The impact of electricity constraints on access to finance: A firm-level study

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Abstract

Firms that report insufficient electricity from the public grid are likely to experience higher constraints on access to finance. The lack of availability of electricity will translate to greater production delays and lower expected profits. Consequently, it will have an adverse impact on the constraints on access to finance. In this paper, I study the impact of constraints on getting electricity as well as electricity usage costs on the constraints on access to finance. I determine whether firms within countries with a deficit level of electricity supply exhibit different patterns in the aforementioned relationship than firms within countries with a surplus level of electricity supply.

Keywords: constraints on getting electricity; electricity usage costs; access to finance; government institutions;

JEL Classification: D24, H41, G21, G31, L21, L60 , O25

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Introduction

Lack of availability of electricity may inhibit the ability of firms to produce their output without delays and adversely impact their expected profits. Similarly, lack of access to financial markets may restrict the amount of external finance firms can obtain to enhance their business activities[1]. Firms that face constraints on getting electricity and report insufficient electricity usage costs are likely to be unattractive to potential lenders, such as banks and other financial markets. As uninterrupted power supply is likely to lower the constraints on getting electricity reported by the firms, a power generation and distribution infrastructure that guarantees minimal blackouts is crucial for firms to generate output, meet their production deadlines and make timely payments to all their creditors. In essence, firms that report higher constraints on getting electricity or report low electricity usage costs are likely to be less preferred to lenders in the financial markets. In addition, rather than invest in profitable activities, several firms may be required to invest in alternatives, such as self-generation of electricity, to substitute for the lack of electricity provided by the public grid. In this paper, I study the relationship between the constraints on getting electricity as well as electricity usage costs and the constraints on access to finance as reported by firms [2] .

In developing countries, access to financial markets is likely to hamper growth of firms. In the

[1] Although, the lack of availability of loans from the banking sector and the inability of the firms to apply for such loans may be the most common factors that influence the constraints on access to financial markets, the lack of a viable infrastructure that provides firms with a necessary resource such as electricity is likely to exacerbate the losses.

[2] Electricity can be defined as rival and excludable since consumption of electricity by a single firm reduces the supply of the resource to the other firms. A weak infrastructure may exacerbate this problem as it may limit the number of firms that can avail electricity. I consider the role of investments in electricity infrastructure rather than water or telecommunication as private users of electricity are not likely to be able to store electricity similar to water resources nor is self-generation of electricity as cost-effective as obtaining water from a private well. First, self-generation of electricity may require substantial fixed costs, maintenance of generators and large fuel costs, which is likely to reduce its cost-effectiveness. Second, with the advent of cellular and satellite technology, telecommunication facilities have become widely accessible at low costs. Therefore, the investment in assets that would allow firms to undertake self-generation of electricity is likely to be a relatively expensive compared to firms that may seek alternate sources to the public infrastructure for water resources and connectivity of telecommunication services.

seminal paper on the relationship between financial development and economic growth, Rajan and Zingales (1998), suggest that lack of access to financial markets may amplify the constraints on firm growth as financial dependence of firms influences their growth in output. Beck and Demirguc-Kunt (2006) stress the importance of access to finance for firm growth, particularly for the small and medium-sized firms, and suggest that an improvement of the business environment or the investment climate within a country plays an important role. An improvement in the business environment may also include better provision of basic facilities such as an effective electricity infrastructure[3]. Musso and Schiavo (2008) confirm the findings that financial constraints are detrimental to firm survival. However, Musso and Schiavo (2008) suggest that financially constrained firms are more likely to be forced to improve efficiencies in the short-run as productivity growth is positively associated with financial constraints during the short-run. Beck and Demirgüç-Kunt (2008) further indicate how access to finance favorably influences firm performance. Better access to finance not only allows small firms and start-up to be more dynamic and innovative but gives opportunities to larger firms to exploit growth and investment opportunities. In this paper, I suggest that an inefficient infrastructure within a country that inhibits firms to produce output effectively is likely to positively influence the constraints on access to finance. Therefore, the lack of public investment in power generation and distribution that involves provision of electricity to all firms may inhibit the access to financial markets and in turn dampen firm growth.

The quality of the infrastructure plays an important role to promote economic growth within a country. Hall and Jones (1999) determine the influence of government policies and institutions that define the economic environment of a country on the large differences in income-levels across countries. This suggests that the differences in income is only partially explained by the differ-

[3]For instance, Aterido, Hallward-Driemeier, and Pagés (2007) consider the impact of power outages, as one of the variables that influences the investment climate, on firm growth

ences in the level of physical and human capital present within a country. Acemoglu, Johnson, and Robinson (2002) consider the role of the quality of institutions in influencing the income differences in colonies between pre-colonization and post-colonization eras. The Europeans introduced institutions that supported extraction of resources rather than economic growth in colonies that are today characterized with low levels of income. The authors suggest that the lack of investment in institutions that would have otherwise promoted property rights and in turn encouraged economic growth led to the reversal of income levels from rich to poor in several of the former European colonies. The aforementioned studies do not specify infrastructure as physical assets but rather as social institutions that protect property rights and encourage investments in productive activities. On the other hand, Easterly and Rebelo (1993) and Esfahani and Ramırez (2003) point to the benefits of investment in physical infrastructure, such as telecommunication and power sectors, on the economic growth of a country. Romp and De Haan (2007) review the literature that surveys the impact of infrastructure on economic growth and state that several recent studies determine the impact to differ across countries, regions and sectors due to the variance in the quality and the quantity of the infrastructure stock.

The provision of an effective public infrastructure that is conducive to firm growth is an important measure of the investment climate within a country. The article, "Getting Electricity: A Pilot Indicator Set Comparing Access to Electricity for 140 Economies", published by the *World Bank* in 2010, discusses the various costs firms face in getting electricity. Firms not only face constraints due to the lack of provision of continuous electricity supply that is needed to run the production processes effectively but the costs incurred to obtain an electricity connection can be exorbitantly high. According to the database on 'Getting Electricity' provided by *Doing Business*, the cost of obtaining an electrical connection in the Latin American & Carribean region is on average 500% of the economy's income per capita. On average the total time to obtain an electricity connection

takes 65 days, which involves six procedures that require interaction of company employees with external parties. Dollar, Hallward-Driemeier, and Mengistae (2005) measure the variations in the investment climates across countries and consider the role of the variation in the growth of the firms. The authors determine that the reliability of the power grid is a major concern for firms as it plays an important role to influence the total factor productivity. Hallward-Driemeier and Stewart (2004) suggest that the lack of an effective infrastructure and policy uncertainty coupled with the inability of a government to enforce laws may compel firms to bribe government officials in order to lower the constraints faced in the business environment. The authors include electricity outages as an example of infrastructure disruptions[4].Carlin, Schaffer, and Seabright (2010) conduct estimates on the effect of unreliable public infrastructure on firm growth and determine a positive impact between the variables if the infrastructure in a low income country is made as reliable as that present within a high income country.

Reinikka and Svensson (2002), Foster and Steinbuks (2009) and Alby, Dethier, and Straub (2012) study the impact of deficiencies in electricity supply on the decision of firms to invest in technologies that mitigate the shortage in electricity supply. Reinikka and Svensson (2002), focusing on firms in Uganda, show how poor provision of public capital may significantly reduce the ability of firms to undertake productive investments as substitutes for public capital may instead crowd out private investment. Similarly, Straub (2008) suggest that improvement in the investments in public infrastructure make services more reliable and reduces the need for investments in substitutes for public capital. Foster and Steinbuks (2009) determine the role of power outages and self generation of electricity on the structure of firms within sub-Saharan African economies. Alby et al. (2012) consider whether investments in generators ease the ability of firms to obtain

[4]Firms that need to make additional payments to public officers in order to ensure continuous electricity supply are likely to divert resources that could otherwise be used to increase output and generate revenue.

credit. Large gaps in efficiency between firms that invest in generators and those that do not invest in generators, particularly in industries that rely heavily on electricity, may reduce overall levels of production. Investments in generators help to mitigate the deficiencies in the lack of electricity supply but the effect is likely to be stronger on firms that rely more heavily on electricity as an important input into their production process[5].

