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Delays in connecting firms to electricity: what matters?

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Abstract

This paper discusses institutional factors that influence delays in connecting businesses to electricity across the world. These delays lead to significant economic consequences at the early stages of commercial operations of a newly established firm. The level of economic development of a country can influence this indicator, but there are also conflicting results as quality of institutions increase, in a duality of increasing regulation and control of corruption. Aggregate national level data from World Bank Enterprise Surveys Project, Worldwide Governance Indicators and World Development Indicators is used to estimate and quantify these effects in a broad sample of 141 countries across the world. Panel data techniques are implemented to explore the fact that there are multiple surveys conducted over time, particularly in transition economies (mostly FSU economies). Analysis is mainly focused on this sub-sample of transition economies. There is clear evidence of a positive effect of increased control of corruption and the negative effect of increasing regulation, likely to be associated with extra steps to establish a connection. The latter result is also confirmed by alternative measures of regulation in the power sector in transition economies. There is no evidence that interconnected advances in several dimensions of governance leads to positive outcomes in this context.

JEL Classification: D73, L94, Q40

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1. Introduction

Electricity supply and infrastructure have important consequences for businesses. Delays in creating new connections to electricity networks have consequences in growth and productivity, as it can significantly delay the process of starting a business and hurt its output and sales. Issues with connectivity and quality of supply can often lead firms to rely on generators for their daily business, with particular impact for small firms. This paper aims to conduct a broad level examination the role of institutions through aspects such as governance, corruption and regulations as drivers of delays in obtaining an electricity connection for establishments using aggregate data from the World Bank Enterprise Surveys Project. This is a more aggregate analysis than previous efforts in the literature and also focuses further on the specific issue of delays in connections to firms. It takes advantage of the most recent data on firm surveys and governance indicators up to 2014. In a World Bank Establishment Surveys sample of 141 countries between 2005 and 2014, the waiting times to establish an electricity connection varied between a minimum of 1.8 days in Panama and a maximum of 207 days in Estonia. The regions with distinctively higher waiting times are Middle East and North Africa, as well as South Asia, with regional averages over 50 days. These delays are additional complications for new investment and businesses to establish themselves and contribute to the local economy. In Sub-Saharan Africa and South Asia, the average of firms stating that electricity is their biggest obstacle in business is over 20%.

As the surveys have been conducted multiple times across the world since 2005, it is possible to implement panel data techniques to determine causal links between governance aspects and delays in connections, particularly for a sub-sample of transition economies where there were three surveys in the last decade. The results point to a positive effect of increased corruption control and a negative effect of different measures of increasing regulation, likely to be associated with extra steps to establish a connection. These results are also seen in the sub-sample of transition economies, where different measures of regulation are used at a more disaggregated level. There is no strong evidence that interconnected advances in several dimensions of governance leads to positive outcomes in this context. However, there is some evidence of non-linear relationships between delayed connections and institutional measures.

2. Literature Review

The importance of electricity services in businesses has been studied from a variety of perspectives in the literature. Dollar et al. (2005) analyse large random surveys of establishments in Bangladesh, India, China and Pakistan to conclude that the investment climate matters for productivity, wages, profit rates and employment. This general conclusion can also be considered at a more specific level regarding electricity supply, which also plays an important role in this investment climate. In countries such as Uganda and Nigeria, more than 40% of businesses see access to electricity as their biggest obstacle. In Gambia, Pakistan this percentage goes over 50%. The role of electricity supply is explored in previous literature. Reinikka and Svensson (1999), in their study of the Ugandan economy, find the quality and price of utility services to be a major constraint to investment. Besant-Jones (2006) argues that the right environment for attracting investors and operators is by reforming market governance. Investors will have less fears of corruption and expropriation while consumers and regulators will honour the contractual rights of utilities to recover their revenues. Power utilities can become distressed by endemic corruption, political interference and the inability to work on a long-run vision. Nepal and Jamasb (2012) show in the context of transition economies that power sector reform is highly interdependent with other reforms. The failure to harmonize inter-sector reforms leads to ineffective power sector reform. This perspective will be taken into account in the empirical approach of this paper.

Dal Bó and Rossi (2007) present a theoretical model which formalizes the impact of corruption on technical efficiency of electricity provision firms and tests it on data of South American firms. There is evidence that corruption diverts managerial efforts away from supervision and coordination, leading to the use of more inputs than necessary to generate a given level of output. At the customer level, the effects of inefficient service can be quite significant. Ahmed (2012) studied petty corruption in electricity provision in Karachi, Pakistan, where people from all educational backgrounds are affected, but there is special incidence of search for informal payments with richer customers and house owners. In the case of Sub-Saharan Africa, Auriol and Blanc (2009) highlight a problem of capture by the ruling elite, as services for rich people are public and there is provision by small private unregulated firms for the middle class and the poor. With the subsidizing of electricity, this highly benefits the richer parts of the population. This can also create problems of delay in provision, as a new connection for a firm can face the challenges posed by the governance framework.

