Can multinational enterprises foster access to electricity in developing countries?

The case of sub-Saharan Africa

Keywords: Multinational enterprises, institutional void, electricity infrastructure, liability of origin, legitimacy, developing countries

Abstract

The paper tests if multinational companies foster access to electricity in developing countries affected by institutional voids through the development of electricity infrastructures, needed to run their own business and gain the legitimacy to operate locally. This is true especially when multinational enterprises come from well-established institutional home countries, as they are more likely to possess the needed managerial expertise to operate and need to fill a higher gap in legitimacy. An econometric analysis is performed and our sample is composed by 83 worldwide home and 15 sub-Saharan host countries, observed from 2005 to 2011. Empirical results confirm our hypotheses.

I. INTRODUCTION

In recent years, there has been a raising attention of scholars, civil society and international institutions around the inadequacy of electricity system in most of developing countries (e.g., Alby, Dethier & Straub, 2012; Gibson & Olivia, 2010; IEA, 2013; IEA, 2014; Kebede, Kagochi, & Jolly, 2010; Khavul & Bruton, 2013; Winkler, Simões, La Rovere, Alam, Rahman & Mwakasonda, 2011). Access to electricity with other commodities, functions and services, such as drinkable water, education, transportation, communication and health, it is what scholars call collective goods and their provision is necessary for the development of standards of living as well as for the normal running of business activities (Boddewyn & Doh, 2011). However, in developing countries often governments fail in supplying collective goods[1]. A possible cause is what scholars call institutional voids (Khanna & Palepu, 1997; Boddewyn & Doh, 2011). In international business (IB) literature, the term institutional void typically refers to the "lack of reliable market information, efficient intermediary institutions, predictable governmental actions, and an efficient bureaucracy" (Chan, Isobe & Makino, 2008), and to the consequent serious presence of unsatisfied social needs. This inability of governments to provide collective goods can lead these countries to become potential failed states (Khanna & Palepu, 1997; Boddewyn & Doh, 2011). Under these circumstances, investments from different actors, such as development banks, bilateral assistance, no-profit organizations and private sector, led by multinational enterprises (MNEs), can be essential to fill the institutional voids and provide collective goods to the communities.

In the specific case of access to electricity, among the factors that contribute to its shortage there is the lack of adequate infrastructures, for the production, transmission and distribution of electricity. Developing countries, indeed, may face difficulties in financing the needed infrastructures because of low domestic savings rates and tax revenues and because they might not have an effective system of governance. Under these circumstances, MNEs

[1] With *failure* we refer to "non- or sub-performance on account of factors (e.g., uncertainty and bounded rationality) preventing or hampering institutions, organizations and individuals from fulfilling their functions" (Boddewyn & Doh, 2011).

and foreign direct investments (FDIs), which in the past years massively grew in developing countries[2], could, in principle, play a role. We claim that, for MNEs investing in foreign countries affected by institutional voids it is important to participate to the reinforcing of infrastructures, not only to gain access to essential production inputs, to reduce costs, and to increase their business opportunities, but also to stimulate the development of local communities and to gain legitimacy to operate therein (Boddewyn & Doh, 2011; Hanson, 2001; Khadaroo & Seetanah, 2007; Kostova & Zaheer,1999; North, 1990). We argue that this participation is even stronger when MNEs come from other institutionally weak home countries, as they are more likely to possess the needed managerial expertise to operate in the context (Cuervo-Cazurra & Genc, 2008), and they need to fill a high gap in legitimacy in the host countries, due to their liability of origin (Cuervo-Cazurra & Ramamurti, 2014; Kostova & Zaheer, 1999; Ramachandran & Pant, 2010).

The scope of this paper is to show if FDIs can foster the access to electricity for the communities of developing countries affected by institutional voids and if this effect is stronger when FDIs come from other countries affected by institutional voids. To this aim, we adopt an econometric approach and we focus on sub-Saharan Africa.

Sub-Saharan countries have experienced an unprecedented growth of inward FDIs in the last years. Based on the United Nations Conference on Trade and Development (UNCTAD), in 2013, FDI inflows to the region reached a new high at $ 42 billion, after twelve years, from 2001 to 2013, of a continuous yearly average growth of 15 percent. However, accordingly to International Energy Agency (IEA) in 2013, 290 million out of 915 million people had still no access to electricity (IEA, 2014). For this reason, the region represents an ideal test-bed for our analysis.

Our sample concerns FDIs from 83 worldwide home countries to 15 sub-Saharan host countries, observed throughout the period 2005 - 2011. Given the nature of data, we adopt dynamic panel techniques. Our findings

[2] Based on the United Nations Conference on Trade and Development (UNCTAD), in 2013, foreign direct investment (FDI) flows to developing countries reached a new high at $778 billion, accounting for 54% of global inflows. Developing Asia has been the region with the highest FDI inflows, with a total amount of $426 million. Then there was Latin America and Caribbean region, which experienced a growth of 6%, reaching a pick of $292 million. Finally, Africa has experienced a growth of 4% and FDI inflows rose to $57 billion (UNCTAD, 2014).

provide support to the institutional void perspective. Foreign MNEs can promote the access to electricity for local communities in institutionally weak countries and this holds stronger when they come from other institutionally weak countries. This result is far from obvious if the issues at stake are infrastructure development and access to electricity. Thus, it is common wisdom between institutional theorists that a regulatory authority is necessary in infrastructure sectors to restrain the tendency of private firms to exert monopoly power. Highly specific investments (i.e. sunk costs), large economies of scale and scope, widespread consumption imply that customers of infrastructure services have a limited bargaining power, and suppliers tend to adopt an opportunistic behavior, if regulation is absent (Cowan, 2003; Sawant, 2010; Spiller, 2013; Williamson, 1976). For this reason, the delivery options for electricity has historically been direct provision through state-owned enterprises or indirect provision through regulation of private business (Spiller, 2013).

This work means to contribute to several streams of literature: institutional voids and MNE behavior (Khanna & Palepu, 1997; Boddewyn & Doh, 2011), institutional arrangement for the provision of collective goods (e.g. Henisz, 2002; Levy & Spiller, 1994; Spiller, 2013), legitimacy mechanisms for MNEs and liability of origin (e.g., Kostova & Zaheer, 1999; Ramachandran & Pant, 2010; Cuervo-Cazurra & Ramamurti, 2014), competitive advantages and disadvantages (Cuervo-Cazurra & Genc, 2008) as well as on the role of FDI and MNE on the development of the local context (Moran, Graham & Blomström, 2005).

The paper is organized as follows: Section II describes the conceptual framework and develops our hypotheses, Section III presents data and methodology, Sections IV and V illustrate our results and robustness checks, respectively, while Section VI reports our discussion, conclusion and further researches.

II. CONCEPTUAL FRAMEWORK

Collective goods and institutional voids: the role of MNEs

When we talk about access to electricity in developing counties necessarily, we have to consider their institutional environment and system of governance. Thus, often these countries are affected by institutional voids and, consequently, are not able to provide collective goods, such as electricity (Boddewyn & Doh, 2011), directly, through state-owned enterprises, or indirectly, through regulation of private business. Indeed, in countries that

suffer from institutional voids the "ineffective legal framework, the inconsistent enforcement of rules, the prevalence of corruption and the public sector incapacity may impede the effective functioning of governments" (Boddewyn & Doh, 2011). Countries under these conditions are considered failed states (Khanna & Palepu, 1997).

In order to promote access to electricity, two options can be adopted: (1) on-grid-systems, i.e., large and medium-sized power plants connected to large-scale international, national or regional grids and; (2) distributed small-size systems, namely mini-grid [3] and off-grid [4] systems (IEA, 2014)[5]. However, following the definition of utilities provided by Spiller (2013)[6] and based on the adopted technological solutions[7], only the on-grid and mini-grid solutions can be fully considered electricity utilities (see Table 1).

