned enterprises, then there is a need for policies that will assist female-owned enterprises so as to restore gender parity. We take this into consideration and include a measure of female ownership in our regressions. In this sense, our analysis is similar to Asiedu et al. (2013) and Goel and Nelson (2019). Both studies employ data from the same source

as we do, the WBES—Asiedu et al. (2013) test whether female-owned enterprises are more financially constrained than male-owned enterprises and Goel and Nelson (2019) examine whether corruption is more of an obstacle for female-owned firms than male-owned firms.

Finally, the paper contributes to the literature on the determinants of energy poverty. This literature has generally focused on household poverty analysis (Barnes et al., 2011; Churchill and Smyth, 2021). This paper also examines the determinants of energy poverty, however, it focuses on firms instead of households. The rest of the paper is as follows. Section 2 describes the data we use in our empirical analysis, Section 3 describes the variables included in the regressions, Section 4 presents the empirical results and Section 5 concludes.

2 Data

The World Bank's Enterprise Survey (WBES) is the most comprehensive and widely used survey that collects data on the constraints faced by firms in developing countries. An important feature of the survey is that the same questionnaire is used in all the countries and the data are standardized and comparable across countries. In addition the survey is universal in that it covers 144 countries.[3] As part of the survey, firms are presented with a list of 15 elements that shape the business environment and asked to select the single most important obstacle faced by their establishment. Specifically, firms are asked to answer this question: "By looking at the list of the business environment, please tell me which one, if any, currently represents the biggest obstacle faced by this establishment." The percentage of firms that selected each of the obstacles listed as a top constraint is shown in Graph 1, which shows that electricity is ranked as the second most important obstacle to firm performance, next to access to finance. Furthermore, electricity ranks higher as an obstacle than political instability, corruption and tax rates. Table 1 presents the information for each of the five regions and it shows a wide variation across regions in the extent to which firms consider

[3]For more information see https://www.enterprisesurveys.org/en/enterprisesurveys

electricity as an obstacle. Electricity is the top obstacle for firms in SSA and South Asia, and it ranks second and third for Middle East and North America (MENA) and East Asia and Pacific (EAP), respectively. Electricity is less of an obstacle in Latin America and Caribbean (LAC) and East and Central Asia (ECA), however, it still ranks high on the list of business constraints—it ranks 6 and 7 for LAC and ECA, respectively.

Tables 2 provides information about the severity of each constraint and is derived from the question: "To what degree are each of the following an obstacle to the current operations of this establishment?" Based on the responses we report the percentage of firms that consider each of the 15 elements as a constraint to their business in Table 2. Table 3 reports similar information, but only for electricity constraint and by region. Table 2 shows that about 34.5% of firms reported that electricity is a major obstacle or a very severe obstacle to their business. This compares with 24% for access to finance, 32.8% for political instability and 31.3% for taxes. Table 3 shows that SSA is the most energy constrained region, where about 46% of firms reported that electricity is a major obstacle or a very severe obstacle to their business, followed by South Asia (about 41%), MENA (about 40%), LAC (about 37%) and EAP (about 15%).

In sum, the data suggest that overall, firms consider electricity a very important obstacle to their business, more important than many of the other business constraints. Indeed, this is one of the motivations of the paper.

3 Variables

3.1 Dependent variable

We define a firm as energy poor if the firm reports that electricity is an obstacle to the firm's operations. The dependent variable is derived from the response to the survey question: "To what degree is electricity an obstacle to the current operations to this establishment?" The five possible responses are “no obstacle”, “minor obstacle”, “moderate obstacle”, “major

obstacle" and "very severe obstacle". To facilitate the discussion, we re-categorize the responses such that "no obstacle" corresponds to "no energy poor", and "minor", "moderate", "major" and "very severe obstacles" correspond to "minor", "moderate", "major" and "very severe energy poverty" respectively. We construct the dependent variable Energy_ poverty, which takes on values zero to four where a higher number implies the firm is more energy poor. About 31% of the respondents fall in the "no energy poverty" category and 19%, 16%, 18% and 16% fall in the "minor", "moderate", "major" and "very severe energy poverty" categories, respectively.

We note that our measure of energy poverty is subjective and that such measures of poverty have been employed in several studies (Price et al., 2007; Thompson et al., 2017; Churchill et al., 2020).[4] One advantage of our poverty measure is that it reflects firms' perception of the extent to which electricity inhibit their business operations. This is important because a firm's perception is one of the most important factors that influence firms' operational and investment decisions (Asiedu and Freeman, 2009).

3.2 Firm explanatory variables

We define firm size as the number of fulltime employees and firm age as the number of years the firm has been established. We take logs of both variables to mitigate the effect of outliers. We include three firm ownership dummy variables: female-owned takes value 1 if at least one of the firm owners is a female (Asiedu et. al, 2013; Goel and Nelson, 2019); foreign-owned takes value 1 if at least 10% of the firm is owned by a foreign private entity and zero otherwise; government-owned takes value 1 if the government owns majority shares, i.e., at least 50% government ownership. To control for industry, we include a dummy variable which takes on value 1 if the firm is in manufacturing. To test whether power outages is a binding constraint, we include a dummy variable, outage_yes, that takes on value 1 for firms that experienced

[4] Churchill et al., (2020) employ both objective and subjective measures of energy poverty in their analysis. In addition, they construct a composite measure of energy poverty by combining the objective and subjective measures.

outages the fiscal year. It is important to note that the relationship between outage_yes and the dependent variable is not one-to-one. In addition, we run separate regressions for firms that experienced an outage in a typical month where we include the number of outages and the duration of outages (in hours) as explanatory variables to determine whether the frequency and duration of power outages increases the probability of firm energy poverty.

We now describe the firm explanatory variables. We define firm size as the number of fulltime employees and firm age as the number of years the firm has been established. We take logs of both variables to mitigate the effect of outliers. We include three firm ownership dummy variables: female-owned takes value 1 if at least one of the firm owners is a female (Asiedu et. al, 2013; Goel and Nelson, 2019); foreign-owned takes value 1 if at least 10% of the firm is owned by a foreign private entity and government-owned takes value 1 if the government owns majority shares, i.e., at least 50% government ownership. To control for location and industry, we include two dummy variables: Firm_City equals 1 if the firm is located in a business city and manufacturing takes on value 1 if the firm operations are in manufacturing. The WBES includes questions that pertain to firm's innovation activities and that permits us to construct three measures that reflect firm innovation. Specifically, we define three dummy variables: Product Innovation that takes on value 1 if the firm introduced new or improved products or services in the past three years; Process Innovation takes on value 1 if the firm introduced new or improved process in the past three years, and R&D, takes on value 1 if the firm spent on research and development activities in the past fiscal year. We note that the process of innovation and research and development typically requires more electricity and therefore all else equal firms that engage in R&D and firms that innovate are likely to be energy poor. To test whether power outages is a binding constraint, we include a dummy variable outage_yes that takes on value 1 for firms that experienced outages the fiscal year. In addition, we run separate regressions for firms that experienced outages and include the number of outages in a typical month and the duration of outages (in

hours) as explanatory variables to determine whether the frequency and duration of power outages increases the probability of firm energy poverty.