Issues with electricity supply have even been linked to institutional problems such as electoral cycles in some cases. Min and Golden (2014) show evidence that supports the thesis of political parties deliberately redirecting electricity to flat rate and unbilled users before elections and a connection between hanging on to a seat and bigger electricity losses in the Indian state of Uttar Pradesh. Baskaran et al. (2015) also find electoral cycles in electricity service provision in India with more manipulation

of the power supply in contested constituencies, with no positive welfare effects of these manipulations. These governance issues lead to non-optimal management of the service and its provision to the public.

One of the consequences of a severe delay in creating an electricity connection or the inability to create one is the use of small generators to feed the firm directly without relying on the local grid. Steinbuks and Foster (2010) find that the prevalence of an own generator is as high as 20% in a sample of 25 African countries, even in cases where power supply is reliable. The price of the use of generators can be three times higher than the cost of (subsidized) electricity supply, even if the overall effects are not negative due to compensation effects in lost load.

Geginat and Ramalho (2015) build a new dataset on electricity connections for businesses in 183 economies. This study covers procedures, time and cost that businesses have to invest to obtain a connection. The study finds that income differences are not the only factor justifying differences in performance of distribution utilities, with bureaucracy being another important factor. The data gathered from utilities across the world allows to conclude that it takes (on average) twice as long to connect to electricity in a low-income country, but also that the cost associated with the connection is 70 times higher. Higher waiting times to establish connections lead to higher likelihood of bribes and worse firm performance. This study regresses the delay to establish a connection on factors such as GNI and time to start a business, to transfer property and to obtain a construction permit, finding that income levels are a fundamental factor. Although the paper deals with regulation and bureaucracy as a source of outcomes in the sector, it does not directly address those in the context of delays in obtaining a connection. These issues will be addressed further in this paper.

3. Data and Results

The literature review has identified multiple factors which can influence the electricity sector and also problems in establishing a new electricity connection: regulation issues, corruption issues, more general governance problems and also the general level of economic development of the country. As previous literature also argues for the possible inter-dependency of reforms and the ineffectiveness of isolated reform efforts, the approach in this paper completes the one in Geginat and Ramalho (2015) as it uses aggregate, national level data on governance indicators to assess the impacts on delays in connection to electricity, but also uses interaction terms to explore the relationship between aspects of governance. A simple pooled model is estimated, with and without UN region dummies to capture regional differences.

However, there is also enough data due to repeated surveys to explore panel data techniques. Most countries had two surveys since 2005, and most transition surveys had three surveys. The data contains 250 observations in 141 countries with the time dimension varying between 1 and 4.

Data is sourced from the World Bank, with some exceptions for transition data where some variables are sourced from EBRD data. The dependent variable is the number of days to obtain an electrical connection (upon application), sourced from Enterprise Surveys. The explanatory variables are GDP per capita (constant 2011 US$, PPP) sourced from World Development Indicators, and Control of Corruption (CC), Government Effectiveness (GE) and Regulatory Quality (RQ) estimates from Worldwide Governance Indicators. Data is logarithmically transformed, except for Worldwide Governance Indicators (which are already normalized by construction).

The first estimated model is a simple pooled regression with all data, with and without UN region dummies (six regions are included in the sample). Results can be seen in specifications (1) to (3). However, these are likely to be biased due to several omitted factors that are hard to capture. To capture the causal relationship more appropriately, fixed effects models are estimated in specifications (4) and (5), and also to a sub-sample of transition economies where there are at least three surveys conducted per country provide a bigger time dimension to the panel (specifications (6) to (9)). In the latter specifications, further EBRD data (power sector reform indexes and information on the independence of the electricity regulator) is used as alternative measures of regulation.