Historically, governments, more recently as regulator of private business, have always been involved in the provision of electricity utilities (Boycko, Shleifer & Vishny, 1996; Cowan, 2006; Laffont & Tirole, 1991; Ostrom, Shroeder & Wynne, 1993; Sawant, 2010; Spiller, 2013; Williamson, 1976). Indeed, because of their characteristics, i.e., natural monopoly, and the highly political nature of the sector, utilities are especially sensitive to the country's institutional environment, whereof governments are the prominent expression of formal dimension (Henisz, 2002; Levy & Spiller, 1994; Ramamurti & Doh, 2004; Savedoff & Spiller, 1997; Scott, 1995). For this reason, we could expect governments to be active in the provision of electricity utilities or in their regulation.

However, in the past years, the lack of strong and stable formal institutions has undermined the ability of governments of developing countries to provide collective goods to the population (Boddewyn & Doh, 2011;

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[3] Mini-grid systems are small grid systems linking a number of households and other consumers (IEA, 2014).

[4] Off-grid systems are stand-alone systems for individual households or groups of consumers (IEA, 2014).

[5] The on-grid solution is targeted for urban and peri-urban population or for growing demand centers, such as the neighboring of mining plants, while the distributed solution is more apt for rural and remote areas (IEA, 2014).

[6] Spiller (2013) defines utilities systems with following features: (1) high level of physical specificity of the investment (i.e., high component of sunk investment); (2) widespread domestic consumption and; (3) economies of scale and scope (Spiller, 2013).

[7] For on-grid systems, available technologies are: large solar photovoltaics farms, gas plants (gas turbine or combined cycle gas turbines), onshore wind farms, large hydropower plants and coal plants. For mini-grid systems, available technologies are: small solar photovoltaics plants, small hydropower plants and small wind plants. Finally, for off-grid systems, the only technology available are the stand-alone generators, generally fuelled by diesel or gasoline (IEA, 2014).

Khanna & Palepu, 1997; Robbins & Perkins, 2012). This has motivated other actors (e.g., the private - either profit and nonprofit – sector or interest group coalitions) to intervene in order to fill this institutional void by "shoring up public agencies or substituting for them" (Boddewyn & Doh, 2011; Cantwell, Dunning & Lundan, 2010; Oetzel & Doh, 2009; Valente & Crane, 2010). In fact, collective good, such as electricity utilities, are a necessary condition to operate successfully in a country (Khadarooa & Seetanah, 2010).

Under these circumstances, MNEs can play a crucial role in enhancing the provision of electricity utilities in developing countries. They can do it mainly through the development of large and small-scale electricity infrastructures assets[8] (Corkin, 2012; Cuervo-Cazurra & Genc, 2008; Robbins & Perkins 2012). Precisely, the engagement of MNEs can pass through four channels: (1) planning[9]; (2) financing; (3) construction, i.e., greenfield or repowering and; (4) operation and maintenance (Ostrom et al., 1993 pp. 29-41) of electricity infrastructures[10]. Table 1 summarizes the characteristics of the electricity provision focusing on the case of sub-Saharan Africa.

[insert Table 1 about here]

[8] Infrastructures refer to a range of facilities, services and installations essential for the distribution of products or services over geographic space (Gómez-Ibáñez, 2009 p. 4; Sawant, 2010). Infrastructure assets typically comprise oil, gas, petrochemicals, electricity utilities, transportation, telecommunication, mining and other tangible, capital-intensive assets (Sawant, 2010).

[9] By *planning* we refer to the decision process related to the definition of: (1) the type of goods and services to be provided; (2) the quantity and quality of the goods and services to be provided; (3) the degree to which private activities related to these goods and services are to be regulated; (4) how and where arrange the production of these goods and services; (5) how to finance the provision of these goods and services and (5) how to monitor the performance of those who produce these goods and services (Ostrom et al., 1993 p. 74).

[10] It should be remarked that MNEs' direct involvement as sponsors, developers or operators, alone or in partnership, it is not the only engagement mode. Supporting the planning process through formal and informal relations with governments is also a viable option. Indeed, event though planning is a public-specific activity, in institutional weak countries the governments can keep blunter the boundaries around it, allowing the intervention of private sector, i.e., MNEs.

Namely, based on the business sector in which MNEs operate, the provision of electricity infrastructures, useful to fill the institutional voids, can be related to the enterprise's market or non-market strategies[11] (Doh, Lawton & Rajwani, 2012; Valente & Crane, 2010). In the first case, firms deliver electricity infrastructure as part of their core product/service or in the chain of activities responsible for delivering that product/service. A good example is Electricité de France Group (EDF), a global leader in the power sector, which signed several agreements with national governments and other MNEs to cooperate to the improvement of electrification rate in several sub-Saharan countries, such as Botwana, Mali, South Africa or Senegal. It did it through the development of both on-grid and mini-grid systems[12] [13]. In other industrial sectors, MNEs need to supplement government activities in the provision of electricity infrastructures, as part of their non-market strategies that, in these contexts, are essential to gain competitive advantage (Boddewyn & Doh, 2011). The provision of electricity infrastructures, indeed, is not only needed for the development of local communities and the increase of their standards of living but it is also essential for the innovative, productive and distributive activities of firms because, without them, economic activity is either physically impossible or too expensive (IEA, 2013). For instance, Robins and Perkins (2012) describe the cases of Tanzania and Mozambique, where mining companies had heavily investing in power generation and supply in order to ensure that their operations were not at risk, due to inadequate energy coverage. Finally, participating to the planning or financing of electricity infrastructures may help MNEs of whatever sector to gain the legitimacy that is necessary to countervail their liabilities of being a foreign as well as a profit-driven company (Boddewyn & Doh, 2011).

Accordingly, our first hypothesis states as follows.

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[11] Non-market strategies are the "actions taken to favorably position the firm in its nonmarket environment by managing those uncertainties and resource dependences stemming from the influence and/or resistance of other non-market actors that (can) affect the firm's overall economic performances" (Doh et al., 2012).

[12] See http://about-us.edf.com/strategy-and-sustainable-development/our-priorities/society/energy-access-developing-countries/projects-in-africa-84686.html accessed on 26th March 2015.

[13] See http://www.fres.nl/en/how-fres-works/fres-in-mali/86-10-jaar-ontwikkeling-in-mali-dankzij-zonne-energie.html accessed on 26th March 2015.

Hypothesis 1: In countries that suffer from institutional voids, MNEs promote the development of electricity infrastructures.

MNEs, legitimacy and their liability of origin

When MNEs internationalize they have to deal with uncertainty related to their liability of foreignness (Zaheer, 1995). In particular, they have to face differences in the institutional environment, and this challenges their ability to operate, because institutions "alter the costs of engaging in business activities in one host country compared with another one" (Chan, Isobe & Makino, 2008). Institutional differences between countries are multifaceted and can be related to their regulatory, cognitive, and normative institutions (Scott, 1995). They can include differences in the laws and regulations surrounding the acquisition of property; in the licensing of new businesses; in the domestic or international contracting for the acquisition of needed factors of production or for downstream sales; in the protection of intellectual property; in the payment of taxes, acquisition of government licenses and payment of fees; in the prevalence of corruption and; in the means and feasibility of exit (Henisz, 2004). The greater the institutional difference between home and host environment, the more difficult for the MNE understanding and correctly interpreting local institutional requirements, as well as the extent of necessary adjustments (Kostova & Zaheer, 1999). This difficulty arises because MNEs are constrained by their home country environment (Kwok & Tadesse, 2006) that may significantly influence their ability to handle institutional idiosyncrasies (Henisz, 2003; Chan et al., 2008; Roth & Kostova, 2003). Thus, firms' organizational structures, policies, and practices tend to reflect the institutional environment in which they have been developed and established (Chan et al., 2008; Roth & Kostova, 2003). For this reason, operating in a foreign country is exceptionally challenging when foreign investors have to interact with institutional environments that differ from those of their home countries (Chan et al., 2008). In other words, it is easier for an MNE to understand and adjust to the requirements of a country that is institutionally similar to its home country (Kostova & Zaheer, 1999; Cuervo-Cazurra & Genc, 2008).