3.3 Country explanatory variables

The country characteristics we consider can be broadly classified into two. The first pertains to the quality of institutions and the second the availability of electricity in host countries. We first note that in most developing countries, utilities, in particular, electricity is provided by the government. Furthermore, obtaining an electricity connection can be arduous. Geginat and Ramalho (2018) report that in some developing countries, businesses have to go through about 7-11 procedures in order to obtain an electricity connection and the average processing time is about 141 days. About 14% of the respondents in our dataset submitted an application for an electricity connection within a two year period—57% waited for more than a week to obtain a connection, 34% waited for more than a month and 23% waited for more than three months. Thus, to get around the long waiting period, firms often pay bribes to the utility company or agent. For example about 17% of the firms in our dataset paid bribes in order to receive an electricity connection. Based on data from 183 countries, Geginat and Ramalho (2018) construct a "Getting Electricity" index which is based on procedures, cost and the time it takes for firms to obtain electricity in various countries. The authors make three assertions about the index. First, they argue that the index reflects the overall performance of electricity in the various countries. Second, they find that the index is strongly correlated with the level of bureaucracy and corruption in the countries. Third, they find that the index is positively correlated with firm performance. Thus, the study suggests that the quality of institutions in a country is correlated with the performance of electricity in the country and this in turn affects firm performance. We employ four measures of institutional quality in our regressions: government effectiveness, regulatory quality, rule of law and control of corruption. The data on government effectiveness reflects the ability and credibility of government to provide quality public services, regulatory quality captures

the level of bureaucracy that affect private sector development, rule of law reflect the extent to which contracts are enforced and corruption reflects corruption in government, such as paying bribes. The data are from World Governance Indicators (Kaufmann et al., 2010). Each of the variables range from -2 to 2, however in order to facilitate the interpretation, they are transformed so they take on positive values from 0 to 4.

Naturally, we expect firms that are located in countries with inadequate electricity to be energy poor, i.e., the firms are likely to report that electricity is a constraint to their operations. We use three measures of "electrification rate", defined as the share of populations that have access to electricity, to characterize energy poor countries. Specifically, we use the electrification rates for a country's rural population, urban population and total population. Intuitively, one would expect the urban electrification rate to be correlated with firm energy poverty, however, the effect of rural electrification rate is not too clear, since firms typically locate in urban areas. Furthermore, it is important to note that in many countries the electrification rates is significantly lower in rural areas than in urban areas. For example the rural (urban) electrification rates for Burundi are 1% (52%), Guinea 4% (72%) and Mauritania 2% (65%). This makes a case for examining the impact of both rural and urban electrification rates separately, in addition to the electrification rate for the entire population.

As shown in Table 3, energy poverty rates by firms varies significantly across regions. We therefore include regional dummy variables in the regressions. Finally we include year dummy variables in all the regressions to capture the impact of exogenous annual changes. The summary statistics are reported in Table 4. The countries included in the regressions are listed in the appendix.

4 Results

As pointed out earlier, the dependent variable, Energy_poverty, runs from zero to four, where a higher number implies more poverty. As is standard in the literature, we estimate an ordered probit model. Tables 5, 6 and 7 report the regressions for the three measures of access to electricity by a country's residents. Table 5 employs the electrification rate of the entire population, and Tables 6 and 7 use the electrification rates for rural and urban regions, respectively. In all the regressions, we include region and year dummy variables. Finally, we include the four measures of institutional quality, one at a time. One of our goals is to include as many observations as possible, and therefore our base regressions are the estimations that has 110,396 observations, i.e., the regressions that employ the electrification rate for the entire country (Table 5).

We start with the firm variables. Table 5 shows that in all the regressions, the estimated coefficients of foreign-owned, female-owned and firm size are not significant. The estimated coefficients of the dummy variables for firms that experienced an outage and firms in the manufacturing sector are positive and significant at the 1% level, the estimated coefficients of firm age are negative and significant at the 1% level, and the estimated coefficients of majority-owned government firms are also negative but significant at the 5% level. The estimated coefficient of the outage dummy variable is negative and significant at the 1%, suggesting that experiencing a power outage is a binding constraint for firms. A plausible reason why manufacturing firms may be more energy poor than firms in other industries is that overall, manufacturing is relatively more electricity intensive. Majority-owned government firms being less energy poor than other firms may be explained by the fact that in most countries, the government is the sole provider of electricity. Finally, the negative relationship between firm age and firm energy poverty may be attributed to the fact that over time, firms tend to find ways to resolve or mitigate the energy insufficiency problem. In sum, we conclude that all else equal, the probability of firm energy poverty is higher for

firms in the manufacturing sector and firms that experienced power outage, and it is lower for majority-owned government firms and positively correlated with firm age.

With regards to country characteristics, we note that the estimated coefficients of the share of total population that have access to electricity as well as the estimated coefficients of all the four institutional variables are negative and significant at the 1% level, suggesting that all else equal, firms that operate in countries that have strong institutions and in countries where citizens have access to electricity are less likely to be energy poor.[5] Finally, the sign and estimated coefficients of the regional dummy variables indicate that overall, firms that operate in EAP, LAC, MENA and SSA are less energy poor than firms in South Asia. The results for the estimations that employ the rural electrification rate (Table 6) and urban electrification rate (Table 7) are qualitatively similar.

The sign and significance of the estimated coefficients of the ordered probit regressions reported in Tables 5, 6 and 7 provide information about the qualitative relationship between energy poverty and the variables. However, for policy purposes, it is important to quantify the "causal" impact of the variables that have a significant effect on firm energy poverty. To conserve on space we report the average marginal effect of the estimated ordered probit model for the regressions that employ the electrification rate for the entire population, i.e., the base regressions. Table 8 presents the results where we control for corruption and Tables 9, 10 and 11 control for the effectiveness of rule of law, government effectiveness and bureaucratic quality, respectively.