Table 1. Regression Results

	Pooled World Sample (1)	Pooled World Sample (2)	Pooled World Sample (3)	FE World Sample (4)	FE World Sample (5)	FE Transition Economies Subsample (6)	FE Transition Economies Subsample (7)	FE Transition Economies Subsample (8)	Mundlak Transition Economies Subsample (9)
CC	-0.0227 (0.1666)	-0.0150 (0.1785)	-0.0702 (0.1850)	-0.7398 (0.7132)	-0.7663 (0.9053)	**-2.2439 (1.1969)***	**-3.7397 (1.5498)****	-1.1831 (1.3058)	-1.2777 (1.0938)
CC^2	-0.1169 (0.1303)	-0.1204 (0.1285)	-0.2330 (0.4483)	**-1.1691 (0.5865)****	-0.0892 (1.2993)	**-2.0971 (1.1573)***	-3.9575 (2.3391)	-1.6606 (1.1345)	**-1.8520 (0.8439)****
GE	**-0.5029 (0.2444)****	**-0.5526 (0.2832)***	**-0.5315 (0.2867)***	-0.3244 (1.1559)	-0.9946 (1.2552)	-0.3705 (1.7951)	-0.4161 (2.0473)	0.6912 (1.7819)	0.2337 (1.3727)
GE^2	-0.1917 (0.1638)	-0.2428 (0.1690)	0.5588 (0.5688)	0.2948 (0.8629)	0.4904 (1.9410)	0.2175 (1.4803)	0.4193 (2.9344)	0.1213 (1.4918)	0.2690 (1.0054)
RQ	**0.3638 (0.1728)****	**0.4533 (0.1902)****	**0.4821 (0.1888)****	0.7592 (0.5501)	**1.5584 (0.8547)***	**1.9776 (0.8482)****	**3.1075 (1.6086)***	-	-
RQ^2	0.0269 (0.1322)	0.0666 (0.1410)	**0.4848 (0.2933)***	0.2388 (0.3355)	-0.5717 (0.7810)	0.3880 (0.6149)	-0.5890 (1.4347)	-	-
Log(GDP per capita)	**-2.2804 (1.0027)****	**-2.7850 (1.0587)*****	**-2.9817 (1.0413)*****	-1.0159 (3.5930)	-0.1512 (3.5762)	-4.8507 (8.4727)	-5.2316 (8.9631)	-9.6323 (8.9727)	-2.7174 (8.0820)
Log(GDP per capita)^2	**0.1321 (0.0607)****	**0.1641 (0.0638)****	**0.1766 (0.0627)*****	0.1287 (0.2342)	0.0680 (0.2343)	0.3641 (0.5021)	0.3971 (0.5234)	0.6678 (0.5312)	0.2712 (0.4757)
Constant	**12.9423 (4.1040)*****	**15.6271 (4.4180)*****	**16.3264 (4.3469)*****	3.0204 (13.6668)	-0.0788 (13.527)	17.1475 (35.626)	17.8103 (38.3128)	27.0445 (35.2098)	25.2269 (16.1386)
CC*GE	-	-	-0.3298 (0.8920)	-	-2.5687 (2.3568)	-	0.4706 (4.5751)	-	-
CC*RQ	-	-	0.6647 (0.5071)	-	0.2168 (1.7794)	-	2.8677 (2.9609)	-	-
GE*RQ	-	-	**-1.4601 (0.7225)****	-	1.9944 (1.4038)	-	-0.7043 (2.0870)	-	-
EBRD Electric Power Index	-	-	-	-	-	-	-	5.8502 (4.3289)	-
EBRD Electric Power Index^2	-	-	-	-	-	-	-	-0.8711 (0.6703)	-
Partially indep. Regul. (dummy)	-	-	-	-	-	-	-	-	**0.9566 (0.4452)****
Fully indep. Regul. (dummy)	-	-	-	-	-	-	-	-	0.7467 (0.5246)
UN region dummies	No	Yes	Yes	No	No	-	-	-	-
Fixed Effects	No	No	No	Yes	Yes	Yes	Yes	Yes	RE with cross-sectional means
R-squared (Within) (Between)	0.0686	0.1597	0.1726	0.0002 0.1114 0.0053	0.0004 0.1351 0.0086	0.1136 0.2697 0.1584	0.1137 0.2888 0.1565	0.0973 0.2270 0.1361	0.2875 0.2009 0.4277
corr(u_i, Xb)	-	-	-	-0.8991	-0.9075	-0.9178	-0.9242	-0.9469	-
Number of observations	250 N=141	250 N=141	250 N=141	189 N=80	189 N=80	79 N=26	79 N=26	75 N=25	79 N=26

***, ** and * denote significance at 1%, 5% and 10% levels respectively. Pooled standard errors are unclustered (small or no changes to results with clustering by UN region). FE standard errors are clustered by country. CC = Control of Corruption, GE = Government Effectiveness, RQ = Regulatory Quality.