These difficulties are amplified in countries affected by institutional voids. Indeed, in this contexts, for foreign subsidiaries the conformity process becomes more challenging, because the lack of strong and stable local institutions prevents effective markets, including governance mechanisms that prevent corruption, protect property rights, ensure the rule of law and establish supportive public investments and infrastructures (Ahlstrom, Levitas,

Hitt, Dacin & Zhu, 2014; Young, Tsai, Wang, Liu & Ahlstrom, 2014). Under these circumstances, coming from an institutional weak country can be an advantage (Cuervo-Cazurra & Genc, 2008). Namely, MNEs from countries affected by institutional voids already know how to operate in a challenging institutional environment (Cuervo-Cazurra & Genc, 2008; Eriksson, Johanson, Majkgard & Sharma, 1997). Thus, these firms have a competitive advantage, compared with MNEs from well-established institutional country, because their managers already know the norms for conducting business in countries under the condition of institutional voids (Cuervo-Cazurra, 2006; Cuervo-Cazurra & Genc, 2008).

Likewise, MNEs from institutionally weak countries normally suffer from the lack of legitimation in the host country. Legitimacy is defined as "the acceptance of the organization by its environment" and it is essential to operate and succeed in a foreign context (Kostova & Zaheer, 1999). Institutional theorists have identified three factors that shape firms' legitimacy: (1) the environment's institutional characteristics; (2) the organization's characteristics, and (3) the legitimation process by which the environment builds its perception of the organization (Kostova & Zaheer, 1999). Talking about MNEs, a higher complexity is added to any of these factors, making more difficult for firms to establish and maintain legitimacy (Kostova & Zaheer, 2009). This additional complexity is due to their widespread presence that exposes these firms to a diversity of institutional environments with varying and sometimes conflicting expectations (Cuervo-Cazurra & Ramamurti, 2014 p. 209; Kostova & Zaheer, 1999). This difficulty in gaining and maintaining legitimacy is even stronger for MNEs from institutional weak countries. Indeed, these foreign affiliates are subject to what scholars call liability of origin, because, based on the characteristics of the home country they lack of credibility in the host one (Chung, Sparrow, & Bozkurt, 2014; Ramachandran & Pant, 2010). This suggests that when these MNEs enter in foreign markets they suffer from a negative image (Cuervo-Cazurra & Genc, 2008; Lall, 1983; Ramachandran & Pant, 2010), due to the power of "negative legitimacy spillover" associated with a less legitimated home country (Cuervo-Cazurra & Ramamurti, 2014 pp. 209-211; Kostova & Zaheer, 1999). This comes from a negative stereotype that associates to home country with weak institutions, weak firm governance that "does not provide to stakeholders adequate information for evaluating these firms" (Cuervo-Cazurra & Ramamurti, 2014 pp. 209-211). In order to overcome this liabilities of origin and transforming a competitive disadvantage in an advantage, MNEs from weak institutional countries

need to engage in "alternative legitimation mechanisms" (Ramachandran & Pant, 2010; Kostova, Roth & Dacin, 2008) and have to develop strategic responses instead of adapting passively (Doh, McGuire, & Ozaki, 2014, Oliver, 1991). They need to mobilize resources, create strong relationships with salient actors, e.g., non-governmental organizations (NGO) or groups of interest, or they have to collaborate with other firms facing similar problems, in order perform collective actions in acquiring legitimacy (Ramachandran & Pant, 2010). Under this perspective, the development of electricity infrastructures can be employed as a legitimacy strategy, helping, in combination with other initiatives, such as corporate social responsibility (CSR) activities (Gifford, Kestler, & Anand, 2010; Zheng, Luo, & Maksimov, 2014), in alleviating the host-country stakeholders negative perception. MNEs coming from institutional weak countries might use the development of electricity infrastructures as an instrument to overcome their competitive disadvantage in the host country, thus mitigating their liability of origin by achieving and sustaining legitimacy with host-country stakeholders.

Accordingly, our second hypothesis states as follows.

Hypothesis 2: In countries that suffer from institutional voids, MNEs from institutional weak countries are more effective in promoting the development of electricity infrastructures, compared with MNEs from well-established institutional countries.

III. METHODOLOGY

Sample and Data Sources

In order to study the role played by MNEs in promoting the development of electricity infrastructures, an econometric analysis is performed using a panel dataset. Sample is composed by pairs of 15 host countries from sub-Saharan Africa and 83 worldwide home countries, observed from 2005 to 2011, with a total of 1547 observations. Appendix 1 shows the list of host and home countries considered for this study. Data sources are reported in remaining part of the section.

Dependent variable

Access to electricity. The development of electricity infrastructures is our dependent variable and it is proxied by the percentage of households having access to a minimum level of electricity consumption (Source: IEA). Based

on the definition provided by IEA, access to electricity involves more than a first supply to the household; it also comprises consumption of a specified minimum level of electricity. The amount varies based on whether the household is in a rural or an urban area and it is calculated based on an assumption of five people per household. The threshold level of electricity consumption for rural households is assumed to be 250 kilowatt-hours (kWh) per year and for urban households it is 500 kWh per year (IEA, 2013). We are conscious that this proxy has two main limitations. First, it may overestimate the phenomenon because it also includes access to off-grid systems (see Table 1). Second, it considers mainly the supply side of the electricity access. However, we believe that these two limitations can be overcame by including appropriate control variables, presented in details in the remaining part of the section, which capture a few demand side (e.g., economic variables such as industry and services value added or low-income or lower-middle income country dummies) and the obstacles in the development of electricity infrastructures (e.g., rural population and population density).

Finally, this variable is affected by a problem of missing data, i.e., 30%, that we overcame by using an approach that showed good statistical properties, i.e., the multiple imputation (Allison 2001, pp 27-50; Honaker & King, 2010)[14]. In order to strengthen our study, we run a robustness check where we replace *access to electricity* with another variable that represents the lack of access to clean safe means of cooking, which has a lower number of missing data (16%) , i.e., *use of traditional biomass* (Source: IEA). More details are presented in Section V.

Explanatory variables

FDI stock per capita. The presence of MNEs in sub-Saharan countries is proxied by inward FDI stocks disaggregated by home and host country, i.e., country-pair FDIs (Source: UNCTAD). Since inward FDI stocks are an extensive variable, which varies with the country's size while our dependent variable is expressed as percentage of population, we employ country-pair FDIs per capita.

[14] With multiple imputation missing values are drawn from a distribution of observed variables, including the variables at stake, not interpolated from contiguous values. Imputation is generated by a chained equation approach, which allows dealing with high proportion of missing data (Allison 2001, pp 27-50). In order to guarantee the consistency of imputed data we removed all pair countries with less than 3 observations per variable, over the 7 years. Results of the multiple imputation are available upon request from the authors.

Even this variable is affected by missing data[15], that we also solve with the multiple imputation approach, previously described.

Institutional quality of host and home country. Institutional quality of country is described through the six World Bank's Worldwide Governance Indicators (WGIs): regulatory quality, control of corruption, voice and accountability and absence of violence and terrorism, rule of law, governance effectiveness and political stability. These variables, developed by Kaufman, Kraay and Mastuzzi (2011), have been widely used by scholars to empirically studying the impact of regulatory and formal institutions (e.g., Cuervo-Caruzza & Genc, 2008; Hernandez & Jesus Nieto, 2015). However, due to the high correlation between these variables, and in line with previous literature (e.g., Farla, Crombrugghe & Verspagen, 2014; Hernandez & Jesus Nieto, 2015), a factorial analysis is performed in order to obtain a single indicator. Two factors are used, one to proxy the quality of regulatory and formal institutions in the host country and another in the home one.