Table 8 shows that all else equal, a one percent increase in the age of a firm increases the probability of being in the "no energy poverty" category by 1.65 percentage points, "minor energy poverty" category by 0.23 percentage points, and it decreases the probability of being in the "moderate energy poverty", "major energy poverty" and "very severe energy poverty" categories by 0.14 percentage points, 0.56 percentage points and 1.18 per-

[5] We experimented with GDP per capita as an explanatory variable, however, it did was not significant in most of the regressions once we controlled for institutional quality and access to electricity.

centage points, respectively. The probability of being in the "no energy poverty" category is about 2.07 percentage points higher for majority government owned firms and the probability of being in the "very severe energy poverty" category is about 1.42 percentage points lower for such firms. With regards to industry, the probability of being in the "no energy poverty" category is about 6.64 percentage points lower for firms in the manufacturing industry than non-manufacturing firms, and the probability of being in the "very severe energy poverty" category is about 4.62 percentage points higher for manufacturing firms than non-manufacturing firms. An important result is that the effect of experiencing an outage on firm energy poverty is quite large. Specifically, the probability of being in the "no energy poverty" category is about 24.91 percentage points lower for firms that experienced an outage and the probability of being in the "very severe energy poverty" category is about 14.2 percentage points higher for such firms. This clearly suggests that power outage is an important energy constraint for firms.

We next discuss the country variables. All else equal, a one percentage point increase in the electrification rate increases the probability of being in the "no energy poverty" category by 8.95 percentage points, the "minor energy poverty" category by 1.23 percentage points, and it decreases the probability of being in the "moderate energy poverty", "major energy poverty" and "very severe energy poverty" categories by 0.77 percentage points, 3.03 percentage points and 6.38 percentage points, respectively. With regards to institutional quality, recall that a higher number implies better institutions. Thus, a one percent reduction in corruption increases the probability of being in the "no energy poverty" category by 23.36 percentage points and it decreases the probability of being in the "very severe energy poverty" category by 16.66 percentage points. For the other three institutional variables, Table 9 shows that a one percent increase in the effectiveness in the rule of law raises the probability of being in the "no energy poverty" category by 17.64 percentage points and lowers the probability of being in the "very severe energy poverty" category by 12.58 per-

centage points. Table 10 shows that a one percent increase in government effectiveness raises the probability of being in the "no energy poverty" category by 24.52 percentage points and lowers the probability of being in the "very severe energy poverty" category by 17.51 percentage points. The estimated marginal effect for bureaucratic quality is much lower than the other institutional variables. Specifically, as shown in Table 11, a one percent reduction in bureaucratic quality increases the probability of being in the "no energy poverty" category by 5.69 percentage points and decreases the probability of being in the "very severe energy poverty" category by 4.07 percentage points. Thus the results clearly demonstrate the importance of institutions in mitigating firm energy poverty in developing countries.

The results in Tables 8-11 also permits us to quantify the differences in energy poverty across regions. For example, Table 8 shows that compared to firms in South Asia, the probability of being in the "no energy poverty" category is about 24.94 percentage points higher for firms in EAP and about 15.37, 4.36, 4.26 and 3.89 percentage points higher for firms in ECA, SSA, LAC and MENA, respectively; and the probability of being in the "very severe energy poverty" category is about 12.56 percentage points lower for firms in EAP and about 8.88, 2.98, 2.92 and 2.59 percentage points lower for firms in ECA, SSA, LAC and MENA.

We now turn our attention to firms that experienced a power outage during the survey year. Specifically, we test whether the number of outages and the duration of outages has a significant impact on firm poverty. To conserve on space we report the regressions that employ the electrification rate for the entire population. The estimated coefficients of the ordered probit regressions is reported in Table 12. Note that the estimated coefficients of the number of outages and the duration of outages are positive and significant at the 1% level in all the regressions, suggesting that all else equal, the frequency and the duration of outages increase the probability of firm energy poverty. The estimated coefficients of the other explanatory variables retain their sign and their significance. Similar to the previous

regressions, we report the marginal effects of the ordered probit regressions for all the four institutional variables. Table 13 reports the average marginal effect for the regressions that employ the corruption variable. It shows that all else equal, an additional power outage reduces the probability of being in the "no energy poverty" category by 0.07 percentage points, "minor energy poverty" category by 0.05 percentage points, "moderate energy poverty" category by 0.01 percentage points, and it increases the probability of being in the "major energy poverty" and "very severe energy poverty" categories by 0.03 percentage points and 0.09 percentage points, respectively. A one percent increase in the duration of outages reduces the probability of being in the "no energy poverty" category by 5.02 percentage points, "minor energy poverty" category by 3.68 percentage points, "moderate energy poverty" category by 0.96 percentage points, and it increases the probability of being in the "major energy poverty" and "very severe energy poverty" categories by 2.57 percentage points and 7.09 percentage points, respectively. The estimated average marginal effect for the regressions that employ the other measures of institution are reported in Table 14 (rule of law), Table 15 (government effectiveness) and Table 16 (bureaucratic quality). The results show that the estimated coefficients and signs of the number of outages and duration of outages are stable across estimations.

5 Conclusion

To the extent that firms are the engine of growth and development in developing countries, it is important to identify the factors that inhibit firm growth. This paper focuses on one of the most important constraints faced by firms, electricity. Specifically, it identifies firm and country characteristics that affect firm energy poverty. To the best of our knowledge this is the first paper to study this subject. The analysis is based on survey data from 108 developing countries over the period 2006-2017 and we estimate an ordered probit model. We find that firms that experienced power outages and firms in the manufacturing industry

are likely to be energy poor. In contrast, majority-owned government firms and older firms are less likely to be energy poor. The gender of the firm owner and the size of the firm are not correlated with firm energy poverty. We also find that among firms that experienced power outages, energy poverty increases with the frequency as well as the duration of outages. With regards to country characteristics, we find that all else equal, firm energy poverty is negatively correlated with the electrification rate of the country—firms that operate in countries where a high share of the population have access to electricity are less likely to report that they are energy poor. We also find that firms that operate in countries that have good institutions, i.e., countries that have less corruption, effective government, better law enforcement and less bureaucracy are less likely to be energy poor. This result is consistent with that of Geginat and Ramalho (2018) who find evidence that a country's bureaucratic environment is correlated with the ease of getting electricity. To the best of our knowledge this is the first paper to stress the importance of institutional quality in the energy poverty literature.

We end by making three recommendations that governments may implement to mitigate the firm energy poverty problem. The first recommendation is to increase the electrification rate by making electricity accessible to more of the country's residents. Note that this policy is in tune with Sustainable Development Goal 7—to ensure access to affordable, reliable and sustainable modern energy to all. The second policy is to make electricity more reliable by reducing the number and frequency of power outages experienced by firms. This may include providing generators to firms, in particular firms in the manufacturing sector and younger firms. The third recommendation is for countries to adopt policies that will enhance their institutions. Indeed, several papers have found that institutions have a robust and positive impact on economic growth (North, 1990, Acemoglu et. al., 2002, Rodrik et al., 2004). This suggests that our policy recommendation will yield a double dividend: reduce firm energy poverty and also promote growth. A caveat is that as noted by Acemoglu and Robinson

(2008), institutions are persistent and take a long time to change, and therefore it may take a while for the policy to produce the desired result.

