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THE RELATIONSHIP BETWEEN FINANCIAL DEVELOPMENT AND PRIVATE INVESTMENT COMMITMENTS IN ENERGY PROJECTS

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This paper investigates the extent to which the level of development of country's financial sector draws private participation in energy projects' financing in a 1990-2007 dataset on 56 developing countries. We find that a financial sector that offers proper financing and risk-mitigating instruments indeed contributes to improving private participation. Macroeconomic development and stability and greater energy needs are also found to be significant determinants of a country's appeal to private investors. While country risk dampens investors' will to participate in energy projects, higher interest rate and exchange rate risk do not seem to divert them away.

Keywords: Infrastructure; Energy, Public-private Partnership, Financial Development, Growth, Panel Data
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1. INTRODUCTION

In the last decade, many countries in the developing world have experienced noticeably high economic growth while facing the challenges of rapid urbanization,

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demographic trends, climate change, and the induced increase in economic activity.[1] However, some observers have come to the conclusion that to sustain such growth prospects these countries would need to accelerate investment to rehabilitate, upgrade, and expand their infrastructures.[2] Sustaining good quality of infrastructure service delivery requires a better composition of the infrastructure stock, a good level of maintenance, and an appropriate sequencing of institutional reforms across sectors, along with a modernization of the financial sector (OECD, 2014). Given their public sector's limited resources, however, developing countries need to improve the quality of public spending in infrastructure as well as to attract more private investment to bridge the investment gap.

Infrastructure projects mobilize lumpy capital, are characterized by high economic stakes and long payback, and are exposed to political, economic and financial risks. Because they deliver future gains in local currency, these projects are usually financed with hard currency, and hence are exposed to currency devaluation and interest rates' volatility. While the private sector is expected to bring financing, expertise and efficiency to infrastructure projects, improving private participation in developing countries is challenging, essentially due to their poor or non-existent credit-worthiness and under-developed financial sectors. With a mix of equity and non-recourse debt, Public-Private Partnerships (PPPs) came to be increasingly viewed as a way of improving private participation in developing countries' infrastructure projects (Platz, 2009). Many of these countries also implemented large-scale reforms of their infrastructure sectors in the late 80s early 90s in an attempt to promote competition and enhance private involvement.

After a sharp decline from relatively high levels in the mid-90s following liberalization reforms, annual private investment in infrastructure in these regions has stabilized in the 11 to 16 billion USD range since 2001 with a debt-equity distribution that significantly varies across regions. For instance, while bonds have become an important tool for financing infrastructure investments in the Latin America and East Asia regions, representing respectively 29% and 14% of investment during the 1996-2004 period, bond financing is nearly non-existent in the Middle East and North Africa region where about 98% of private investment in infrastructure has been in the form of bank loans. Moreover, private participation in developing countries were more concentrated in the telecommunications and energy sectors, which respectively received 44% and 28% of investments in the 1990-2001 period (Kirkpatrick et al., 2006).

[1] Over the 1990-2010 period considered in this paper, the 56 developing countries included in our sample saw their GDP grow at an average rate of 3.7% while for a selection of 32 OECD countries it only grew at an average of 2.5%.

[2] The World Bank suggests that developing countries need to invest approximately 5 to 7% of their GDP in infrastructure to be able to maintain economic growth in the 2008-2115 period at its current average rate of 5%. For a recent survey on the relationship between growth and infrastructure development, see Straub (2008).

Strengthening the capacity of local financial markets to allow debt extension and equity financing with local currency under competitive terms is crucial to accelerating private participation in infrastructure. In the late 80s early 90s, many developing countries sought to develop their financial markets by implementing structural reforms, including removing regulatory bottlenecks and rolling back the interventionist role of the state through privatization of commercial banks, or by strengthening the independence of central banks. However, these efforts to support the financing of infrastructure projects have faced additional difficulties due to the fact that, given the high economic stakes they involve, these projects were exposed to great political interference.

While the need for developing countries to foster investment in infrastructure sectors has been largely emphasized in the literature, the issue of these countries' (limited) capacity to attract private capital remains somewhat weakly explored (see Section 3 below). This paper seeks to contribute to filling this void. More specifically, given the reforms of the financial sector that have been implemented in various developing countries through the 80s and 90s, we seek to test whether the level of development of this sector is a good predictor of the amount of private investment commitments in the financing of infrastructure projects, both when taken globally and when the banking segment and the stock market are separately treated.

Focusing on the energy sector and controlling for institutional environment, we specify random effects regression models for explaining investment with private participation that we fit to a 1990-2007 annual dataset on 56 developing countries. Although public funds, private capital, and donors' aid all play a sizeable role in the financing of infrastructure projects, in this paper we focus on the private participation in the funding of these projects.