In Section V, where robustness checks are presented, we replace the WGIs with the indicators of political and military pressures, developed by Fund for Peace (FFP), a no-profit and no-governmental American research and educational institutional. More details are provided later on.

Control variables

In order to reduce risks of spurious correlations and estimation biases we control for some host country specific characteristics.

Population. This variable allows controlling for the host country size (Source: World Bank).

Rural population. Only 37 per cent of sub-Saharan population lives in urban areas (UNDP, 2013). This rises barriers to access to electricity, because it makes more difficult and costly to develop electricity infrastructures (IEA, 2014). For this reason, we control for the share of rural population in the host country, expressed as a percentage of total population (Source: World Bank).

[15] *FDI per capita* has 26% of missing data.

Population density. As rural population, also low population density, i.e., expressed as people per squared kilometer per land area (Source: World Bank), is a barrier for the enlargement of access to electricity, mainly when this is driven by the implementation of national and/or regional grids (Crousillat, Hamilton & Antmann, 2010).

Dummies for low-income (LIC) and lower middle-income (LMIC) country. These two dummies allow controlling for the income group of the host country, as defined by the World Bank, and enable to observe the effects that income group has on the access to electricity rate[16].

Industry and services value added. With these two variables, we control for the economic structure of the host country, which is strictly related to its economic development (Medlock & Soligo, 2001; UNIDO, 2007)[17], and we study how the country sectorial composition influences the access to electricity (Source: World Bank). Industry value added, expressed as a percentage of gross domestic product (GDP), covers mining, manufacturing construction, electricity, water, and gas. Services value added, also expressed as a percentage of GDP, comprises wholesale and retail trade (including hotels and restaurants), transport, government, financial, professional, and personal services such as education, health care, and real estate services. Of course these variables take a low value if the country is specialized in agriculture, husbandry, forestry and fishing.

Time and country-pair dummies. These dummies are included in our model in order to capture time varying macroeconomic shocks and unobservable country-pair specific factors.

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[16] Based on the World Bank guidelines, countries are defined as low-income (LIC) if in 2013 had a per capita gross national income (GNI) of $1,035 or less; lower middle-income (LMIC) if in 2013 had a per capita GNI between $1,036 and $4,085; upper middle-income (UMIC) if in 2013 had a per capita GNI between $4,086 and $12,615 and; high-income (HI) if in 2013 had a per capita GNI of $12,616 or more (See http://data.worldbank.org/news/new-country-classifications accessed on 19th March 2015).

[17] Low-income countries (LIC) have an economic structure in terms of percentage of GDP as agriculture 31%, industry 22% and services 41%. Then, lower-middle income countries (LMIC) have an economic structure in terms of percentage of GDP as agriculture 19%, industry 30% and services 51%.Upper-middle income countries (UMIC) have an economic structure in terms of percentage of GDP as agriculture 11%, industry 34% and services 55%. Finally, high-income countries (HIC) have an economic structure in terms of percentage of GDP as agriculture 3%, industry 31% and services 65% (Medlock & Soligo, 2001, p. 81).

In Table 2 are listed all the variables used for the study and their sources.

[insert Table 2 about here]

Model

In order to test our hypotheses we rely on a growth model, widely used by scholars (e.g., Barro, 1991; Henisz, 2000; Henisz & Zelner, 2001; Solow, 1956), and we modify it by introducing two interaction terms, i.e., *FDI per capita* $_{i,j,t-1}$ * *Institutional quality host* $_{i,t-1}$ and *FDI per capita* $_{i,j,t-1}$ * *Institutional quality home* $_{j,t-1}$. The model then becomes:

$$
\begin{aligned}
&Access\ to\ Electricity\ Growth_{\ i,t} = \\
&\alpha_0 + \alpha_1\ Access\ to\ Electricity_{\ i,t-1} + \beta_1\ FDI\ per\ capita_{\ i,j,t-1} \\
&+ \beta_2\ Institutional\ quality\ host_{\ i,t-1} + \beta_3\ Institutional\ quality\ home_{\ j,t-1} \\
&+ \beta_4\ FDIs\ per\ capita_{\ i,j,t-1} *\ Institutional\ quality\ host_{\ i,t-1} \\
&+ \beta_5\ FDIs\ per\ capita_{\ i,j,t-1} *\ Institutional\ quality\ home_{\ j,t-1} \\
&+\gamma_1\ Population_{\ i,t-1} + \gamma_2\ Rural\ Population_{\ i,t-1} \\
&+\gamma_3\ Population\ Density_{\ i,t-1} + \gamma_4\ Industry\ value\ added_{\ i,t-1} \\
&+\gamma_5\ Services\ value\ added_{\ i,t-1} + \gamma_6\ LIC_{i,t} \\
&+\gamma_7\ LMIC_{i,t} + \varphi_t + \chi_{ji} + \varepsilon_{ij,t} \qquad (1)
\end{aligned}
$$

Where i is the host country, j is the home country, t is the year, φ_t and χ_{ji} are respectively the unobservable year and country-pairs specific effects; $\varepsilon_{ij,t}$ is the i.i.d. disturbance term. *Access to electricity growth* $_{i,t}$ is the country growth of percentage of households having access to electricity between time t-1 and t (i.e., *access to electricity* $_{i,t}$ - *access to electricity*$_{i,t-1}$). A*ccess to electricity* $_{i,t-1}$ is the lagged dependent variable in level, which allows controlling for the dynamics of the process. In addition, to alleviate reverse causality problems, explanatory variables and controls, excepted for the dummies LIC and LMIC, are lagged by one period.

Due to the presence of two interaction terms in our model, for testing our hypotheses, we need to evaluate the marginal effects of *FDIs per capita* on *access to electricity growth*. Equations used for this evaluation state as follows.

Hypothesis 1

H_0: The impact of *FDIs per capita* on *access to electricity growth*, other things been equal, is not significantly different from zero if host countries' institutional quality is equal to the minimum level.

$$\left.\frac{\partial(\text{Access to electricity growth}_{\text{i.t}})}{\partial(\text{FDIs per capita}_{\text{i,j,t}-1})}\right|_{\substack{(Institutional\ quality\ host_{i,t-1})_{min} \\ (Institutional\ quality\ home_{j,t-1})_{median}}} =$$

$$\beta_1 + \beta_4\,(Institutional\ quality\ host_{\,i,t-1})_{min} + \beta_5(Institutional\ quality\ home_{\,j,t-1})_{median} = \vartheta$$

$$H_0 \quad \vartheta = 0 \quad ; \quad H_a \quad \vartheta > 0 \qquad (2)$$

Hypothesis 2

H_0: The impact of *FDIs per capita* on *access to electricity growth*, other things been equal, is not significantly different from zero if host and home countries' institutional quality are equal to the minimum level.