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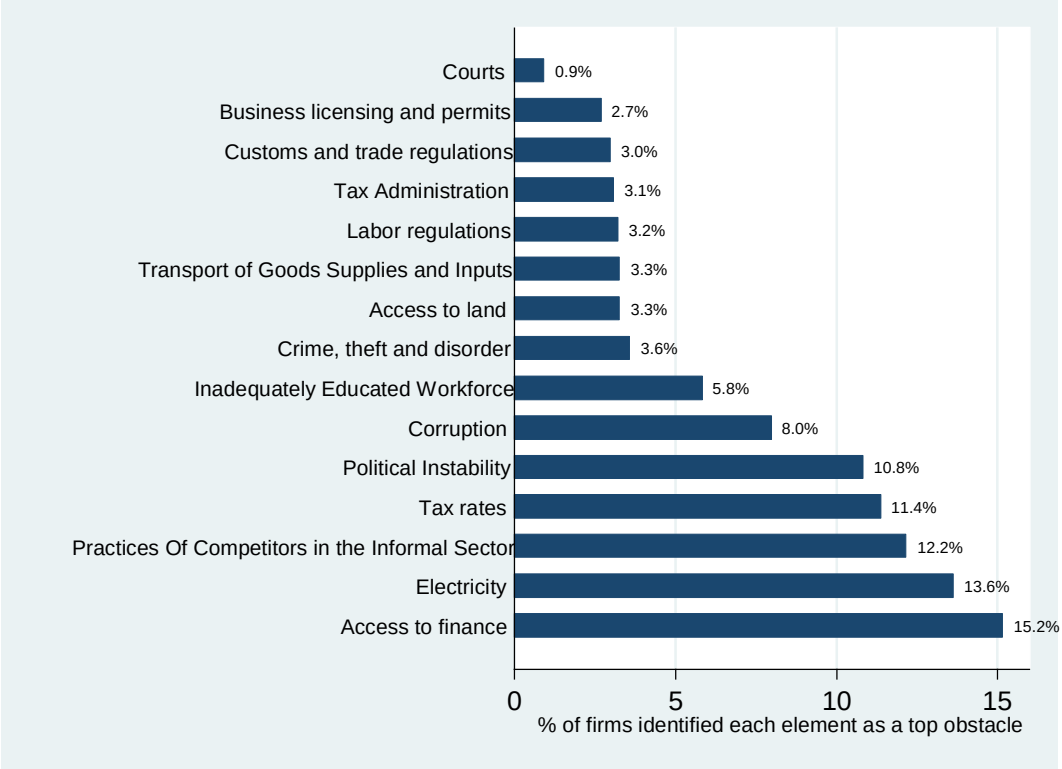
Figure 1

Percentage of firms that selected each element as the top obstacle to the growth of their business



Notes: Author's calculations based on 104,985 responses from firms in 108 countries from 2006-2017. Data are from the World Bank Enterprise Survey.

Table 1

Percentage of firms that selected each element as the top obstacle to the growth of their business, by region

Constraints for the Establishment	SSA	EAP	ECA	LAC	MNA	SAR
Access to finance	21.26	16.55	15.39	11.39	11.16	12.62
Access to land	4.92	4.72	2.98	0.95	2.41	3.84
Business licensing and permits	1.63	2.90	3.22	3.42	3.68	1.83
Corruption	5.90	3.88	8.14	8.20	7.50	14.48
Courts	0.43	0.54	1.33	1.18	0.87	1.24
Crime, theft and disorder	4.27	2.10	1.55	6.91	2.00	1.98
Customs and trade regulations	3.38	3.72	2.93	3.05	2.75	1.81
Electricity	24.53	8.78	4.72	6.08	12.93	23.54
Inadequately Educated Workforce	2.00	9.38	8.06	7.69	4.61	3.48
Labor regulations	1.21	3.19	1.37	5.67	3.14	4.43
Political Instability	5.75	7.21	11.00	10.50	34.12	10.04
Practices Of Competitors in the Informal Sector	9.34	16.41	11.99	18.67	5.34	6.08
Tax Administration	2.76	2.82	3.29	4.06	1.68	2.79
Tax rates	8.50	10.66	21.50	10.40	6.59	9.43
Transport of Goods Supplies and Inputs	4.14	7.13	2.53	1.82	1.20	2.41
Total number of firms	23,449	15,197	17,133	24,657	8,251	16,298

Notes: Author's calculations based on 104,985 responses from firms in 108 countries from 2006-2017. Data are from the World Bank Enterprise Survey.

Table 2

Percentage of firms that consider each of the 15 elements as a constraint to their business

(By the severity of the constraint)

Constraints for the Establishment	No obstacle	Minor obstacle	Moderate obstacle	Major obstacle	Very severe obstacle
Access to finance	31.94	20.90	22.24	16.04	8.88
Access to land	51.16	16.02	14.71	11.98	6.13
Business licensing and permits	44.97	22.07	18.49	10.07	4.39
Corruption	30.31	16.16	16.71	19.56	17.27
Courts	52.41	19.14	14.11	9.15	5.19
Crime, theft and disorder	42.54	23.86	15.35	11.44	6.81
Customs and trade regulations	49.89	19.47	16.10	9.62	4.92
Electricity	30.85	18.84	15.84	18.32	16.15
Inadequately Educated Workforce	38.22	22.27	19.76	13.91	5.84
Labor regulations	47.52	22.87	17.96	8.26	3.39
Political Instability	34.81	15.62	16.79	18.36	14.42
Practices Of Competitors in the Informal Sector	33.90	19.01	20.40	16.52	10.17
Tax Administration	33.85	22.20	23.58	14.17	6.20
Tax rates	24.78	19.23	24.73	20.84	10.42
Transport of Goods Supplies and Inputs	39.57	22.96	19.27	12.18	6.01

Notes: Author's calculations based on 104,985 responses from firms in 108 countries from 2006-2017. Data are from the World Bank Enterprise Survey.

Table 3

Percentage of firms that consider electricity as a constraint by region.

Region	No obstacle	Minor obstacle	Moderate obstacle	Major obstacle	Very severe obstacle
Sub-Saharan Africa (SSA)	17.7	19.1	17.3	24.8	21.1
East Asia and Pacific (EAP)	44.6	25.7	14.6	11.0	4.2
Europe and Central Asia (ECA)	49.9	14.3	11.2	12.6	12.1
Latin America and Caribbean (LAC)	27.5	19.1	16.4	16.3	20.6
Middle East and North Africa (MNA)	34.3	12.6	13.5	20.5	19.1
South Asia (SAR)	18.4	19.9	20.5	24.3	16.9

Notes: Author's calculations based on 104,985 responses from firms in 108 countries from 2006-2017. Data are from the World Bank Enterprise Survey.