Majority of the studies mentioned above concentrate on firms located within the sub-Saharan African economies. I consider firms located within the Latin American economies. It is likely that the behavior of firms in dealing with infrastructure deficiencies will vary across regions[6]. Lee, Anas, and Oh (1999) suggest that the ownership of generators is much lower for firms located in the East Asian economies of Thailand and Indonesia than those located in Nigeria and consider the lack of reliable power to be relatively a more serious issue to firm development in the latter economy. Similarly, Foster and Steinbuks (2009) report 37% of the firms own a generator in sub-Saharan African economies compared to 21% of the firms in Latin American economies. Additionally, the number of power outages faced by the firms within sub-Saharan African economies is 61 compared to 12 faced by the firms within Latin American economies. The lesser number of power outages faced by firms and the smaller proportion of firms owning generators suggest that the firms in

[5]As discussed later in this paper, investment in generators shows the dependency of firms on electricity as a major input to production. Therefore, firms that invest in generators are likely to have large electricity usage costs as well. Ownership of a generator may imply more sensitivity of a firm to electricity as a major input into its production process, for instance, to provide continuous power for a cold storage, but not necessarily directly lower the constraints on access to finance. A firm that owns a generator or has applied for an electricity connection during the last two years given that it has been established for more is likely to have a production process that is requires electricity as a major input and hence the higher electricity usage costs. In addition, the studies do not consider whether self-generated electricity is used for productive activities rather than non-productive activities.

[6]Although, the investments in infrastructure within the Latin American economies did collapse due to fiscal austerity measures adopted in the region in the 1980s and 1990s, Calderón and Servén (2010) show that the quality of the infrastructure in the Latin American economies is more comparable to the non-Latin American middle-income countries than the less developed sub-Saharan African countries. Similarly, Calderón (2009) reports that in terms of electricity generating capacity in all regions of Africa, only the North African region outperforms South Asia, a region that is significantly less developed than Latin America.

Latin American economies are likely to face a more reliable electricity distribution network and the firms that require electricity connections for their production process are more likely to obtain one. Therefore, the availability of electricity to the firms is less likely to be a cause of factors that may cause bias, such as political connections of owners and the amount of gifts firms are compelled to pay to public officials, than that observed within sub-Saharan African economies.[7].Bacon and Besant-Jones (2001) review the reforms undertaken in the power sector across the developing countries and state that the governments in the Latin American economies had undertaken several reforms in the 1990s to improve the distribution of electricity, while reforms were almost non-existent in sub-Saharan African countries. Therefore, as firms within Latin American economies are likely to enjoy a relatively more efficient infrastructure, firm characteristics may determine the constraints faced by firms rather than due to the failure of the infrastructure to fulfill the basic needs of the firms [8]. Therefore, the constraints on getting electricity and the electricity usage costs as reported by the firms will be reported relatively more accurately within Latin American economies than within sub-Saharan African economies.

In this paper, I consider whether firms that either report constraints on getting electricity or firms that tend to have lower electricity usage costs are likely to face constraints on access to finance. For instance, the constraints on getting electricity may restrict the ability of firms to access financial markets as such firms have lower expected profits. Consequently, such firms may be less favorable to their lenders. On the other hand, firms that report lower electricity usage costs

[7]As political connections and paying gifts to public officials may reduce the constraints, they are likely to distort the impact of the constraints on firm growth.

[8]As Latin American economies are relatively developed than the sub-Saharan African economies, I expect that the regulatory authorities in the Latin American economies play more of a role to ensure better provision of electricity supply to firms and reduce the number of firms that face power outages or own generators. Andres, Foster, and Guasch (2006) report improvements in labor productivity, efficiency and quality of services provided by the electricity distribution firms in Latin American economies during the transition period from public ownership to private ownership. Further, Andres, Guasch, and Azumendi (2008) suggest that the mere existence of regulatory authorities leads to improvement in the performance of the electricity distribution system and the impact is much stronger in countries where the regulatory authorities are well-structured.

may not involve electricity-intensive production processes that are expected in similar firms and not be able to meet production deadlines as preferred by their customers. Therefore, I believe this paper is an important contribution to the literature on the relationship between constraints on firm growth and the access to financial markets. This paper will study whether the lack of an effective electricity distribution system that limits the availability of electricity across firms also reduces their ability to access financial markets. In the next section, I will introduce the empirical strategy. I will report the results in the section thereafter. I will follow the results with the conclusion of the paper.

Empirics

Data

I borrow firm-level data from *The Enterprise Surveys*, commonly known as the Business Environment and Enterprise Performance Survey (BEEPS). The survey is provided by the *World Bank* and is conducted on firms across several developing countries. There are 12,980 observations spanned across 20 Latin American economies. In Appendix A, I list the names of the countries. The surveys were conducted across the region in 2006, 2009 and 2010 [9]. The majority of the firms considered were surveyed in 2010. I include firms that belong to the manufacturing industries only, which are categorized as *sectors 15 to 37* in the *ISIC Rev 3.1* classification.

The country-level data on electricity production, consumption and distribution loss has been borrowed from the *World Bank Indicators*. The surplus and deficit levels of electricity is calculated as the difference between the amount of electricity produced and the amount of electricity

[9] As firm identifiers are not available, I assume that each firm is surveyed only once

consumed. I report the values for the initial year, 2006, for all countries[10]. Approximately 50% of the firms that belong to countries with surplus level of electricity.

Econometric Specification

In this paper, I expect firms that report severe constraints on getting electricity to also report severe constraints on access to finance as well. On the other hand, I expect firms that have higher electricity usage costs than their counterparts to report lower constraints on access to finance. If an electricity-intensive production process increases the efficiency of production and allows firms to meet production deadlines, it is likely that such a production process will be favorable to their lenders in the financial market.In addition, I also consider the sample of countries on the basis of the difference in electricity supplied and demanded. I conduct probit regressions as well as instrumental variable regressions in order to determine the impact of the constraints on getting electricity and the electricity usage costs on the constraints on access to finance.

In Table 1,2,5,6 I report the results for the probit regressions. The equation is:

$$Y^*_{ijklt} = \beta_1 * Electricity_{ijklt} + \beta_2 * Z_{ijklt} + \alpha_j + \omega_k + \theta_l + \phi_t + \epsilon_{ijklt} \quad (1)$$

where Y^*_{ijklt} is a binary dependent variable that accounts for the constraints on access to finance. Firms that report moderate, major or very severe obstacles on access to finance are given a value of 1 and firms that report none or minor obstacles on access to finance are given a value of 0. The

[10]As input prices may vary across time periods, the ability of countries to produce electricity may differ across the years and bias the results. Further, it is also likely that technological changes may favor more efficient production in latter years.

independent variable $Electricity_{ijklt}$ accounts for the constraints on getting electricity in columns 1, 2 and 3 and accounts for electricity usage costs in columns 4, 5, and 6 of Table 2[11]. i denotes firm,j denotes industry, k denotes region, l denotes country and t denotes time. Z_{ijklt} considers the independent variables that account for the firm characteristics as listed in Table 2. The firm characteristics control for factors such as the level of productivity, international trading activities, age of firm, capacity utilization, amount of working capital available and whether the firm has applied for a loan. These variables are likely to influence the constraints on access to finance as they either determine the ability of the firm to generate profit, the number of years it has been established or if it needs substantial external finance to continue production. Sales per worker, intensity of exports, age of firm, capacity utilization and percentage of working capital financed by internal funds are likely to negatively influence the constraints on access to finance as they either increase the profitability of the firm or reduce the need to access financial markets. On the other hand, intensity of imports or application of a loan may increase the constraints on access to finance[12]. α_j, ω_k, θ_l and ϕ_t account for the industry, country, region and time fixed effects respectively.

The probit regressions are likely to be plagued by endogeneity bias, which can arise when the independent variables may be correlated with the error term. The bias may be a result of unobserved factors. For instance, it is likely that variables such as perception of the quality of the electricity infrastructure that cannot be quantified influence the constraints and the electricity usage costs and subsequently bias the results[13]. In the probit regressions, the constraints on getting electricity and the electricity usage costs are likely to be biased toward zero. The instrumental

[11]I assume that the model takes the form $Pr(Y = 1|X) = X'\Phi\beta$. Further,$Y = 1 \;\; if \;\; Y^* > 0 \;\; and \;\; Y = 0 \;\; otherwise.$ I assume $\epsilon_{ijklt} \;\sim\; N(0, 1)$.

[12]The former variable suggests that a firm which imports a large proportion of its inputs but does not export its output may be paying higher prices for inputs that can otherwise be bought from the local market. Such firms are likely to be considered have an inefficient production process according to its lenders.