$$\left.\frac{\partial(\text{Access to electricity growth}_{\text{i.t}})}{\partial(\text{FDIs per capita}_{\text{i,j,t}-1})}\right|_{\substack{(Institutional\ quality\ host_{i,t-1})_{min} \\ (Institutional\ quality\ home_{J,t-1})_{min}}}$$

$$-\left.\frac{\partial(\text{Access to electricity growth}_{\text{i.t}})}{\partial(\text{FDIs per capita}_{\text{i,j,t}-1})}\right|_{\substack{(Institutional\ quality\ host_{i,t-1})_{min} \\ (Institutional\ quality\ home_{J,t-1})_{max}}} =$$

$$+\beta_5\left[(Institutional\ quality\ home_{\,j,t-1})_{min} - (Institutional\ quality\ home_{\,j,t-1})_{max}\right] = \omega$$

$$H_0 \quad \omega = 0 \quad ; \quad H_a \quad \omega > 0 \qquad (3)$$

Following the literature on dynamic panel data models (Arellano & Bond, 1991; Arellano & Bover, 1995; Blundell & Bond, 1998; Roodman, 2009), we adopt the Generalized Method of Moments (GMM) estimator. In order to deal with the endogeneity problems coming from the lagged-dependent variable and the potential correlation of the explanatory variables with the error term we utilize the Arellano-Bover/Blundell-Bond estimator; i.e., the

system-GMM estimator (Arellano & Bover, 1995; Blundell & Bond, 1998). This estimator instruments the lagged-dependent variable and any other similarly endogenous variables with variables uncorrelated with fixed effects, dramatically improving estimates efficiency (Roodman, 2009). In addition, a two-steps system GMM (SYST-GMM) is adopted, because it results in more asymptotically efficient estimates than one-step method (Baltagi, 2005). The bias in the two-steps standard errors is fixed by Windmeijer's (2005) correction procedure. Specifically, we control for the endogeneity of *FDIs per capita, institutional quality host, industry value added, services value added, LIC, LMIC*. We consider pre-determined the following variables: *population*, *rural population* and *population density*. We hold the *year dummies* and *institutional quality home* as exogenous variables. Finally, we add some external instruments, i.e., level of country's globalization and of human capital, internal ethnic and religious tensions, and other aspects of economic development that we did not insert in the model. We deal these external instruments as pre-determined variables[18].

In order to prove the robustness of our findings we also carried out our model with the bias-corrected Least Square Dummy Variable (corrected LSDV) estimator (Bruno, 2005; Kiviet, 1995). This estimator has the drawback that relies on the assumption that all other regressors other than the lagged-dependent variable are uncorrelated to any time-varying unobserved heterogeneity (Garrone & Grilli, 2010). However, its advantage is that it corrects the endogeneity bias of the lagged dependent variable without the use of any instrumental variables[19].

Descriptive Statistics and Correlations

[18] The level of country's globalization is proxied by the *KOF index of globalization* introduced by Dreher (2006), from the KOF Swiss Economic Institute. The level of human capital is proxied by the *human flight and brain drain variable* (Source: Fund for Peace). The internal tensions are represented by the variable *group grievance* (Source: Fund for Peace). At last, the economic development is caught by the variable *poverty and economic decline* (Source: Fund for Peace) that aggregates dimensions such as unemployment, youth unemployment, economic deficit, government depth, inflation, purchasing power and GDP growth. We also consider using the Human Development Index, developed by World Bank, as external instrument to catch economic and social dimensions, but it was affected by a problem of missing data, i.e., 25% of missing. For this reason, we prefer to adopt the variables *poverty and economic decline* and *group grievance* that have not this problem.

[19] The Stata command for the corrected LSDV estimator does not allow having a different dependent variable at right and left side of the equal, as in our model. For this reason, the coefficient of the lagged dependent variable is obtained with a post-estimation computation.

Tables 3 and 4 display the correlation matrix and the descriptive statistics of our model variables, respectively. In Table 4, we notice that *access to electricity* varies from the worst case of Republic Democratic of Congo, where in 2005 and 2006 only 5.8% of population had access to electricity, to the best case of Mauritius, where, in 2010, 100% of population had access to electricity.

[insert Table 3 about here]

[insert Table 4 about here]

IV. RESULTS

Tables 5 and 6 show estimates obtained with SYST-GMM and corrected LSDV estimators. Table 5 contains six Models computed with the SYST-GMM. The first model is our baseline and contains only control variables and the lagged dependent variable in level (Model 1), then from Model 2 to 6 one-by-one all explanatory variables and the interaction terms are added. For sake of synthesis, in Table 6 are reported only the results of the most complete model obtained with corrected LSDV estimator[20]. The section is structured as follows. First, we describe the results of explanatory variables and interaction terms, then of control variables and finally of marginal effects used to test our hypotheses (see Table 7).

[insert Table 5 about here]

[insert Table 6 about here]

[insert Table 7 about here]

In all Models of Tables 5 and 6, the lagged dependent variable in level (*access to electricity* $_{i,\,t-1}$) is negative and significant. This means that the higher the access to electricity rate at time t-1, the lower the growth rate of the access to electricity at time t. In Model 2 of Table 5, we add the *institutional quality host* variable. In line with our theoretical background, we find that local institutions matter in raising the access to electricity

[20] Results of the intermediate models are available upon request from the authors.

(magnitude of 1.8468 and p<.1). This effect becomes even more significant when we consider the most complete Model 6 (magnitude of 0.0049 and p<.05). In Model 3 of Table 5, we linearly add the *FDIs per capita* variable but we do not find any evidence of the impact of *FDIs per capita* on the *access to electricity growth*. However, when we introduce the interaction term between *FDIs per capita* and *institutional quality host* (Model 4 of Table 5), we find that *FDIs per capita* positively affect *access to electricity growth*, (coefficient of *FDIs per capit*a is 0.0049 and p<.05). This positive effect is strengthen when host institutions are weak, i.e., coefficient of the interaction term *FDIs per capit*a**institutional quality host* is -0.0056 and p<.05. In Model 5, we linearly introduce the *institutional quality home* variable, but it has a positive but not significant impact on the *access to electricity growth*. Finally, Model 6 of Table 5 and Model 1 of Table 6 show the results obtained respectively with SYST-GMM and corrected LSDV estimators for the most complete model where we insert our explanatory variables linearly and the interaction terms. Estimates show that *FDIs per capita* foster the access to electricity in countries affected by institutional voids (coefficient of the interaction term *FDIs per capita*Institutional quality host* is -0.0046 and p<.05 with SYST-GMM and -0.0011 and p<.1 with corrected LSDV). Furthermore, with corrected LSDV estimator, we find that the impact of *FDIs per capita* becomes stronger when FDIs come from institutional weak countries (magnitude of the interaction term *FDIs per capita* Institutional quality home* is -0.0052 and p<.01). Nevertheless, in order to test our hypotheses it is also important to compute the marginal effects. Results of this computation are discussed after the following session about outcomes obtained for control variables.

Across all models, most of control variables maintain steady sign and significance when SYST-GMM is used (see Table 5). Some slight differences in sign and significance emerge between results obtained with SYST-GMM and corrected LSDV estimator[21]. This difference comes out mainly because with the latter estimator all control variables are considered strictly exogenous. For this reason and for sake of synthesis we present in details only results obtained for the most complete model with SYST-GMM estimator (see Model 6 in Table

[21] With corrected LSDV estimator, controls have values similar to the ones obtained with SYST-GMM estimator. Differences are that variables *population density* and *industry* and *services value added* have the same sign but are not significant, and that variable *population* is negative and not significant.

5). Namely, *population* and *population density* have a positive and significant impact on the *access to electricity growth* (for population the coefficient is 0.1425 and p<.01 while for population density the coefficient is 0.0534 and p<.01). On the contrary, *rural population* is a high barrier to the improvement of access to electricity (magnitude of -0.4420 and p<.01). The level of economic development of the host country strongly affects the *access to electricity growth*. Indeed, historical trends show that when households increment their income, first, they use them for heating and lighting in addition to food, education and, health (IEA, 2014; Paul & Bhattacharya, 2004, p. 980). For this reason, it is not surprising that the dummy *LIC* has a strong and negative impact on the *access to electricity growth* (magnitude of -12.0008 and p<.01). On the contrary, dummy *LMIC* has a negative coefficient but it is not significant. Finally, *industry value added* coefficient is not significant while *services value added* positively affect the *access to electricity growth* (magnitude of 0.2898 and p<.05). If the endogeneity of the economic structure of a country is controlled, we learn that this is tied to its stage of economic development (Medlock & Soligo, 2001; UNIDO, 2007) and it is reasonable to assume that a higher level of services valued added correspond to a higher economic development, which, as demonstrated before, foster the access to electricity.