Table 4

Summary Statistics

Variable	No. of Observations	Mean	Standard Deviation	Minimum	Maximum
Dependent variable: energy_poor	110,396	1.70	1.47	0	4
ln(Employment)	110,396	3.25	1.39	0	11.07
ln(Age of the firm)	110,396	2.76	0.68	0.69	5.83
Female owned	110,396	0.34	0.47	0	1
Foreign owned	110,396	0.10	0.30	0	1
Government owned	110,396	0.01	0.12	0	1
Manufacturing sector	110,396	0.57	0.49	0	1
Outage (Dummy)	110,396	0.59	0.49	0	1
Number of outages	54,695	19.74	46.14	1	2400
ln(Duration of outages)	54,118	1.33	0.78	0.02	7.82
ln(Control of corruption)	110,396	1.05	0.15	0.62	1.55
ln(Rule of law)	110,396	0.87	0.19	0.13	1.36
ln(Regulatory Quality)	110,396	1.12	0.17	0.45	1.45
ln(Government Effectiveness)	110,396	1.11	0.17	0.36	1.49
Access to electricity (total)	110,396	0.79	0.26	0.019	1
Access to electricity (rural)	109,708	0.71	0.32	0.004	1
Access to electricity (urban)	110,103	0.91	0.15	.035	1

Table 5

Estimated Coefficients of the Ordered Probit regressions

Regressions that employ the electrification rate for total population

VARIABLES	Corruption	Rule of law	Regulatory quality	Government Effectiveness
ln(Employment)	0.0028	0.0026	0.0007	0.0046*
	(0.289)	(0.312)	(0.779)	(0.077)
ln(Age of the firm)	-0.0542***	-0.0508***	-0.0528***	-0.0490***
	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0051	0.0041	-0.0060	0.0059
	(0.487)	(0.569)	(0.407)	(0.418)
Foreign owned	-0.0039	-0.0088	-0.0104	-0.0111
	(0.737)	(0.453)	(0.374)	(0.344)
Government owned	-0.0671**	-0.0749**	-0.0680**	-0.0690**
	(0.022)	(0.010)	(0.020)	(0.018)
Outage (Dummy)	0.7501***	0.7576***	0.7612***	0.7503***
	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	0.2155***	0.2199***	0.2133***	0.2237***
	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	-0.2933***	-0.2503***	-0.4589***	-0.1223***
	(0.000)	(0.000)	(0.000)	(0.000)
ln(Control of Corruption)	-0.7658***			
	(0.000)			
ln(Rule of law)		-0.5779***		
		(0.000)		
ln(Regulatory quality)			-0.1858***	
			(0.000)	
ln(Government Effectiveness)				-0.8043***
				(0.000)
EAP	-0.7465***	-0.7711***	-0.7000***	-0.7624***
	(0.000)	(0.000)	(0.000)	(0.000)
ECA	-0.4715***	-0.4847***	-0.3828***	-0.4955***
	(0.000)	(0.000)	(0.000)	(0.000)
LAC	-0.1382***	-0.2103***	-0.0972***	-0.2225***
	(0.000)	(0.000)	(0.000)	(0.000)
MENA	-0.1248***	-0.1579***	-0.0617***	-0.2455***
	(0.000)	(0.000)	(0.001)	(0.000)
SSA	-0.1417***	-0.1378***	-0.1535***	-0.1408***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes
Observations	110,396	110,396	110,396	110,396
Wald chi^2 (26)	23618	23256	22752	23342
Prob > chi^2	0	0	0	0
Log pseudolikelihood	-161001.91	-161048.68	-161457.83	-160996.34

Robust p-values in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 6

Estimated Coefficients of the Ordered Probit regressions

Regressions that employ the electrification rate for rural residents

VARIABLES	Corruption	Rule of law	Regulatory quality	Government Effectiveness
ln(Employment)	0.0034	0.0031	0.0015	0.0051*
	(0.198)	(0.231)	(0.557)	(0.052)
ln(Age of the firm)	-0.0582***	-0.0546***	-0.0568***	-0.0524***
	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0054	0.0043	-0.0054	0.0060
	(0.457)	(0.556)	(0.456)	(0.409)
Foreign owned	-0.0031	-0.0080	-0.0089	-0.0111
	(0.793)	(0.496)	(0.453)	(0.343)
Government owned	-0.0677**	-0.0756***	-0.0691**	-0.0695**
	(0.021)	(0.009)	(0.018)	(0.017)
Outage (Dummy)	0.7523***	0.7602***	0.7629***	0.7526***
	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	0.2127***	0.2171***	0.2107***	0.2213***
	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (rural)	-0.2041***	-0.1498***	-0.3456***	-0.0331
	(0.000)	(0.000)	(0.000)	(0.161)
ln(Control of Corruption)	-0.7832***			
	(0.000)			
ln(Rule of law)		-0.5986***		
		(0.000)		
ln(Regulatory quality)			-0.1968***	
			(0.000)	
ln(Government Effectiveness)				-0.8500***
				(0.000)
EAP	-0.7610***	-0.7878***	-0.7145***	-0.7781***
	(0.000)	(0.000)	(0.000)	(0.000)
ECA	-0.4833***	-0.5040***	-0.3871***	-0.5205***
	(0.000)	(0.000)	(0.000)	(0.000)
LAC	-0.1805***	-0.2548***	-0.1388***	-0.2655***
	(0.000)	(0.000)	(0.000)	(0.000)
MENA	-0.1393***	-0.1795***	-0.0723***	-0.2755***
	(0.000)	(0.000)	(0.000)	(0.000)
SSA	-0.1307***	-0.1197***	-0.1465***	-0.1198***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes
Observations	109,708	109,708	109,708	109,708
Wald chi^2 (26)	23416	23063	22477	23181
Prob > chi^2	0	0	0	0
Log pseudolikelihood	-159946.3	-159992.24	-160412.11	-159928.09