[13]Firms may expect higher frequency of power outages during summer months when the demand for electricity is much higher.

variable estimation is likely to overcome the bias discussed here as the predicted values of the two aforementioned variables are calculated by taking into account the quality of the infrastructure as well as the deficiencies in electricity supply, such as power outages faced by firms. In addition,the importance of electricity as an input into its production process can be determined by whether a firm has applied for an electricity connection in the last two years or has invested in a generator to produce an alternative source of energy during periods of electricity shortage[14].

The equation for the first-stage regression employed in the instrumental variable regression can be expressed as:

$$Electricity^{*}_{ijklt} = \gamma_1 * Excluded_{ijklt} + \gamma_2 * Z_{ijklt} + \alpha_j + \omega_k + \theta_l + \phi_t + \mu_{ijklt} \tag{2}$$

and the second-stage regression can be expressed as:

$$Y^{*}_{ijklt} = \beta_1 * \overline{Electricity}_{ijklt} + \beta_2 * Z_{ijklt} + \alpha_j + \omega_k + \theta_l + \phi_t + \epsilon_{ijklt} \tag{3}$$

where μ_{ijklt} is the error term and the other variables are as listed in Equation 1. $Excluded_{ijklt}$ accounts for the excluded instrumental variable included in the first-stage regression only. $\overline{Electricity}_{ijklt}$ is the predicted value calculated in the first-stage regressions for the constraints on getting electricity in Table 3 and electricity usage costs in Table 4. In Table 3, the excluded instrument is a binary variable that indicates if firms have experienced a power outage. In Table 4, the excluded

[14]For the former variable, I only consider firms that have been established for more than two years. Therefore, there can be several firms that have applied for an electricity connection more than two years ago which will be treated similar to firms that do not have an electricity connection. A recent investment in complementary assets is an appropriate indicator for the type of production process employed by a firm. The purpose is to determine firms that have recently paid substantial fixed costs to connect to the power grid as such firms are more likely to have a current production process that requires electricity as an important input.

instrument is a binary variable that accounts for whether the firm has applied for an electricity connection during the last two years. In Table 3, I conduct bi-probit instrumental variable estimations as the dependent variable in the second-stage regression and the dependent variable in the first-stage regression are a binary variable. In Table 4, I conduct probit instrumental variable regressions, in which the first-stage regression is an OLS regression, as only the dependent variable in the second-stage regression is a binary variable. In Appendix B, I report the probit instrumental variable regressions that includes the ownership of a generator as an excluded variable in the first-stage regressions.

In Appendix C, I compare the percentage of firms that face constraints on access to finance based on whether they experience power outages, have applied for an electricity connection during the last two years and whether they own a generator. The numbers suggest that at least 45% of the firms face constraints on access to finance regardless of whether they have either experienced power outages, applied for an electricity connection during the last two years or own a generator. Therefore, firms that do not experience power outages, have applied for an electricity connection during the last two years or own a generator do not necessarily face lower constraints on access to finance than their respective counter-parts that observe the opposite of the aforementioned variables.

Although, power outages experienced by firms does well to explain the constraints on getting electricity, it is weakly correlated with the electricity usage costs incurred by firms[15]. Power outages do not necessarily suggest the intensity of electricity as an input into the production process. In Appendix D, I show the differences in electricity usage costs incurred by firms that face power outages, applied for an electricity connection during the last two years and own a generator and their respective counterparts. The differences in the electricity usage costs between the firms that

[15]The dataset does report the losses from power outages but the number of observations for this variable is low.

have experienced power outages and have not experienced power outages is the smallest in comparison to the other two variables across the three samples of countries. In other words, power outages experienced by firms may not play as important a role to determine the electricity usage costs as obtaining an electricity connection in the last two years and ownership of a generator suggests. Variables such as application for electricity connection or ownership of a generator may be more powerful in predicting electricity usage costs incurred by a firm as such variables show the importance of electricity as an input into the production process.

In Appendix E , I sort firms according to their firm size, accounted by the number of employees working in the firm, and observe that neither the direction nor the significance of the influence differ across firms with different sizes[16]. The same can be said for the lack of significance of the influence of the electricity usage costs on the constraints on access to finance across firm size. In the next section, I will discuss the results of the regressions as suggested in Equations 1,2 and 3.

Results

In Figure 1, I consider the distribution of the binary variables that account for the constraints on access to finance and constraints on getting electricity in terms of level of severity of the constraints. Approximately 44% of the firms surveyed are unconstrained in terms of their constraints on access to finance and constraints on getting electricity in the whole sample. In Figure 2, I sort the binary variables on the constraints on access to finance and constraints on getting electricity according to the level of electricity supplied within the countries in terms of deficit and surplus. The firms that face greater constraints on getting electricity belong to countries that report a weaker electricity infrastructure as such is likely from a deficit level of electricity supply. Approximately 60% of the

[16]The small-sized firms have 11-50 employees, medium-sized firms have 51-200 employees and large-sized firms have 200+ employees. This is similar to the categorization in Aterido et al. (2007).

firms report higher levels of constraints on getting electricity and access to finance within the countries with deficit level of electricity supply. This figure drops to approximately 50% of the firms when I consider countries with surplus levels of electricity[17]. In Figure 3, I report higher values for electricity usage costs for firms within countries with deficit level of electricity than countries with surplus level of electricity. As electricity consumers demands more electricity than the infrastructure can supply, they are likely to face higher per unit costs of electricity consumed. Therefore, firms within countries with a deficit level of electricity supply may report higher electricity usage costs.

In Figure 4, approximately 90% of the firms that report getting electricity as a top constraint across the three sample of countries are constrained (record a dummy value of 1) in comparison to approximately 50% of the firms (record a dummy value of 0) that do not report getting electricity as a top constraint[18]. On the other hand, a larger percentage of firms that do not report getting electricity as a top constraint are constrained on access to finance as such firms are likely to face constraints other than getting electricity[19]. In Figure 5, the average electricity usage costs for firms that report getting electricity as a top constraint is lower than the average electricity usage costs for firms that do not report getting electricity as a top constraint across the three sample of countries[20]. In addition, the difference in the values between the firms that report and do not report as a top constraint is more noticeable for countries with deficit level of electricity supply relative to countries

[17]Although, the financial crisis may have resulted in higher reported value of the constraints on access to finance, the constraints on getting electricity have also increased during this period.

[18]There are several firms that report top three constraints instead of one constraint. I consider constraints on getting electricity as one of the top three constraints for such firms.

[19]This is as expected as firms that report getting electricity as a top constraint are may not necessarily report access to finance as one of the top constraint as well. There are several other constraints that a firm can report as one of its top three constraints.

[20]This suggests that firms that do not report constraints on getting electricity as a top constraint are more likely to receive the required amount of electricity from the public grid. Other constraints may not necessarily limit their electricity usage cost.

with surplus level of electricity surplus. The pattern suggests that in countries where electricity is a scarce resource, the electricity usage costs of firms that do not report constraints on getting electricity as a top constraint is more severe. This is as predicted as firms that report constraints on getting electricity as a top constraint are likely to experience more power outages or receive less electricity to support their production process. Such firms may adjust their production process to limit the adverse impact of the constraints on getting electricity. Such firms are less dependent on electricity as an input. I do not observe a difference in electricity usage costs for firms that report getting electricity as a top constraint in countries with a surplus level of electricity. This can be explained by the fact that constraints on getting electricity does not necessarily influence the electricity usage costs in a country which does not face electricity shortages and the resource is not as relatively scarce as in other countries[21].

In Table 1, I consider the probit regressions with and without the variables that account for fixed effects on year, industry and country. I observe that the influence of the constraints on getting electricity on the constraints on access to finance is positive and significant at 1% level across the three samples of countries regardless of whether the aforementioned fixed effects are included in the regressions. However, the influence of electricity usage cost on the constraints on access to finance is negative. This suggests that the firms that are likely to be constrained on getting electricity will report higher constrains on access to finance. On the other hand, the firms that are likely to have greater electricity usage costs will report lower constraints on access to finance. The firms that tend to consume greater amounts of electricity will likely obtain finance at easier terms from credit markets as such firms are more attractive to the lenders in terms of their ability to meet

[21]Firms that report constraints on getting electricity as a top constraint in a country with a surplus level of electricity may not be a result of electricity outages but rather a result of constraints on getting electricity limiting business activities relative to other constraints on business activities faced by a firm. Therefore, the electricity usage costs may not be different than firms that do not report constraints on getting electricity as a top constraint.

production deadlines and expect higher profits. The inclusion of the fixed effects does not alter the results across the three groups of countries.[22].