Finally, in order to test our hypotheses it is important to compute the marginal effects, as explained in the methodology section (see Table 7). Hypothesis 1 is strongly confirmed by both estimators, i.e., with SYST-GMM the coefficient is 0.0164 and p<.05 while with corrected LSDV estimator coefficient is 0.0075 and p<.05. Hypothesis 2 is also verified but only by the corrected LSDV, i.e., coefficient 0.0207 and p<.001; with SYST-GMM the coefficient is positive but not significant[22].

[22] To better understand the role played by FDIs in fostering the access to electricity growth based on the quality of host and home institutions we also run our model using the single WGIs instead of the factorial variables *institutional quality host* and *home*. We find that not all institutional dimensions have the same impact; specifically, *FDIs per capita* have a crucial role in fostering the *access to electricity growth* when the host country has a low *control of corruption*, *governance effectiveness* and *voice and accountability* and when FDIs come from countries with low *political stability* and *voice and accountability*. Results are available upon request from the authors.

V. ROBUSTNESS CHECKS

We test the robustness of our findings in several ways.

As explained in Section III, our dependent variable, *access to electricity*, has a high number of imputed data, for this reason we replace it with the *use of traditional biomass* variable (Source: IEA), which has a lower number of missing data, i.e., 16%. Indeed, following the guidelines provided by IEA the "definition of energy access also includes provision of cooking facilities which can be used without harm to the health of those in the household and which are more environmentally sustainable and energy efficient than the average biomass cookstove currently used in developing countries. This definition refers primarily to biogas systems, liquefied petroleum gas (LPG) stoves and improved biomass cookstoves that have considerably lower emissions and higher efficiencies than traditional three-stone fires for cooking" (IEA, 2013). In addition, the two variables are highly correlated (coefficient of -0.86 and $p<.01$), and this justifies the adoption of *use of traditional biomass* variable even from an empirical point of view. Tables 8 and 9 display findings obtained with *use of traditional biomass* as dependent variable with SYST-GMM and corrected LSDV estimators and the results of marginal effects. It is important to specify that, due to the negative correlation between *use of traditional biomass* and *access to electricity*, H_a has an inverted sign compared to the formulas (2) and (3), presented in Section III.

[insert Table 8 about here]

[insert Table 9 about here]

With SYST-GMM we do not have significant results. On the contrary, with the correct LSDV we find that *FDIs per capita* reduce the growth of *use of traditional biomass* mainly when they come from less-developed institutional countries and when the host country has weak regulatory and formal institutions. In conclusion, even with this alternative dependent variable our two hypotheses are confirmed, even though only with the corrected LSDV estimator.

In order to measure the quality of regulatory and formal institutions we rely on the WGIs, widely used in the literature (e.g., Cuervo-Caruzza & Genc, 2008; Farla et al., 2014; Hernandez & Jesus Nieto, 2015). These indicators are drawn from different types of sources, such as surveys on households and firms, commercial business information providers, non-governmental organizations and public sector organizations (Kaufman et al., 2011). However, in in the recent years many scholars believe that the new frontier of economics studies passes by the use of big data (Einav & Levin, 2014; George, Haas & Pentland, 2014). With the term big data, we refer to a large volume of data that can be collected rapidly and with a greater coverage and scope (Einav & Levin, 2014). In line with this new approach, in 2005 the FFP, started using big data, extracted from several sources, to build-up the Fragile State Index (FSI), composed by twelve indicators of state vulnerability classified in three main categories, i.e. social, economic and, political and military pressures. To test the robustness of our results we replace the WGIs with the indicators of political and military pressure of FFP that, in our opinion, well represent the different dimensions of regulatory and formal institutions. Specifically, they are state legitimacy, state ability to provide public services, presence of factionalized elites, interventions from external actors, human rights and, rule of law and security apparatus (FFP, 2011). Following the guidelines provided by FFP, we create a unique indicator, called political strength, which is the inverse of the sum of the six previously mentioned indicators; it ranks from 1 to 60. Tables 10 and 11 show results obtained by adopting political strength variable as proxy of host and home country institutional quality and the related marginal effects.

[insert Table 10 about here]

[insert Table 11 about here]

Results are in line with the ones obtained with WGIs, bringing robustness to our empirical findings. Specifically, hypothesis 1 is strongly confirmed by both estimators, i.e., SYST-GMM and corrected LSDV, while hypothesis 2 is only confirmed by corrected LSDV.

VI. DISCUSSION AND CONCLUSIONS

In this paper, we study if MNEs can promote access to electricity for local communities in developing countries affected by institutional voids (Khanna & Palepu, 1997; Boddewyn & Doh, 2011), and how the effectiveness of

their intervention changes based on their country of origin. With this work, we want to join the on-going debate on the role of MNEs on the development of local context, mainly in developing countries, and contribute to several body of theories, such as institutional theory and MNEs behavior, MNEs' legitimacy mechanisms and liability of origin and, institutional theory and provision of collective goods.

Namely, our hypotheses state as follows. In developing countries where governments are affected by institutional voids and are not able to provide collective goods, such as electricity (Khanna & Palepu, 1997; Boddewyn & Doh, 2011), MNEs can partially fill these voids by hasting the access to electricity for the local population. They can do it mainly through the development of electricity infrastructures, i.e., on-grid and mini-grid systems (IEA, 2014) that they need to run their own business (Boddewyn & Doh, 2011; IEA, 2013; Khadarooa & Seetanah, 2010; Robbins & Perkins, 2012; Valente & Crane, 2010) and to gain legitimacy with local population, essential to overcome their liability of been foreign (Kostova & Zaheer, 1999; North, 1990; Zaheer, 1995). Nevertheless, the impact of MNEs is stronger when they come from weak-established institutional home countries. First, because these MNEs already developed at home the managerial expertise required to operate in this context (Cuervo-Cazurra, 2008; Eriksson et al., 1997). Secondly, because the development of electricity infrastructures can be an instrument for these MNEs to overcome their liability of origin, originated from the low quality of their home-country institutions and the consequently lack of credibility between host country stakeholders (Cuervo-Cazurra & Ramamurti, 2014; Kostova & Zaheer; Ramachandran & Pant, 2010).

Sub-Saharan Africa has been identified as an ideal test-bed. Indeed, in the last years, many MNEs invested in this region, attracted by its economic growth (UNCTAD, 2014), while, in 2013, 32% of population still did not have access to electricity (IEA, 2014). Our sample is composed by 83 worldwide home countries and 15 sub-Saharan host countries, observed from 2005 to 2011 and we perform an econometric analysis adopting panel data techniques. In order to have robust and consistent results we run our model with two different estimators, i.e., SYST-GMM and corrected LSDV, and we carry out several robustness tests. Specifically, we run our model with different institutional variables, i.e., WGIs and FFP's indicators, and with two proxies of access to modern energy services, i.e., household access to electricity and use of traditional biomasses. Across all cases, our results are stable and confirm our hypotheses: in countries affected by institutional voids, MNEs promote the access to

electricity for local population and this is more likely to be true if they come from other institutional weak countries.

Other interesting findings come out from our empirical analysis. First, we confirm that low population density and high rate of rural population are a high barrier to the diffusion of access to electricity, in line with last estimates data by IEA (IEA, 2014). Indeed, in countries with low domestic savings rates and tax revenues and high percentage of rural population, such as sub-Saharan countries (IEA, 2014), the development of national grid systems (i.e., on-grid solution) is too expensive. For this reason, specific strategies and technical solutions for rural communities should be considered, e.g., off-grid or mini-grid (IEA, 2014). On the contrary, the size of the country positively affects the access to electricity growth, mainly because, as urban economists suggest (e.g., Fujita, 1989), "the provision of many public services and facilities, such as schools, hospitals, utilities, and highways" and thus electricity infrastructures, "typically exhibits the characteristic of economies of scale" (Fujita, 1989, p.135). As expected, the stage of the economic development of a country and the related economic structure matter. Indeed, the poorest countries, i.e., low-income countries, which are generally more dependent from agriculture and have less developed industry and services sectors (Medlock & Soligo, 81), are the most affected by a shortage of access to electricity.