Robust p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7

Estimated Coefficients of the Ordered Probit regressions

Regressions that employ the electrification rate for urban residents

VARIABLES	Corruption	Rule of law	Regulatory quality	Government Effectiveness
ln(Employment)	0.0027	0.0026	0.0000	0.0047*
	(0.307)	(0.318)	(0.995)	(0.072)
ln(Age of the firm)	-0.0531***	-0.0493***	-0.0524***	-0.0476***
	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0044	0.0038	-0.0075	0.0060
	(0.548)	(0.605)	(0.305)	(0.409)
Foreign owned	-0.0077	-0.0127	-0.0120	-0.0136
	(0.512)	(0.281)	(0.310)	(0.246)
Government owned	-0.0597**	-0.0691**	-0.0631**	-0.0654**
	(0.041)	(0.017)	(0.030)	(0.025)
Outage (Dummy)	0.7555***	0.7624***	0.7688***	0.7522***
	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	0.2143***	0.2195***	0.2105***	0.2237***
	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (urban)	-0.3421***	-0.2906***	-0.4052***	-0.1396***
	(0.000)	(0.000)	(0.000)	(0.000)
ln(Control of Corruption)	-0.8272***			
	(0.000)			
ln(Rule of law)		-0.6262***		
		(0.000)		
ln(Regulatory quality)			-0.2851***	
			(0.000)	
ln(Government Effectiveness)				-0.8381***
				(0.000)
EAP	-0.7816***	-0.8026***	-0.7494***	-0.7768***
	(0.000)	(0.000)	(0.000)	(0.000)
ECA	-0.5327***	-0.5371***	-0.4732***	-0.5202***
	(0.000)	(0.000)	(0.000)	(0.000)
LAC	-0.1830***	-0.2532***	-0.1736***	-0.2429***
	(0.000)	(0.000)	(0.000)	(0.000)
MENA	-0.1843***	-0.2108***	-0.1605***	-0.2737***
	(0.000)	(0.000)	(0.000)	(0.000)
SSA	-0.1294***	-0.1283***	-0.1009***	-0.1374***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes
Observations	110,103	110,103	110,103	110,103
Wald chi^2 (26)	23520	23174	22522	23289
Prob > chi^2	0	0	0	0
Log pseudolikelihood	-160553.96	-160592.12	-161075.27	-160534.94

Robust p-values in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 8

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include control of corruption and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	-0.0008	-0.0001	0.0001	0.0003	0.0006
	(0.289)	(0.289)	(0.289)	(0.289)	(0.289)
ln(Age of the firm)	0.0165***	0.0023***	-0.0014***	-0.0056***	-0.0118***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	-0.0015	-0.0002	0.0001	0.0005	0.0011
	(0.487)	(0.488)	(0.485)	(0.486)	(0.487)
Foreign owned	0.0012	0.0002	-0.0001	-0.0004	-0.0009
	(0.737)	(0.736)	(0.739)	(0.737)	(0.737)
Government owned	0.0207**	0.0025***	-0.0020**	-0.0071**	-0.0142**
	(0.023)	(0.009)	(0.041)	(0.024)	(0.018)
Outage (Dummy)	-0.2491***	-0.0278***	0.0326***	0.0945***	0.1499***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0664***	-0.0086***	0.0061***	0.0227***	0.0462***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.0895***	0.0123***	-0.0077***	-0.0303***	-0.0638***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Control of Corruption)	0.2336***	0.0320***	-0.0200***	-0.0790***	-0.1666***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EAP	0.2494***	0.0035***	-0.0404***	-0.0869***	-0.1256***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.1537***	0.0103***	-0.0209***	-0.0543***	-0.0888***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0426***	0.0051***	-0.0041***	-0.0144***	-0.0292***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	0.0389***	0.0043***	-0.0040***	-0.0133***	-0.0259***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SSA	0.0436***	0.0050***	-0.0042***	-0.0146***	-0.0298***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	110,396	110,396	110,396	110,396	110,396

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 9

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include rule of law and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	-0.0008	-0.0001	0.0001	0.0003	0.0006
	(0.312)	(0.312)	(0.312)	(0.312)	(0.312)
ln(Age of the firm)	0.0155***	0.0021***	-0.0013***	-0.0052***	-0.0111***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	-0.0013	-0.0002	0.0001	0.0004	0.0009
	(0.569)	(0.570)	(0.568)	(0.569)	(0.569)
Foreign owned	0.0027	0.0004	-0.0002	-0.0009	-0.0019
	(0.454)	(0.448)	(0.460)	(0.454)	(0.452)
Government owned	0.0232**	0.0028***	-0.0023**	-0.0079**	-0.0158***
	(0.011)	(0.003)	(0.023)	(0.012)	(0.008)
Outage (Dummy)	-0.2520***	-0.0278***	0.0331***	0.0955***	0.1512***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0678***	-0.0088***	0.0062***	0.0232***	0.0472***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.0764***	0.0105***	-0.0065***	-0.0259***	-0.0545***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Rule of law)	0.1764***	0.0242***	-0.0151***	-0.0597***	-0.1258***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EAP	0.2579***	0.0026***	-0.0422***	-0.0897***	-0.1286***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.1583***	0.0103***	-0.0217***	-0.0560***	-0.0909***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0651***	0.0072***	-0.0065***	-0.0221***	-0.0437***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	0.0495***	0.0052***	-0.0053***	-0.0170***	-0.0324***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SSA	0.0424***	0.0049***	-0.0041***	-0.0142***	-0.0290***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	110,396	110,396	110,396	110,396	110,396

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 10

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include government effectiveness and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	-0.0014*	-0.0002*	0.0001*	0.0005*	0.0010*
	(0.077)	(0.077)	(0.077)	(0.077)	(0.077)
ln(Age of the firm)	0.0149***	0.0021***	-0.0013***	-0.0051***	-0.0107***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	-0.0018	-0.0002	0.0002	0.0006	0.0013
	(0.417)	(0.419)	(0.416)	(0.417)	(0.418)
Foreign owned	0.0034	0.0005	-0.0003	-0.0011	-0.0024
	(0.345)	(0.338)	(0.354)	(0.346)	(0.343)
Government owned	0.0213**	0.0026***	-0.0020**	-0.0073**	-0.0146**
	(0.019)	(0.007)	(0.035)	(0.020)	(0.015)
Outage (Dummy)	-0.2492***	-0.0277***	0.0326***	0.0945***	0.1498***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0689***	-0.0090***	0.0063***	0.0235***	0.0480***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.0373***	0.0051***	-0.0032***	-0.0126***	-0.0266***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Government Effectiveness)	0.2452***	0.0338***	-0.0209***	-0.0830***	-0.1751***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EAP	0.2548***	0.0030***	-0.0414***	-0.0887***	-0.1276***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.1618***	0.0103***	-0.0222***	-0.0572***	-0.0926***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0688***	0.0075***	-0.0069***	-0.0233***	-0.0461***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	0.0777***	0.0068***	-0.0090***	-0.0267***	-0.0488***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SSA	0.0433***	0.0050***	-0.0041***	-0.0145***	-0.0296***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	110,396	110,396	110,396	110,396	110,396