In Table 2, I observe that the constraints on getting electricity has a positive influence on the constraints on access to finance at 1% level of significance across the three samples of countries. On the other hand, the costs of electricity usage has a negative influence on the constraints on access to finance at 1% level of significance for the pooled sample and countries with surplus level of electricity supply. The level of significance is at 5% for the countries with a deficit level of electricity supply. Sales per worker, age of firm, capacity utilization and percentage of working capital financed by internal funds negatively influence the constraints on access to finance at 1% level of significance across all samples of countries in both regressions. Intensity of exports has no impact on the constraints on access to finance but the intensity of imports positively influences the constraints on access to finance within the pooled sample of countries and countries with surplus supply of electricity at either 5% level or 1% level of significance. A firm that applies for a loan is likely to be constrained on access to finance as the coefficient for the variable on the application of a loan is positive and significant at 1% level across all samples of countries.

In Table 3 and Table 4, I conduct the instrumental variable regressions. I observe that the results of the bi-probit regressions and IV probit regressions in Table 3 and Table 4 respectively reinforce the results of the probit regressions in Table 2. As the coefficients in Table 3 and Table 4 are larger (in absolute terms), the results for the constraints on getting electricity and electricity usage costs in Table 2 may suffer from measurement bias. Power outage is used an excluded instrument in Table 3 as it may influence the constraints on getting electricity but not necessarily influence the

[22]Although I do not report the value of the test statistics for the joint significance of the fixed effects, the tests suggest that all fixed effects except for the year fixed effects should be included in the regressions. However, the inclusion of the year effects does not alter the results.

constraints on access to finance[23]. The impact of this variable in the first stage regression is positive and significant at 1% level across the samples of countries. The firms that report power outages are more likely to face greater constraints on getting electricity. The Wald test of exogeneity suggests that the probit estimations and the biprobit estimations are similar at 5% level of significance. The under-identification test and weak instrument test confirm the validity of power outage as an excluded instrument.

In the first-stage regression reported in Table 4, I consider a variable that accounts for whether a firm has applied for an electricity connection two years ago as an excluded instrument[24]. This variable is a good proxy for a firm that values electricity as an important input as obtaining an electricity connection significant payments. A positive value suggests the firms that have been established for more two years but have connected to the public grid less than two years ago are likely to have greater electricity usage costs. Such a firm is likely to require electricity from the national grid as an important input[25]. In a country where electricity supplied is less than that demanded, a firm that applies for an electricity connection during the last two years is also likely to adjust its production process such that its electricity usage costs do not influence its constraints on finance. As it is likely to face electricity shortages in a country with a deficit level of supply, it may consider investments in alternatives to complement electricity received from the public grid in order to produce without interruptions in electricity supply. Firms in countries with surplus level of electricity supply may not need to undertake such a strategy and their electricity usage costs may influence their constraints on access to finance. The underidentfication test and weak instrument test confirm the validity of the excluded instrument. The Wald tests for exogeneity suggests that the estimates from the probit estimations are likely to be efficient and consistent for the pooled set

[23]The reasoning has been discussed in detail in the previous section.
[24]I only consider firms that have been established for more than two years.
[25]The results do not change when we include firms that have been established less than two years.

of countries and countries with deficit level of electricity but the estimates from the instrumental variable estimations are likely to be efficient and consistent for the countries with surplus level of electricity.

In Appendix B , I consider ownership of a generator to influence the electricity usage costs of firms but not necessarily influence the constraints on access to finance. The first stage estimations determine a positive influence of generator ownership on electricity usage costs, which suggests that firms that own a generator are likely to demand more electricity from the public utilities and indicates the importance for firms to ensure continuous supply of electricity. In Appendix B, electricity usage cost significantly influences the constraints on access to finance in countries with deficit level of electricity supply but the influence is insignificant for the similar set of countries in Table 4. The firms that invest in a generator are likely to have a production process that is sensitive to the supply of electricity as a major input and electricity usage costs. The firms in countries with deficit supply of electricity may not need to adjust their production process as they may have alternative source of electricity generation that can substitute the lack of electricity provided by the public utilities. The Wald tests for exogeneity suggests that the estimates from the instrumental variable estimations are likely to be efficient and consistent. However, as the results are similar for the instrumental variable estimations and the probit estimations, I will continue with the latter in the following tables. The underidentfication test and weak instrument test confirm the validity of the excluded instrument, ownership of a generator[26].

In Table 5, I sort the firms according to whether they consider the constraints on getting elec-

[26]The firms that own a generator reveal a similar distribution for the constraints on access to finance as firms that do not own a generator. Therefore, firms that own a generator not necessarily report lower constraints on access to finance than firms that own a generator. The impact of the ownership of a generator on access to finance is rather indirect as owning a generator may imply that a firm is dependent upon electricity as an important input into its production process and electricity usage costs influences the constraints on access to finance.

tricity as a top constraint. I observe a positive influence of constraints on getting electricity on the constraints on access to finance significant at 1% level across the three samples of countries for firms that do not report constraints on getting electricity as a top constraint. On the other hand, the firms that do report the constraints on getting electricity as a top constraint observe a positive influence of constraints on getting electricity on the constraints on access to finance that is significant at 5% level, 10% level and insignificant for countries with surplus level of electricity, pooled set of countries and countries with deficit level of electricity respectively. With the coefficients of the constraints on getting electricity larger for firms that do not consider the constraints on getting electricity as a top constraint, the results suggest that the economic and statistic significance of the influence of constraints on getting electricity on the constraints on access to finance is larger when firms do not consider getting electricity as a major constraint to their business operations. This pattern confirms the fact that firms which report constraints on getting electricity as a top constraint is likely to adjust the production process so that the lack of electricity supply does not limit the ability of the firm to access financial markets.

In Table 6, I follow a similar strategy as in Table 5 to determine the influence of electricity usage costs on the constraints on access to finance for firms that report constraints on getting electricity as a top constraint and compare the results to firms that do not report constraints on getting electricity as a top constraint. I observe that the influence of electricity usage costs on the constraints on access to finance for the latter firms is negative and significant at 1% level for pooled set of countries and at 5% level for countries with deficit level of electricity supply as well as countries with surplus level of electricity supply. On the other hand, the influence of electricity usage costs on the constraints on access to finance for the firms that report constraints on getting electricity as a top constraint is significant at 10% level for the pooled set of countries and is not significant for the countries with deficit level of electricity supply and countries with surplus level of

electricity supply. The patterns observed in Table 5 and Table 6 suggest that firms which consider constraints on getting electricity as a top constraint to their business operations are likely to adjust their production process such that there is no influence of constraints on getting electricity as well as electricity usage costs on the constraints on access to finance.

Conclusion

The impact of the constraints on getting electricity and electricity usage cost on the constraints on access to finance is significant across the pooled sample of countries, countries with deficit level of electricity supply and countries with surplus level of electricity supply. The influence of the constraints on getting electricity and electricity usage cost on the constraints on access to finance suggests that firms which experience power shortages or do not receive sufficient power for optimal levels of production have trouble accessing financial markets. Therefore, firms are likely to adjust their production process such that the impact of the lack of electricity supply on the constraints on access to finance is minimal. This can be seen by the lack of significance of electricity usage costs on the constraints on access to finance when electricity usage costs have been adjusted for the fact that firms have recently been connected to the public grid in countries with a deficit level of electricity supply. In addition, firms that report constraints on getting electricity as a top constraint are likely to adjust their production process such that the influence of the constraints on getting electricity and electricity usage cost on the constraints on access to finance is insignificant. It is important to note that the influence of the constraints on getting electricity and electricity usage costs on the constraints on access to finance is consistent across countries with a deficit level of electricity supply and a surplus level of electricity supply, except for the results in Table 4. This suggests that the constraints on access to finance is likely to be sensitive to the availability of electricity

perceived by firms across countries regardless of the level of electricity supply and that the lack of it will adversely impact their constraints on access to finance.