The present work suffers from some limitations that we would like to point out. One issue is the lack of complete streams of data for sub-Saharan countries, which required the imputation of missing data. Additionally, current lack of data precludes also the distinction between FDIs in different sectors, which may actually lead to different degree of self-provision of electricity infrastructure development. Furthermore, it would be also interesting to investigate how the effect of MNEs changes depend not only on the level of institutional but also economic development of the host country. Finally, this paper focus only on the lack of strong regulatory and formal institutions, a further step would be taking into account also the informal ones (North, 1990; Scott, 1995). All these issues certainly rank high in our research agenda.

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TABLES

Table 1. Characteristics of electricity provision in sub-Saharan Africa.

Electricity Provision System (IEA, 2014)	Technological Solution (IEA, 2014)	Target Population (IEA, 2014)	Utility Features (Spiller, 1995)			MNEs Engagement Possible Channels (Ostrom et al., 1993 pp. 29-41)
			Widespread domestic consumption	Economies of scale and scope	Specific investment	
On-grid systems (large international, national and regional grids)	Large Solar Photovoltaics Farms Gas - Gas Turbines Plants Gas - Combined Cycle Gas Turbines Plants Onshore Wind Farms Large Hydropower Plants Coal Plants	Urban, Peri-Urban, Growing demand areas	Yes	Yes	Yes	Infrastructure planning, financing, constructing (greenfield or repowering), operating or maintaining
Distributed small scale systems ***Mini - grid systems***	Small Solar Photovoltaics Plants Small Hydropower Plants Small Wind Plants	Rural	Yes	Yes/No	Yes	Infrastructure planning, financing, constructing (greenfield or repowering), operating or maintaining
Off - grid systems	Stand-Alone Generators (fuelled by diesel or gasoline)	Rural	No	No	Yes/No	No engagement

Table 2. Description and sources of model variables.

VARIABLES	SOURCE
Access to electricity (% of total population)	International Energy Agency
FDIs per capita	United Nations Conference on Trade and Development
Institutional quality host	World Bank
Institutional quality home	World Bank
Population	World Bank
Rural population (% of total population)	World Bank
Population density (people per sq. km of land area)	World Bank
Industry value added (% of GDP)	World Bank
Services value added (% of GDP)	World Bank
Dummy Low-Income Country (LIC)	World Bank
Dummy Lower-Middle Income Country (LMIC)	World Bank

Table 3. Correlation matrix.

	VARIABLES	1	2	3	4	5	6	7	8	9	10	11
1	Access to electricity	1										
2	FDIs per capita	0.112**	1									
3	Institutional quality host	0.783**	0.100**	1								
4	Institutional quality home	-0.088**	0.046	-0.110**	1							
5	Population	-0.121**	-0.117**	-0.185*	-0.034	1						
6	Rural population	-0.015	-0.004	-0.060	0.025	0.192**	1					
7	Population density	0.619**	0.170**	0.568**	0.013	-0.469**	-0.027	1				
8	Industry value added	-0.162**	-0.013	-0.339**	0.020	-0.267**	-0.022	-0.283**	1			
9	Services valued added	0.633**	0.072**	0.761**	-0.088**	0.123**	-0.006	0.402**	-0.588**	1		
10	Dummy Low-Income Country (LIC)	-0.591**	-0.071**	-0.460**	0.094**	0.212**	0.060*	-0.164**	-0.419**	-0.293**	1	
11	Dummy Lower-Middle Income Country (LMIC)	-0.222**	-0.009	-0.438**	0.070**	-0.219**	-0.014	-0.188**	0.488**	-0.535**	-0.240**	1

Year and country-pair dummies not included

* Correlation is significant at 0.05 level

** Correlation is significant at 0.01 level

Table 4. Descriptive statistics.

VARIABLES	Obs.	Mean	s.d.	Min	Max
Access to electricity	1547	58.908	28.066	5.800	100
FDIs per capita	1547	181.812	1496.379	0.035	39379.230
Institutional quality host	1547	0	1	-2.495	1.269
Institutional quality home	1547	0	1	-2.582	1.383
Population	1547	29.209	24.546	1.200	160
Rural population	1547	50.696	16.465	13.852	86.752
Population density	1547	170.757	205.002	2.462	633.523
Industry value added	1547	32.788	13.738	10.390	77.414
Services valued added	1547	55.229	14.118	18.909	70.939
Dummy Low-Income Country (LIC)	1547	0.279	0.448	0	1
Dummy Lowe-Middle Income Country (LMIC)	1547	0.130	0.336	0	1

Table 5. Estimates, SYST-GMM estimator.

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Access to electricity t-1	-0.6706***	-0.6881***	-0.6889***	-0.6937***	-0.7422***	-0.7423***
	(0.063)	(0.065)	(0.065)	(0.065)	(0.069)	(0.070)
Institutional quality host t-1		1.8468*	1.9306*	2.0648*	0.0046*	0.0049**
		(1.088)	(1.087)	(1.079)	(0.002)	(0.002)
FDIs per capita t-1			0.0001	0.0049**	1.8367	1.7575
			(0.001)	(0.002)	(1.196)	(1.235)
FDIs per capita t-1 * Institutional quality host t-1				-0.0056**	-0.0050**	-0.0046**
				(0.002)	(0.002)	(0.002)
Institutional quality home t-1					0.2147	0.2925
					(0.352)	(0.389)
FDIs per capita t-1 * Institutional quality home t-1						-0.0013
						(0.002)
Population t-1	0.1160***	0.1349***	0.1370***	0.1401***	0.1424***	0.1425***
	(0.032)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
Rural population t-1	-0.4206***	-0.4066***	-0.4081***	-0.4033***	-0.4379***	-0.4420***
	(0.087)	(0.085)	(0.085)	(0.085)	(0.092)	(0.095)
Population density t-1	0.0514***	0.0510***	0.0512***	0.0520***	0.0532***	0.0534***
	(0.007)	(0.008)	(0.007)	(0.008)	(0.008)	(0.008)
Industry value added t-1	-0.2895***	-0.2361**	-0.2329**	-0.2588**	-0.1403	-0.1384
	(0.090)	(0.099)	(0.097)	(0.101)	(0.119)	(0.117)
Services value added t-1	0.1168	0.0919	0.0892	0.0963	0.2855**	0.2898**
	(0.091)	(0.091)	(0.092)	(0.092)	(0.117)	(0.119)
Dummy low income country (LIC)	-15.3400***	-13.9427***	-13.8315***	-14.0651***	-12.0648***	-12.0008***
	(2.655)	(2.847)	(2.749)	(2.832)	(3.379)	(3.368)
Dummy lower middle income country (LMIC)	-2.4992	-1.3541	-1.3145	-1.3451	0.8223	0.8809
	(1.920)	(2.022)	(1.990)	(2.033)	(2.473)	(2.487)
Constant	59.7517***	58.9124***	54.0819***	58.9678***	48.2732***	48.1236***
	(9.466)	(9.565)	(9.537)	(9.670)	(10.370)	(10.262)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,326	1,326	1,326	1,326	1,105	1,105
Number of pair countries	221	221	221	221	221	221
AR(1)	-5.4293	-5.4132	-5.4101	-5.3690	-4.8606	-4.8680
AR(2)	1.1073	1.1117	1.1120	1.0605	0.3824	0.3863
Wald test	217.0206	217.9898	220.8259	220.9698	220.8573	220.7759

Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10. Two-steps system GMM. Robust standard errors in parentheses.
All AR(1) test statistics statistically significant at 1% level; all AR(2) test statistics statistically insignificant. All Wald test statistics statistically insignificant.