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 11

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include regulatory quality and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	-0.0002	-0.0000	0.0000	0.0001	0.0002
	(0.779)	(0.779)	(0.779)	(0.779)	(0.779)
ln(Age of the firm)	0.0162***	0.0022***	-0.0014***	-0.0055***	-0.0115***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0018	0.0003	-0.0002	-0.0006	-0.0013
	(0.407)	(0.405)	(0.409)	(0.407)	(0.406)
Foreign owned	0.0032	0.0004	-0.0003	-0.0011	-0.0023
	(0.375)	(0.368)	(0.383)	(0.376)	(0.373)
Government owned	0.0211**	0.0026***	-0.0020**	-0.0072**	-0.0145**
	(0.021)	(0.008)	(0.038)	(0.022)	(0.016)
Outage (Dummy)	-0.2542***	-0.0280***	0.0333***	0.0962***	0.1527***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0660***	-0.0086***	0.0060***	0.0225***	0.0461***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.1406***	0.0193***	-0.0119***	-0.0475***	-0.1005***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Regulatory quality)	0.0569***	0.0078***	-0.0048***	-0.0192***	-0.0407***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EAP	0.2347***	0.0049***	-0.0372***	-0.0820***	-0.1202***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.1243***	0.0099***	-0.0159***	-0.0439***	-0.0745***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0300***	0.0038***	-0.0028***	-0.0102***	-0.0208***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	0.0191***	0.0024***	-0.0018***	-0.0065***	-0.0132***
	(0.001)	(0.000)	(0.002)	(0.001)	(0.000)
SSA	0.0474***	0.0054***	-0.0046***	-0.0159***	-0.0324***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	110,396	110,396	110,396	110,396	110,396

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 12

Estimated Coefficients of the Ordered Probit

Regressions include number of outage, the duration of outages and electrification rate for total population

VARIABLES	Corruption	Rule of law	Regulatory quality	Government Effectiveness
ln(Employment)	-0.0011	-0.0008	-0.0013	0.0006
	(0.774)	(0.819)	(0.719)	(0.874)
ln(Age of the firm)	-0.0356***	-0.0353***	-0.0346***	-0.0343***
	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	-0.0072	-0.0060	-0.0093	-0.0037
	(0.485)	(0.560)	(0.370)	(0.724)
Foreign owned	0.0122	0.0123	0.0094	0.0126
	(0.473)	(0.469)	(0.581)	(0.458)
Government owned	-0.1213***	-0.1205***	-0.1187***	-0.1182***
	(0.006)	(0.006)	(0.007)	(0.007)
Number of outages	0.0034***	0.0034***	0.0035***	0.0033***
	(0.000)	(0.000)	(0.000)	(0.000)
ln(Duration of outages)	0.2613***	0.2609***	0.2651***	0.2608***
	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	0.2542***	0.2552***	0.2524***	0.2586***
	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	-0.3064***	-0.2851***	-0.3336***	-0.2077***
	(0.000)	(0.000)	(0.000)	(0.000)
ln(Control of Corruption)	-0.1741***			
	(0.000)			
ln(Rule of law)		-0.1725***		
		(0.000)		
ln(Regulatory quality)			-0.0390	
			(0.282)	
ln(Government Effectiveness)				-0.3496***
				(0.000)
EAP	-0.7387***	-0.7517***	-0.7314***	-0.7653***
	(0.000)	(0.000)	(0.000)	(0.000)
ECA	-0.3773***	-0.3869***	-0.3631***	-0.3996***
	(0.000)	(0.000)	(0.000)	(0.000)
LAC	-0.2361***	-0.2585***	-0.2287***	-0.2769***
	(0.000)	(0.000)	(0.000)	(0.000)
MENA	-0.0129	-0.0280	0.0036	-0.0816***
	(0.626)	(0.299)	(0.888)	(0.004)
SSA	-0.3020***	-0.3011***	-0.3018***	-0.3035***
	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes
Observations	53,727	53,727	53,727	53,727
Wald chi^2 (27)	6068	6061	5947	6080
Prob > chi^2	0	0	0	0
Log pseudolikelihood	-81562.349	-81554.241	-81573.975	-81528.61

Robust p-values in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 13

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include number of outage, the duration of outages, control of corruption and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	0.0002	0.0001	0.0000	-0.0001	-0.0003
	(0.774)	(0.774)	(0.774)	(0.774)	(0.774)
ln(Age of the firm)	0.0068***	0.0050***	0.0013***	-0.0035***	-0.0096***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0014	0.0010	0.0003	-0.0007	-0.0020
	(0.486)	(0.485)	(0.482)	(0.486)	(0.485)
Foreign owned	-0.0023	-0.0017	-0.0005	0.0012	0.0033
	(0.470)	(0.474)	(0.483)	(0.469)	(0.474)
Government owned	0.0248***	0.0166***	0.0032***	-0.0131**	-0.0314***
	(0.009)	(0.004)	(0.000)	(0.011)	(0.004)
Number of outages	-0.0007***	-0.0005***	-0.0001***	0.0003***	0.0009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Duration of outages)	-0.0502***	-0.0368***	-0.0096***	0.0257***	0.0709***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0498***	-0.0360***	-0.0086***	0.0264***	0.0680***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.0588***	0.0432***	0.0113***	-0.0302***	-0.0831***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Control of Corruption)	0.0334***	0.0245***	0.0064***	-0.0172***	-0.0472***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EAP	0.1889***	0.0789***	-0.0132***	-0.1007***	-0.1539***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.0841***	0.0485***	0.0040***	-0.0457***	-0.0909***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0488***	0.0316***	0.0058***	-0.0256***	-0.0607***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	0.0025	0.0018	0.0005	-0.0013	-0.0035
	(0.628)	(0.625)	(0.617)	(0.629)	(0.624)
SSA	0.0617***	0.0394***	0.0077***	-0.0307***	-0.0781***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	53,727	53,727	53,727	53,727	53,727

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 14

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include number of outage, the duration of outages, rule of law and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	0.0002	0.0001	0.0000	-0.0001	-0.0002
	(0.819)	(0.819)	(0.819)	(0.819)	(0.819)
ln(Age of the firm)	0.0068***	0.0050***	0.0013***	-0.0035***	-0.0096***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0012	0.0009	0.0002	-0.0006	-0.0016
	(0.560)	(0.560)	(0.558)	(0.561)	(0.559)
Foreign owned	-0.0024	-0.0017	-0.0005	0.0012	0.0033
	(0.467)	(0.470)	(0.479)	(0.465)	(0.471)
Government owned	0.0246***	0.0165***	0.0032***	-0.0130**	-0.0312***
	(0.010)	(0.004)	(0.000)	(0.011)	(0.004)
Number of outages	-0.0006***	-0.0005***	-0.0001***	0.0003***	0.0009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Duration of outages)	-0.0501***	-0.0367***	-0.0096***	0.0257***	0.0707***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0500***	-0.0361***	-0.0086***	0.0265***	0.0682***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.0547***	0.0402***	0.0105***	-0.0281***	-0.0773***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Rule of law)	0.0331***	0.0243***	0.0064***	-0.0170***	-0.0468***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EAP	0.1930***	0.0795***	-0.0140***	-0.1026***	-0.1558***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.0866***	0.0495***	0.0039***	-0.0470***	-0.0929***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0538***	0.0344***	0.0060***	-0.0282***	-0.0660***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	0.0054	0.0039	0.0010	-0.0028	-0.0075
	(0.305)	(0.296)	(0.271)	(0.308)	(0.295)
SSA	0.0615***	0.0392***	0.0077***	-0.0306***	-0.0778***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	53,727	53,727	53,727	53,727	53,727