In conclusion, I find an important relationship between the dependence of firms on electricity as an important input into the production process and the constraints on access to financial markets. Firms that report greater constraints on getting electricity and lower electricity usage costs face greater constraints on the access to finance. However, firms may adjust their production process such that the constraints on getting electricity and lower usage costs do not affect their constraints on access to finance. Therefore, it is crucial for policymakers to alleviate the negative impact of lack of electricity supply if they want firms to be able to access financial markets. This paper adds to the research on the impact of the weakness of institutions in state-building and suggests the an ineffective power distribution network within a country may negatively impact the ability of firms to access financial markets.

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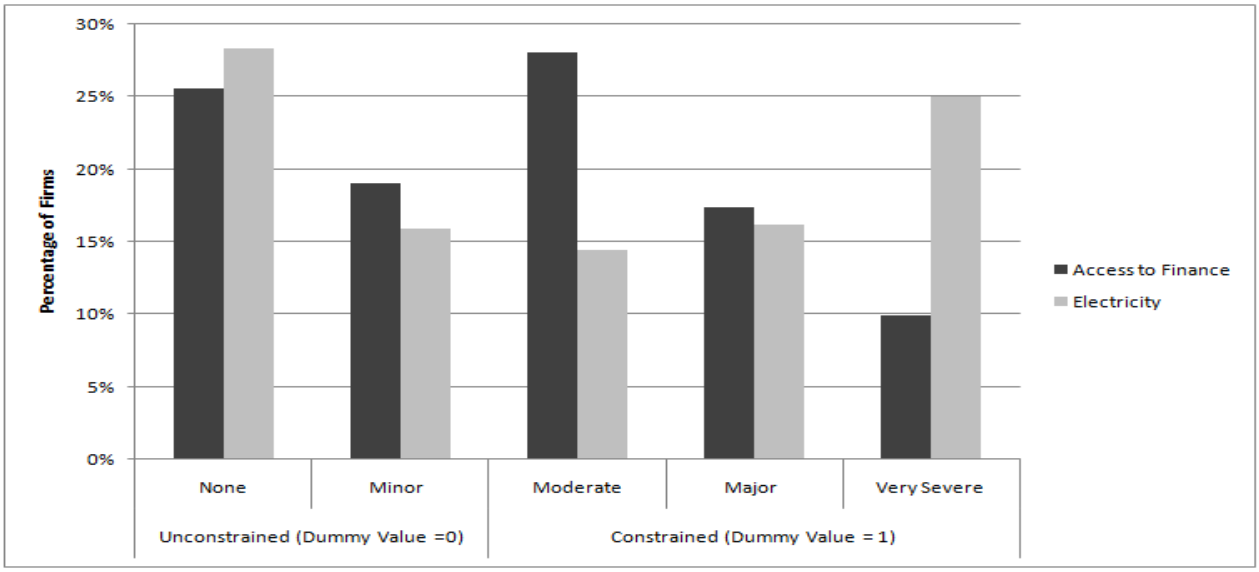

Figure 1: Distribution of Firms by Severity of Constraints on Access to Finance and Electricity

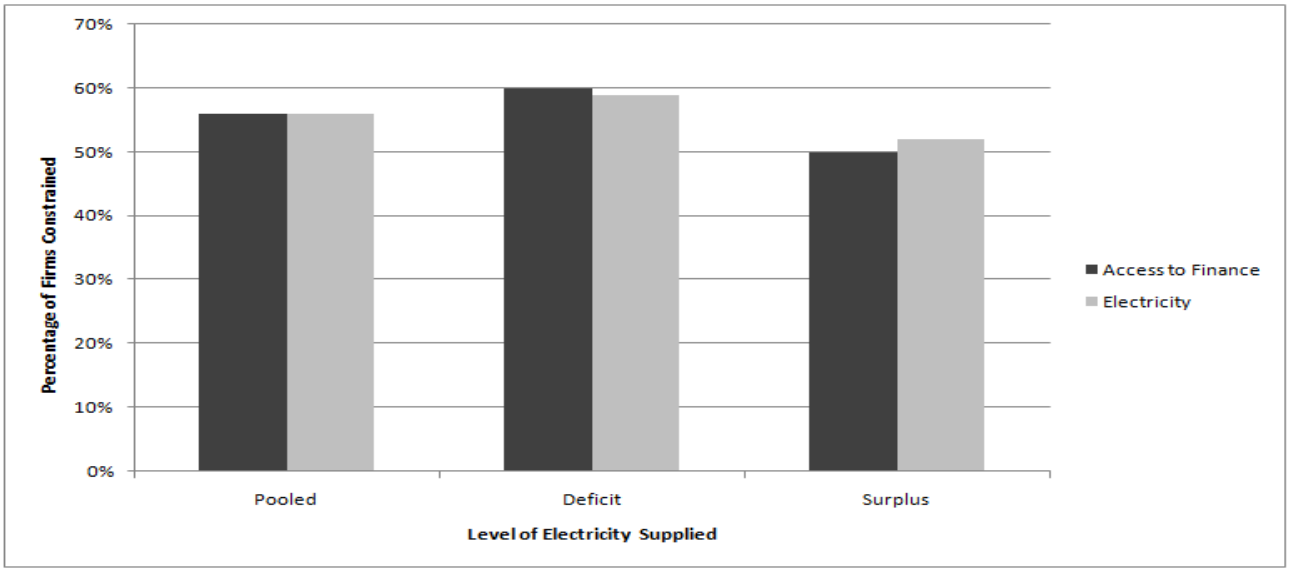

Figure 2: Percentage of Firms Constrained on Access to Finance and Getting Electricity Within a Country Distributed by the Level of Electricity Supplied

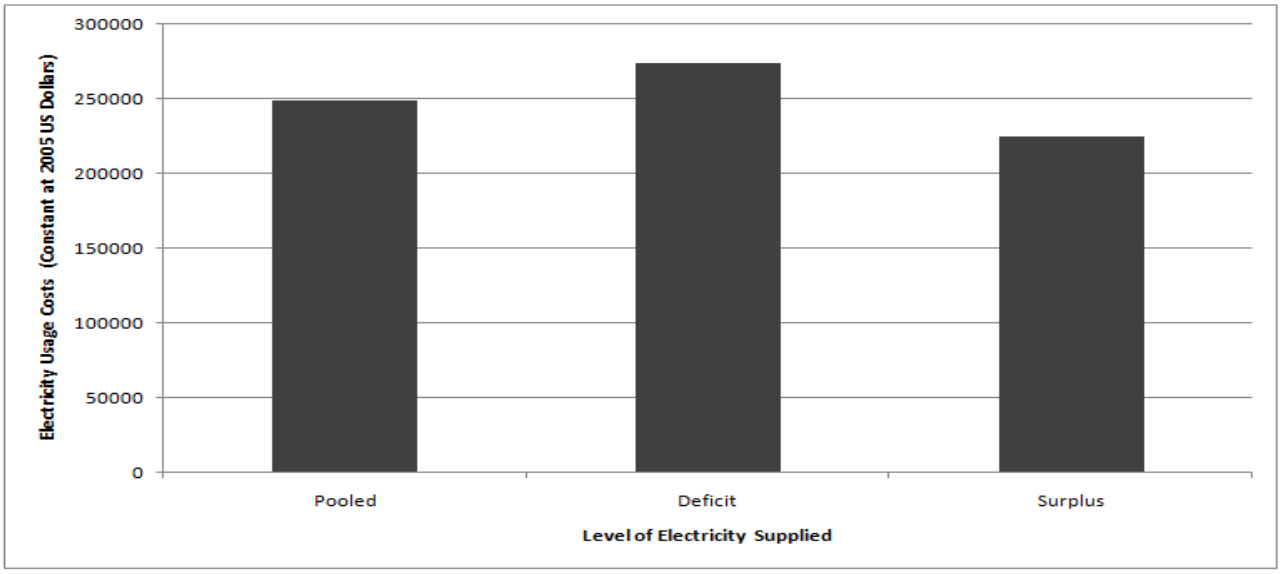

Figure 3: Average Electricity Usage Costs Within a Country Distributed by the Level of Electricity Supplied