Table 6. Estimates, corrected LSDV estimator.

VARIABLES	(1)
Access to electricity t-1	-0.9627***
	(0.069)
Institutional quality host t-1	3.2124
	(2.476)
FDIs per capita t-1	0.0047**
	(0.002)
FDIs per capita t-1 * Institutional quality host t-1	-0.0011*
	(0.001)
Institutional quality home t-1	6.5806***
	(0.909)
FDIs per capita t-1 * Institutional quality home t-1	-0.0052***
	(0.001)
Population t-1	-0.0102
	(0.014)
Rural population t-1	0.0849**
	(0.033)
Population density t-1	0.0018
	(0.006)
Industry value added t-1	-0.2085***
	(0.069)
Services value added t-1	0.1283
	(0.119)
Dummy low income country (LIC)	-8.6780*
	(5.219)
Dummy lower middle income country (LMIC)	0.1197
	(2.082)
Year fixed effects	Yes
Country-pair fixed effects	Yes
Observations	1,326
Number of pair countries	221

Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10. Bias corrected LSDV. Standard errors in parentheses.

Table 7. Marginal effects, Access to electricity growth.

MARGINAL EFFECTS FDIs per capita → Access to electricity growth	(1) SYST - GMM	(2) Corrected LSDV
Hypothesis 1	0.0164**	0.0075**
	(0.008)	(0.004)
Hypothesis 2	0.0052	0.0207***
	(0.009)	(0.004)

Model (1). Two-steps system GMM. Robust standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.
Model (2). Bias corrected LSDV. Standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.

Table 8. Estimates, Use of traditional biomass growth

VARIABLES	(1) SYST - GMM	(2) Corrected LSDV
Use of traditional biomass t-1	-0.4404***	-0.8805***
	(0.171)	(0.045)
FDIs per capita t-1	-0.0038	-0.0074***
	(0.007)	(0.002)
Institutional quality host t-1	-3.6856	-6.4583***
	(2.465)	(1.060)
FDIs per capita t-1 * Institutional quality host t-1	0.0030	0.0051***
	(0.005)	(0.001)
Institutional quality home t-1	-0.2496	-0.6070
	(1.314)	(0.693)
FDIs per capita t-1 * Institutional quality home t-1	-0.0010	0.0001***
	(0.004)	(0.000)
Population t-1	-0.0252	-0.0520***
	(0.051)	(0.007)
Rural population t-1	0.1568	-0.0529**
	(0.106)	(0.026)
Population density t-1	-0.0071	0.0234***
	(0.017)	(0.004)
Industry value added t-1	-0.0267	-0.0077
	(0.201)	(0.074)
Services value added t-1	-0.1823	0.1435
	(0.219)	(0.092)
Dummy low income country (LIC)	10.5206***	-0.9576
	(3.405)	(3.797)
Dummy lower middle income country (LMIC)	3.3604	-2.4810**
	(2.844)	(1.171)
Constant	16.4292	
	(22.864)	
Year fixed effects	Yes	Yes
Country pair fixed effects	Yes	Yes
Observations	1,105	1,326
Number of pair countries	221	221
AR(1)	-4.0881	
AR(2)	-0.0740	
Wald test	220.0635	

Model (1). Two-steps system GMM. Robust standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.
All AR(1) test statistics statistically significant at 1% level; all AR(2) test statistics statistically insignificant.
All Wald test statistics statistically insignificant

Model (2). Bias corrected LSDV. Standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.

Table 9. Marginal effects, Use of traditional biomass growth.

MARGINAL EFFECTS FDIs per capita → Use of traditional biomass growth	(1) SYST - GMM	(2) Corrected LSDV
Hypothesis 1	-0.0113	-0.0166***
	(0.018)	(0.004)
Hypothesis 2	0.0039	-0.005*
	(0.015)	(0.003)

Model (1). Two-steps system GMM. Robust standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.
Model (2). Bias corrected LSDV. Standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.

Table 10. Estimates, political strength (Fund for Peace)

VARIABLES	(1) SYST – GMM	(2) Corrected LSDV
Access to electricity t-1	-0.7582***	-0.9341***
	(0.061)	(0.065)
Political strength host t-1	0.0241***	0.0264***
	(0.009)	(0.009)
FDIs per capita t-1	0.6738***	-0.1371
	(0.124)	(0.234)
FDIs per capita t-1 * Political strength host t-1	-0.0005*	-0.0006*
	(0.000)	(0.000)
Political strength home t-1	0.0251	0.0721***
	(0.034)	(0.002)
FDIs per capita t-1 * Political strength home t-1	-0.0001	-0.0001***
	(0.000)	(0.000)
Population t-1	0.1324***	-0.0280**
	(0.035)	(0.013)
Rural population t-1	-0.3045***	0.1029***
	(0.100)	(0.037)
Population density t-1	0.0455***	0.0035
	(0.008)	(0.003)
Industry value added t-1	-0.0679	-0.2793***
	(0.097)	(0.053)
Services value added t-1	0.2194**	0.1736*
	(0.110)	(0.089)
Dummy low income country (LIC)	-9.3903***	-9.6922**
	(2.646)	(4.736)
Dummy lower middle income country (LMIC)	4.0223*	-0.5907
	(2.207)	(1.268)
Constant	22.9551**	
	(11.501)	
Year fixed effects	Yes	Yes
Country-pair fixed effects	Yes	Yes
Observations	1,105	1,326
Number of pair countries	221	221
AR(1)	-5.0002	
AR(2)	0.2408	
Wald test	220.7460	

Model (1). Two-steps system GMM. Robust standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.
All AR(1) test statistics statistically significant at 1% level; all AR(2) test statistics statistically insignificant.
All Wald test statistics statistically insignificant
Model (2). Bias corrected LSDV. Standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.

Table 11. Marginal effects, political strength (Fund for Peace).

MARGINAL EFFECTS FDIs per capita → Access to electricity growth	(1) SYST - GMM	(2) Corrected LSDV
Hypothesis 1	0.0178**	0.0197**
	(0.008)	(0.009)
Hypothesis 2	0.0067	0.0071***
	(0.005)	(0.001)

Model (1). Two-steps system GMM. Robust standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.

Model (2). Bias corrected LSDV. Standard errors in parentheses. Two-tailed test: *** p<0.01, ** p<0.05, * p<0.10.

APPENDIX

Appendix 1. List of home and host countries of our dataset.

HOME COUNTRIES			HOST COUNTRIES
Angola	Israel	Saudi Arabia	South Africa
Argentina	Italy	Seychelles	Ghana
Aruba	Japan	Singapore	Mauritius
Australia	Kenya	Slovenia	Angola
Austria	Korea, Rep.	South Africa	Cameroon
Bahamas, The	Lebanon	Spain	Congo, Rep.
Bahrain	Liberia	Sri Lanka	Congo, Dem. Rep.
Belgium	Libya	Swaziland	Gabon
Bermuda	Liechtenstein	Sweden	Kenya
Botswana	Luxembourg	Switzerland	Uganda
Brazil	Madagascar	Taiwan, China	Eritrea
Bulgaria	Malawi	Tanzania	Ethiopia
Canada	Malaysia	Thailand	Botswana
Cayman Islands	Maldives	Togo	Namibia
China	Malta	Turkey	Nigeria
Cote d'Ivoire	Mauritius	United Kingdom	
Cyprus	Morocco	United States	
Czech Republic	Mozambique	Uganda	
Denmark	Namibia	United Arab Emirates	
Finland	Netherlands	Uruguay	
France	New Zealand	Yemen, Rep.	
Germany	Nigeria	Zambia	
Ghana	Norway	Zimbabwe	
Greece	Pakistan		
Hong Kong SAR, China	Panama		
Hungary	Paraguay		
Iceland	Philippines		
India	Poland		
Indonesia	Portugal		
Ireland	Russian Federation		