In the pooled case, the specifications with UN region dummies show a much better fit to the data. The introduction of squared governance indicators slightly increases the fit of the model, as can be seen between specifications (2) and (3), pointing to some non-linearities in the relationship. Higher levels of GDP per capita lead to lower wait for connection to electricity in the entire observed range of GDP levels, even with some quadratic effects which bottom out slightly below the mean of income across the observed countries (holding all else constant). This maximum effect is observed close to the mean of South Asian countries, and slightly above the mean of income levels of Sub-Saharan Africa. The possibility of strong quadratic effects is ignored in Geginat and Ramalho (2015). As regulation increases, the number of steps that a firm needs to go through to finalize an electricity connection

increases and this is linked to higher waiting times as highlighted in Geginat and Ramalho (2015). Another issue of interest is the effect of interactions between governance indicators. There is a significant effect from the interaction term between government effectiveness and regulatory quality in Specification (3). Countries with higher levels of combined effectiveness and regulation experience significantly lower levels of delays in establishing connections according to this specification.

However, the specifications (1) to (3) do not take into account the possibility that unobserved heterogeneity can bias the results severely. Therefore, specifications (4) and (5) use a Fixed Effects (FE) model which accounts for unobserved fixed characteristics across countries, leading to a very poor fit of the data and only some limited evidence of corruption control leading to less waiting times, and no significant role of interactions between governance indicators. It also shows an extremely high correlation between the time independent effects and the regressors, which makes the data a poor candidate for estimation of a Random Effects (RE) model. Although the Hausman test is failing to reject the null and therefore arguing for the use of RE, the nature of the test implies that if one variable among many has a significant change, the joint test can hide that effect. That seems to be the case for the control of corruption variables, as confirmed by estimation of RE regressions adding group-means of independent variables to the model. Due to that result and the aforementioned correlation (which is not reduced by removing GDP from specifications), FE is the preferred approach. Although specifications (4) and (5) show some evidence of the positive effect of controlling corruption, they do not lead to very conclusive results as the model fits the data poorly and many of the countries surveyed have been so only twice in the available time frame. As the sub-sample of transition economies had three surveys since 2005, this larger panel allows a better analysis and the specifications (6) to (9) focus on this sub-sample.

After controlling for unobserved characteristics across countries, two patterns are common in FE specifications: the significant effects of control of corruption and regulations. The exception is (8), where power sector indexes are used as a proxy, leading to no significant coefficients. However, the variation in the data is extremely low between 2005 and 2014 which makes identification difficult and therefore this strategy is not preferred. Also, the variable includes a mix of perceptions on regulation, prices, bill collection and others that do not necessarily link to the amount or quality of regulation as a whole. Specification (9) uses the level of independence of regulators as a proxy for regulation, and finds that more independent regulation leads to more waiting times, as in specifications (6) and (7) which use a more general governance indicator instead. This specification uses Random Effects with added cross-sectional means of regressors to allow for correlations with regressors, as the regulation variables are fixed (and therefore cannot be included in a FE model). A pooled regression leads to similar results, with stronger significance for the regulation variables. Interaction terms based on specification (9) are not significant and not reported.

The results point for little or no evidence of the impact of interactions between aspects of governance, and for a positive impact (less waiting times) with more control of corruption and less regulation (as measured by both the level of independence of power regulators and a general measure of regulatory quality). There is no evidence of the impact of government effectiveness. This can be explained by scenarios where more regulation creates extra steps and further institutions to go through to fully establish a connection, but also situations where responsible people in the power sector seek delays in establishing the service to seek informal payments. While more regulation is desirable from the perspective of the entire power sector to allow more transparency and better outcomes for the industry and its customers, a way to fight the delays possibly caused by it is to control corruption and avoid situations where staff in utilities can seek informal payments.

4. Conclusion

This paper investigated the institutional reasons for waiting times that a firm faces when connecting to electricity across the world. Using data from the World Bank, the waiting time is discussed at the light of governance indicators, income levels and some controls for regional differences across the world. This is achieved using panel data techniques in a relatively small panel of 141 countries and a total of 250 observations. There is evidence of more regulations leading to delays but also of increased control of corruption having the opposite effect. There is no evidence of interactions between good governance indicators leading to less waiting times or a strong role of government effectiveness as a stand-alone factor This shows evidence that the economic problems caused by this issue, such as longer times to establish a firm and the associated productivity and investment consequences, could be lessened by implementing reforms to control corruption which can balance the additional delays that are brought on by more layers of regulation, which are often beneficial for customers and other players in the industry. A weakness in the approach is the fact that the governance indicators used are rather general and not exclusively dedicated to utilities or the power sector. There might also be impacts regarding public or private ownership. However, the chosen variables are seen as reasonable proxies and bring some interesting insights which are confirmed by alternative specifications for transition economies which include regulation controls more specific to the power sector. Note that the impacts of these factors in other aspects of power provision, such as quality of supply, pricing and billing issues can differ but fall out of the scope of this paper. Revisiting the issues of connection delays from the perspective of lost output and sales is a future path of research.

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