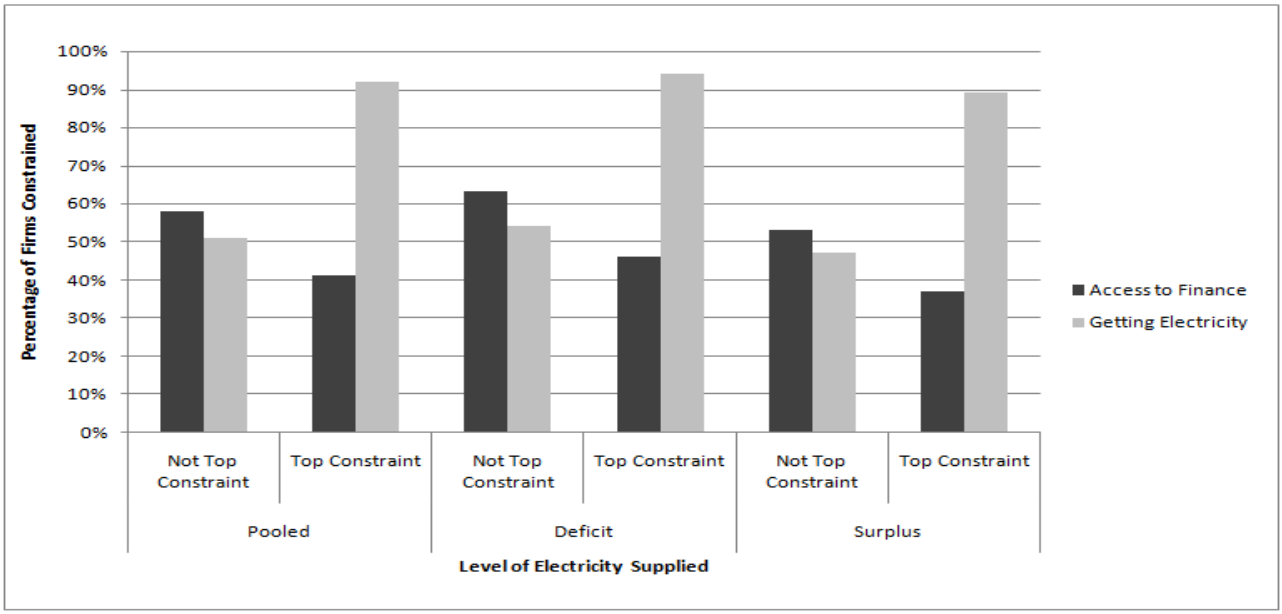

Figure 4: Constraints on Access to Finance and Constraints on Getting Electricity For Firms That Report Constraints on Getting Electricity as a Top Constraint

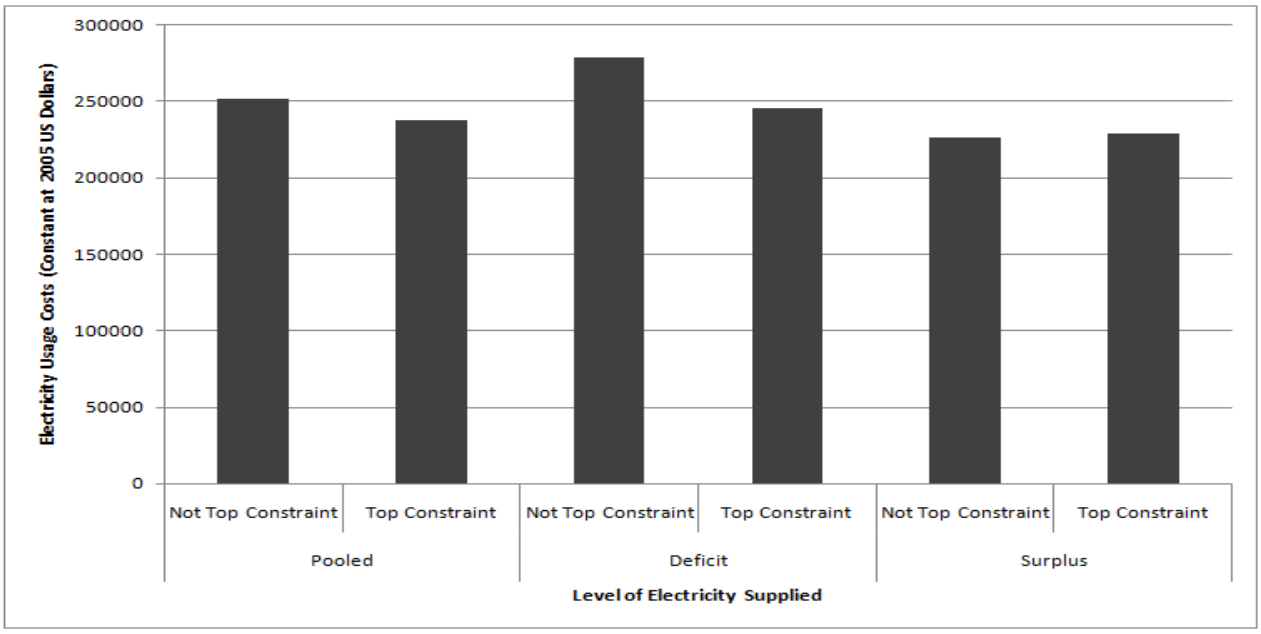

Figure 5: Average Electricity Usage Costs For Firms That Report Constraints on Getting Electricity as a Top Constraint

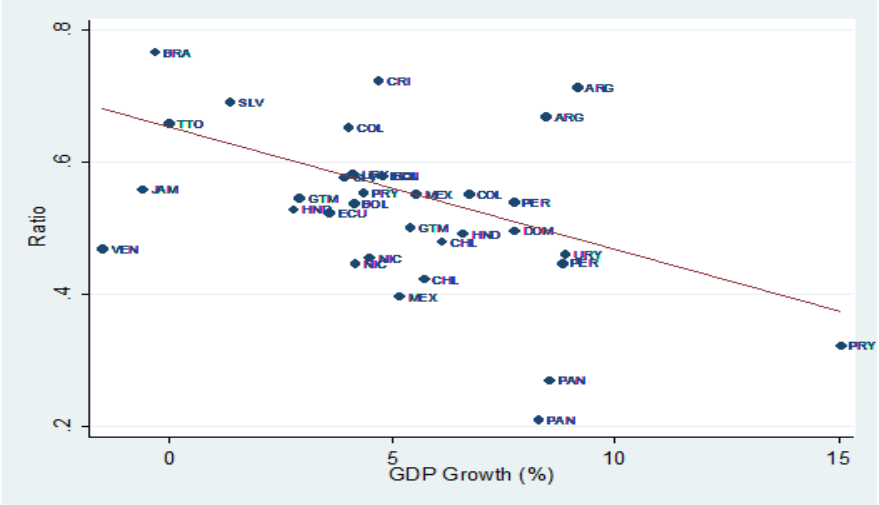

Figure 6: Constraints on Access to Finance at the Country-Level and GDP Growth Rate

Table 1: Probit Regression for the Impact of Constraints on Getting Electricity on Constraints on Access to Finance (With and Without Fixed- Effect Control Variables)

Level of Electricity: Dep. Variable: Access to Finance (Dummy)	(1) Pooled	(2) Deficit	(3) Surplus	(4) Pooled	(5) Deficit	(6) Surplus
Getting Electricity (Dummy)	0.108*** (0.008)	0.096*** (0.013)	0.108*** (0.011)	0.125*** (0.008)	0.120*** (0.013)	0.130*** (0.011)
Fixed Effects:	No	No	No	Yes	Yes	Yes
Observations	12,804	6,402	6,402	12,758	6,359	6,386
Electricity Usage Costs (ln)	-0.016*** (0.003)	-0.018*** (0.004)	-0.014*** (0.004)	-0.018*** (0.003)	-0.020*** (0.004)	-0.016*** (0.004)
Fixed Effects:	No	No	No	Yes	Yes	Yes
Observations	11,302	5,547	5,755	11,258	5,508	5,740

Robust standard errors clustered at industry-level in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Fixed effects include country, region, industry and year dummy variables

Table 2: Probit Regressions for the Impact of Constraints on Getting Electricity on Constraints on Access to Finance(Include all Control Variables)