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 15

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include number of outage, the duration of outages, government effectiveness and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	-0.0001	-0.0001	-0.0000	0.0001	0.0002
	(0.874)	(0.874)	(0.874)	(0.874)	(0.874)
ln(Age of the firm)	0.0066***	0.0048***	0.0013***	-0.0034***	-0.0093***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0007	0.0005	0.0001	-0.0004	-0.0010
	(0.724)	(0.724)	(0.723)	(0.724)	(0.724)
Foreign owned	-0.0024	-0.0018	-0.0005	0.0012	0.0034
	(0.455)	(0.459)	(0.468)	(0.454)	(0.460)
Government owned	0.0241**	0.0161***	0.0032***	-0.0127**	-0.0306***
	(0.011)	(0.005)	(0.000)	(0.013)	(0.005)
Number of outages	-0.0006***	-0.0005***	-0.0001***	0.0003***	0.0009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Duration of outages)	-0.0501***	-0.0367***	-0.0096***	0.0257***	0.0707***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0507***	-0.0366***	-0.0087***	0.0269***	0.0691***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.0399***	0.0292***	0.0076***	-0.0205***	-0.0563***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Government Effectiveness)	0.0671***	0.0492***	0.0129***	-0.0344***	-0.0947***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EAP	0.1971***	0.0801***	-0.0150***	-0.1046***	-0.1577***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.0898***	0.0508***	0.0036***	-0.0488***	-0.0954***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0580***	0.0366***	0.0062***	-0.0303***	-0.0704***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	0.0162***	0.0113***	0.0025***	-0.0085***	-0.0216***
	(0.006)	(0.004)	(0.000)	(0.006)	(0.003)
SSA	0.0620***	0.0395***	0.0077***	-0.0309***	-0.0784***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	53,727	53,727	53,727	53,727	53,727

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 16

Average Marginal Estimated Coefficients of the Ordered Probit

Regressions include number of outage, the duration of outages, regulatory quality and electrification rate for total population

VARIABLES	No Energy poverty	Minor Energy poverty	Moderate Energy poverty	Major Energy poverty	Severe Energy poverty
ln(Employment)	0.0003	0.0002	0.0000	-0.0001	-0.0004
	(0.719)	(0.719)	(0.719)	(0.719)	(0.719)
ln(Age of the firm)	0.0066***	0.0049***	0.0013***	-0.0034***	-0.0094***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female owned	0.0018	0.0013	0.0003	-0.0009	-0.0025
	(0.371)	(0.370)	(0.367)	(0.372)	(0.370)
Foreign owned	-0.0018	-0.0013	-0.0004	0.0009	0.0026
	(0.579)	(0.581)	(0.587)	(0.578)	(0.582)
Government owned	0.0242**	0.0162***	0.0032***	-0.0128**	-0.0308***
	(0.011)	(0.005)	(0.000)	(0.012)	(0.005)
Number of outages	-0.0007***	-0.0005***	-0.0001***	0.0003***	0.0009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Duration of outages)	-0.0509***	-0.0374***	-0.0098***	0.0261***	0.0720***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Manufacturing sector	-0.0495***	-0.0358***	-0.0085***	0.0262***	0.0675***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Access to electricity (total)	0.0641***	0.0470***	0.0123***	-0.0329***	-0.0905***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ln(Regulatory quality)	0.0075	0.0055	0.0014	-0.0038	-0.0106
	(0.282)	(0.282)	(0.283)	(0.281)	(0.282)
EAP	0.1867***	0.0786***	-0.0127***	-0.0997***	-0.1529***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ECA	0.0805***	0.0469***	0.0043***	-0.0438***	-0.0879***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LAC	0.0472***	0.0307***	0.0057***	-0.0247***	-0.0589***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MENA	-0.0007	-0.0005	-0.0001	0.0004	0.0010
	(0.888)	(0.888)	(0.889)	(0.888)	(0.888)
SSA	0.0617***	0.0394***	0.0077***	-0.0307***	-0.0781***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	53,727	53,727	53,727	53,727	53,727

p-value in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Table 1: List of the countries

East Asia and Pacific			
China	Lao PDR	Papua New Guinea	Vanuatu
Fiji	Myanmar	Solomon Islands	Samoa
Micronesia, Fed. States.	Mongolia	Thailand	
Indonesia	Malaysia	Tonga	
Cambodia	Philippines	Vietnam	
Europe and Central Asia			
Albania	Belarus	North Macedonia	Turkey
Armenia	Georgia	Montenegro	Ukraine
Azerbaijan	Kazakhstan	Russian Federation	Uzbekistan
Bulgaria	Kyrgyz Republic	Serbia	
Bosnia and Herzegovina	Moldova	Tajikistan	
Latin America and Caribbean			
Argentina	Dominica	Honduras	Paraguay
Belize	Dominican Republic	Jamaica	El Salvador
Bolivia	Ecuador	St. Lucia	Suriname
Brazil	Grenada	Mexico	St. Vincent & the Grenadines
Colombia	Guatemala	Nicaragua	Venezuela, RB
Costa Rica	Guyana	Peru	
Middle East and North America			
Djibouti	Iraq	Lebanon	Tunisia
Egypt, Arab Rep.	Jordan	Morocco	Yemen, Rep.
Sub-Saharan Africa			
Angola	Ghana	Mauritania	South Sudan
Burundi	Guinea	Malawi	Chad
Benin	Gambia, The	Namibia	Togo

Botswana	Guinea-Bissau	Niger	Tanzania
Central African Republic	Kenya	Nigeria	Uganda
Cameroon	Liberia	Rwanda	South Africa
Congo, Rep.	Lesotho	Sudan	Zambia
Ethiopia	Mali	Senegal	Zimbabwe
Gabon	Mozambique	Sierra Leone	

South Asia			
Afghanistan	Bhutan	Sri Lanka	Pakistan
Bangladesh	India	Nepal	