Level of Electricity: Dep. Variable: Access to Finance (Dummy)	(1) Pooled	(2) Deficit	(3) Surplus	(4) Pooled	(5) Deficit	(6) Surplus
Getting Electricity (Dummy)	0.120***	0.113***	0.127***			
	(0.008)	(0.013)	(0.010)			
Electricity Usage Costs (ln)				-0.013***	-0.013**	-0.011***
				(0.004)	(0.006)	(0.004)
Sales per Worker (ln)	-0.036***	-0.037***	-0.033***	-0.029***	-0.032***	-0.025***
	(0.005)	(0.007)	(0.005)	(0.005)	(0.008)	(0.006)
Intensity of Exports (ln)	-0.006	-0.003	-0.010	-0.001	0.002	-0.006
	(0.004)	(0.005)	(0.007)	(0.005)	(0.005)	(0.007)
Intensity of Imports (ln)	0.007**	0.003	0.012***	0.010***	0.003	0.016***
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Age of Firm (ln)	-0.039***	-0.037***	-0.043***	-0.038***	-0.037***	-0.042***
	(0.008)	(0.008)	(0.010)	(0.007)	(0.008)	(0.010)
Capacity Utilization (ln)	-0.108***	-0.098***	-0.118***	-0.105***	-0.100***	-0.112***
	(0.009)	(0.018)	(0.015)	(0.009)	(0.019)	(0.013)
Internal Funds for Working Cap. (ln)	-0.030***	-0.037***	-0.024***	-0.031***	-0.037***	-0.026***
	(0.004)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)
Apply for Loan	0.087***	0.094***	0.079***	0.095***	0.103***	0.087***
	(0.011)	(0.010)	(0.023)	(0.012)	(0.012)	(0.024)
Observations	11,431	5,708	5,713	10,631	5,241	5,380

Robust standard errors clustered at industry-level in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Includes country, region, industry and year fixed effects

Table 3: Bi-probit Instrumental Variable Regression for the Impact of Constraints on Getting Electricity on Constraints on Access to Finance

	(1)	(2)	(3)	(4)	(5)	(6)
Level of Electricity:	Pooled		Deficit		Surplus	
	Second Stage	First Stage	Second Stage	First Stage	Second Stage	First Stage
Getting Electricity (Dummy)	0.607***		0.675***		0.565***	
	(0.160)		(0.226)		(0.184)	
Sales per Worker (ln)	-0.088***	-0.022**	-0.090***	-0.041***	-0.082***	0.001
	(0.012)	(0.009)	(0.020)	(0.010)	(0.013)	(0.018)
Intensity of Exports (ln)	-0.016	-0.003	-0.010	-0.008	-0.025	-0.002
	(0.010)	(0.010)	(0.012)	(0.015)	(0.017)	(0.013)
Intensity of Imports (ln)	0.018*	-0.003	0.006	-0.002	0.030***	-0.003
	(0.009)	(0.007)	(0.012)	(0.012)	(0.011)	(0.009)
Age of Firm (ln)	-0.093***	-0.037*	-0.087***	-0.043*	-0.103***	-0.036
	(0.019)	(0.020)	(0.022)	(0.022)	(0.026)	(0.027)
Capacity Utilization (ln)	-0.273***	0.024	-0.261***	0.093**	-0.290***	-0.062
	(0.024)	(0.031)	(0.049)	(0.041)	(0.037)	(0.048)
Internal Funds for Working Cap. (ln)	-0.075***	-0.003	-0.096***	0.012	-0.057***	-0.020
	(0.009)	(0.007)	(0.014)	(0.009)	(0.011)	(0.013)
Apply for Loan	0.210***	0.071**	0.229***	0.097**	0.190***	0.037
	(0.026)	(0.030)	(0.033)	(0.040)	(0.059)	(0.030)
Power Outage (Dummy)		0.466***		0.366***		0.575***
		(0.027)		(0.040)		(0.029)
Constant	2.732***	-0.143	2.724***	-0.119	1.853***	0.922**
	(0.219)	(0.144)	(0.344)	(0.229)	(0.340)	(0.364)
Wald test of rho=0: (Prob>Chi2)	0.07		0.12		0.19	
Observations	11,433	11,433	5,721	5,721	5,712	5,712

Robust standard errors clustered at industry-level in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The dependent variable for the second stage is the dummy variable on access to finance

The dependent variable for the second stage is the dummy variable on electricity constraints

Includes country, region, industry and year fixed effects

Table 4: Probit Instrumental Variable Regression for the Impact of Electricity Usage Costs on Constraints on Access to Finance

Level of Electricity:	(1) Pooled Second Stage	(2) Pooled First Stage	(3) Deficit Second Stage	(4) Deficit First Stage	(5) Surplus Second Stage	(6) Surplus First Stage
Electricity Usage Costs (ln)	-0.134**		-0.053		-0.216**	
	(0.066)		(0.094)		(0.097)	
Sales per Worker (ln)	-0.014	0.586***	-0.074	0.617***	0.042	0.536***
	(0.040)	(0.043)	(0.056)	(0.031)	(0.064)	(0.063)
Intensity of Exports (ln)	0.034	0.328***	0.014	0.359***	0.048	0.308***
	(0.024)	(0.023)	(0.038)	(0.036)	(0.033)	(0.022)
Intensity of Imports (ln)	0.034***	0.095***	0.009	0.082***	0.060***	0.115***
	(0.009)	(0.010)	(0.013)	(0.016)	(0.011)	(0.013)
Age of Firm (ln)	-0.059*	0.441***	-0.095**	0.414***	-0.022	0.469***
	(0.033)	(0.038)	(0.042)	(0.052)	(0.054)	(0.046)
Capacity Utilization (ln)	-0.221***	0.332***	-0.248***	0.308***	-0.188***	0.366***
	(0.032)	(0.034)	(0.058)	(0.068)	(0.062)	(0.062)
Internal Funds for Working Cap. (ln)	-0.077***	0.009	-0.100***	-0.002	-0.056***	0.018
	(0.010)	(0.011)	(0.015)	(0.013)	(0.014)	(0.018)
Apply for Loan	0.275***	0.343***	0.270***	0.411***	0.260***	0.264***
	(0.044)	(0.047)	(0.051)	(0.065)	(0.065)	(0.054)
Applied for Electric Connection		0.408***		0.452***		0.353***
During the Last Two Years		(0.047)		(0.059)		(0.077)
Constant	3.136***	0.229	3.389***	0.156	0.026	0.823
	(0.160)	(0.637)	(0.322)	(0.615)	(0.324)	(0.918)
Underidentification test (p-val):	0		0		0.02	
Weak identification test (KP rk F-stat):	76		60		20	
Wald test of rho=0: (Prob>Chi2):	0.13		0.87		0.08	
Observations	10,448	10,448	5,172	5,172	5,266	5,266

Robust standard errors clustered at industry-level in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Includes country, region, industry and year fixed effects

Table 5: Probit Regressions for the Impact of Constraints on Getting Electricity on Constraints on Access to Finance Based on Whether Firms Report Electricity as a Top Constraint

	(1)	(2)	(3)	(4)	(5)	(6)
Electricity Generation (at country-level):	Pooled		Deficit		Surplus	
Electricity as Top Constraint:	No	Yes	No	Yes	No	Yes
Dep. Variable: Access to Finance (Dummy)						
Getting Electricity (Dummy)	0.140***	0.114**	0.127***	0.093	0.154***	0.111*
	(0.008)	(0.045)	(0.013)	(0.064)	(0.012)	(0.066)
Sales per Worker (ln)	-0.038***	-0.028*	-0.035***	-0.045*	-0.040***	-0.006
	(0.005)	(0.015)	(0.009)	(0.023)	(0.005)	(0.024)
Intensity of Exports (ln)	-0.006	-0.001	-0.002	-0.017	-0.012	0.020
	(0.004)	(0.010)	(0.005)	(0.013)	(0.008)	(0.015)
Intensity of Imports (ln)	0.010**	-0.013	0.004	-0.013	0.016***	-0.015
	(0.004)	(0.010)	(0.005)	(0.016)	(0.005)	(0.012)
Age of Firm (ln)	-0.045***	-0.010	-0.041***	-0.012	-0.050***	-0.012
	(0.009)	(0.016)	(0.010)	(0.023)	(0.011)	(0.023)
Capacity Utilization (ln)	-0.111***	-0.058	-0.100***	-0.076*	-0.118***	-0.077
	(0.013)	(0.047)	(0.021)	(0.046)	(0.020)	(0.080)
Internal Funds for Working Cap. (ln)	-0.029***	-0.033***	-0.035***	-0.036***	-0.024***	-0.020**
	(0.003)	(0.008)	(0.005)	(0.014)	(0.005)	(0.009)
Apply for Loan	0.081***	0.112***	0.089***	0.126***	0.073***	0.098
	(0.012)	(0.033)	(0.012)	(0.044)	(0.026)	(0.060)
Observations	9,770	1,455	4,829	760	4,932	636

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Includes country, region, industry and year fixed effects

Table 6: Probit Regressions of Electricity Usage Costs on Constraints on Access to Finance Based on Whether Firms Report Electricity as a Top Constraint

	(1)	(2)	(3)	(4)	(5)	(6)
Electricity Generation (at country-level):	Pooled		Deficit		Surplus	
Electricity as Top Constraint:	No	Yes	No	Yes	No	Yes
Dep. Variable: Access to Finance (Dummy)						
Electricity Usage Costs (ln)	-0.011***	-0.011*	-0.012**	-0.002	-0.010**	-0.011
	(0.004)	(0.006)	(0.006)	(0.012)	(0.004)	(0.014)
Sales per Worker (ln)	-0.032***	-0.019	-0.031***	-0.045**	-0.033***	0.006
	(0.006)	(0.017)	(0.009)	(0.023)	(0.005)	(0.029)
Intensity of Exports (ln)	-0.001	0.001	0.004	-0.023	-0.007	0.028*
	(0.005)	(0.011)	(0.005)	(0.016)	(0.008)	(0.016)
Intensity of Imports (ln)	0.012***	-0.010	0.004	-0.009	0.020***	-0.010
	(0.004)	(0.010)	(0.005)	(0.016)	(0.004)	(0.012)
Age of Firm (ln)	-0.043***	-0.014	-0.042***	-0.012	-0.047***	-0.024
	(0.008)	(0.018)	(0.010)	(0.026)	(0.010)	(0.024)
Capacity Utilization (ln)	-0.107***	-0.053	-0.100***	-0.079*	-0.113***	-0.056
	(0.014)	(0.049)	(0.023)	(0.044)	(0.019)	(0.087)
Internal Funds for Working Cap. (ln)	-0.029***	-0.035***	-0.034***	-0.040***	-0.025***	-0.024**
	(0.004)	(0.009)	(0.005)	(0.014)	(0.005)	(0.012)
Apply for Loan	0.091***	0.114***	0.100***	0.117***	0.081***	0.095*
	(0.014)	(0.030)	(0.014)	(0.043)	(0.026)	(0.055)
Observations	9,063	1,388	4,410	729	4,642	604

Robust standard errors clustered at industry-level in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Includes country, region, industry and year fixed effects

Appendix

Appendix A: List of Countries and Electricity Supply Constraints

Countries	Number of Firms	Year Surveyed
Deficit Countries:		
Argentina	1300	2006, 2010
Brazil	1220	2009
Chile	1326	2006, 2010
Costa Rica	234	2010
Ecuador	424	2006, 2010
El Salvador	494	2006, 2010
Honduras	348	2006, 2010
Nicaragua	393	2006, 2010
Uruguay	669	2006 2010
Total Firms:	6408	
Surplus Countries:		
Bolivia	407	2006,2010
Colombia	1275	2006, 2010
Dominican Republic	121	2006, 2010
Guatemala	543	2006, 2010
Jamaica	116	2010
Mexico	1932	2006, 2010
Panama	297	2006, 2010
Paraguay	430	2006, 2010
Peru	1087	2006, 2010
Trinidad and Tobago	114	2010
Venezuela	79	2010
Total Firms:	6401	

Appendix B: Probit Instrumental Variable Regression for the Impact of Electricity Usage Costs on Constraints on Access to Finance Using Ownership of a Generator as an Excluded Variable

	(1)	(2)	(3)	(4)	(5)	(6)
Level of Electricity:	Pooled		Deficit		Surplus	
	Second Stage	First Stage	Second Stage	First Stage	Second Stage	First Stage
Electricity Usage Costs (ln)	-0.141***		-0.139***		-0.154**	
	(0.040)		(0.042)		(0.063)	
Sales per Worker (ln)	-0.008	0.570***	-0.017	0.589***	0.008	0.533***
	(0.027)	(0.040)	(0.033)	(0.031)	(0.042)	(0.058)
Intensity of Exports (ln)	0.033*	0.297***	0.041*	0.309***	0.026	0.294***
	(0.017)	(0.023)	(0.021)	(0.036)	(0.025)	(0.023)
Intensity of Imports (ln)	0.034***	0.090***	0.017	0.073***	0.054***	0.110***
	(0.008)	(0.010)	(0.012)	(0.015)	(0.010)	(0.014)
Age of Firm (ln)	-0.050**	0.358***	-0.057**	0.308***	-0.044	0.406***
	(0.024)	(0.037)	(0.028)	(0.052)	(0.033)	(0.044)
Capacity Utilization (ln)	-0.223***	0.344***	-0.224***	0.316***	-0.225***	0.382***
	(0.028)	(0.039)	(0.052)	(0.070)	(0.043)	(0.059)
Internal Funds for Working Cap. (ln)	-0.077***	0.007	-0.096***	-0.005	-0.061***	0.018
	(0.010)	(0.010)	(0.014)	(0.013)	(0.012)	(0.017)
Apply for Loan	0.280***	0.361***	0.315***	0.435***	0.246***	0.278***
	(0.038)	(0.043)	(0.038)	(0.060)	(0.065)	(0.050)
Owns A Generator (Dummy)		0.858***		0.933***		0.745***
		(0.065)		(0.080)		(0.091)
Constant	3.131***	0.458	3.386***	0.595	2.257***	0.913
	(0.170)	(0.617)	(0.294)	(0.582)	(0.283)	(0.880)
Underidentification test (p-val):	0		0		0	
Weak identification test (KP rk F-stat):	169		132		67	
Wald test of rho=0: (Prob>Chi2):	0		0		0.04	
Observations	10,604	10,604	5,232	5,232	5,362	5,362

Robust standard errors clustered at industry-level in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Underidentification test and weak identification test calculated using IVREG2
Includes country, region, industry and year fixed effects

Appendix C: Percentage of Firms That Report Constraints on Access to Finance

Firms That:	Power Outage		Electric. Conn.		Owns a Generator	
	Yes	No	Yes	No	Yes	No
Pooled Set of Countries						
Const. on Access to Finance	57	53	54	56	49	57
Countries with Deficit Level of Elect.						
Const. on Access to Finance	61	59	59	61	52	62
Countries with Surplus Level of Elect.						
Const. on Access to Finance	53	48	49	52	45	52

Appendix D: Differences in the Electricity Usage Cost Reported by Firms As per the Excluded Variables

Firms That:	Power Outage		Electric. Conn.		Owns a Generator	
	Yes	No	Yes	No	Yes	No
Pooled Set of Countries						
Electricity Usage Costs	258409	235387	499551	174763	562069	170699
Countries with Deficit Level of Elect.						
Electricity Usage Costs	238997	311379	680996	151644	572898	177861
Countries with Surplus Level of Elect.						
Electricity Usage Costs	277999	166014.1	316823	196682	546272	164456

Appendix E: Probit Regressions for the Impact of Getting Electricity and Electricity Usage Costs on the Constraints on Access to Finance as Per Firm Size

Level of Electricity:	(1) Pooled	(2) Deficit	(3) Surplus	(4) Pooled	(5) Deficit	(6) Surplus
Dep. Variable: Access to Finance (Dummy)						
Small Sized Firms:						
Getting Electricity (Dummy)	0.096***	0.102***	0.102***			
	(0.015)	(0.015)	(0.015)			
Electricity Usage Costs (ln)				-0.000	0.002	-0.001
				(0.004)	(0.005)	(0.003)
Observations	7,362	5,999	6,308	6,933	5,624	5,938
Medium Sized Firms:						
Getting Electricity (Dummy)	0.177***	0.188***	0.165***			
	(0.017)	(0.031)	(0.029)			
Electricity Usage Costs (ln)				0.007	-0.001	0.012
				(0.010)	(0.011)	(0.012)
Observations	2,647	1,335	1,300	2,447	1,212	1,222
Large Sized Firms:						
Getting Electricity (Dummy)	0.120***	0.120***	0.119***			
	(0.035)	(0.045)	(0.039)			
Electricity Usage Costs (ln)				0.001	0.001	-0.001
				(0.008)	(0.010)	(0.010)
Observations	1,343	873	940	1,180	750	823

Robust standard errors clustered at industry-level in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Includes country, region, industry and year fixed effects
All controls listed in Table 1 included