This paper is organized as follows. The next section gives an account of this study's motivations. Section 3 provides a review of some representative work on the role of infrastructure in growth and development, its financing, and the determinants of private participation in infrastructure projects. Section 4 discusses the data analyzed in this paper, the main variables of interest, and some of their properties. Section 5 presents the econometric approach used to analyze the data and reports the results. Section 6 concludes and the appendix gives further details on the data and some summary statistics.

2. BACKGROUND AND MOTIVATION

The importance of infrastructure for poverty reduction and long-run economic growth in low-income and developing countries has been highlighted since the 90s and has been since reinforced. In fact, the relationship between infrastructure development and economic growth has been characterized as one of a "virtuous circle" in the sense that a sustainable development in infrastructure is not possible without strong economic

growth and growth is not possible without substantial improvements in the delivery of infrastructure services (The World Bank, 2006).

The popular view is that infrastructure contributes to growth by enlarging markets, reducing trade barriers and economic risk of private investments, and increasing productivity, output, and employment (Prud'homme, 2005; Saidi, 2006). Infrastructure development also contributes to poverty reduction by enhancing the poor's access to local and foreign markets and providing them with better information on market opportunities and ways to improve their standards of living (Jerome, 2011).

As in most parts of the world, infrastructure services in developing countries were traditionally provided by State-owned vertically integrated monopolies.[3] This model became plagued by poor performance due to various factors including political interference, inefficient management, and under-investment despite the fact that the existing infrastructures needed important upgrading and modernization. This situation has made the financing of infrastructure projects very challenging as demand has substantially increased following population growth and large-scale urbanization.

Under limited resources, the public sector in developing countries cannot ensure adequate infrastructure funding together with the operational activities necessary to effectively provide quality of service. To reduce the gap between demand and supply, partnerships between public and private sectors have been increasingly advocated. Public-Private Partnerships (PPPs) became one of the most popular mechanisms used to mobilize private capital for infrastructure projects funding. Indeed, partnerships between the public and private sectors were widely viewed as mechanisms that would allow gathering and channeling the needed amount of resources to sustain growth and alleviate poverty in developing countries. While local currency financing would have been preferred in most cases to avoid exposure to foreign exchange risk, infrastructure projects with private participation are often financed with a mix of hard currency-denominated equity and non-recourse debt.

Stimulating private participation in the provision of infrastructure services is challenging and even more so for low-income and developing countries essentially due to their poor or non-existent sovereign creditworthiness and under-developed financial markets.[4] The World Bank (2006) has highlighted that the susceptibility of projects to governance, corruption, rule of law, and political interference may also alter private investment. Projects design, risks identification and allocation, the availability of risk

[3] The public good nature of infrastructure services, the existence of externalities, and the incompleteness of markets are the main market failures invoked to justify state intervention (Calitz and Fourie, 2010). However, thanks to innovation, an increasing number of infrastructure services are becoming rival and excludable goods thus questioning the necessity of public intervention for supplying them.

[4] Only 16 of 48 African countries have foreign currency debt ratings, and only 4 of these 16 have ratings that give relatively broad access to financial markets (BB- or higher). These 4 countries represent 43% of regional GNI (dominated by South Africa) while this share represents more than two third of regional GNI in other developing regions.

mitigation financial instruments and long-term financing, the institutional and regulatory framework, and the local financial markets' depth and composition are all but some of the key determinants of a country's ability to successfully mobilize private investment (Calitz and Fourie, 2010; Jerome, 2011; Platz, 2009; Saidi, 2006; Sheppard et al., 2006).[5]

Although the depth and composition of local capital markets significantly affects their ability to mobilize capital, their actual capability to provide infrastructure financing depends on other factors, including the size of the domestic economy, the level of income per capita, macroeconomic stability, and the development of contractual savings institutions such as pension funds and life insurance (Sheppard et al., 2006). Estache and Philippe (2012) argue that low private participation in many countries is rather due to poor access to international capital markets and even more so since the recent financial crisis that worsened investors' risk aversion and many commercial banks' lending capacity. All these factors make investing in infrastructure projects economically risky in developing countries and hence alter private investors' confidence and investment decisions.

Many developing countries undertook large-scale reforms of their infrastructure sectors in the late 80s early 90s with the objectives of promoting competition through liberalization, improving regulation, and involving private and foreign actors in infrastructure ownership, management, operations, and service provision. Despite these reforms, however, developing countries still have to enhance private sector involvement in infrastructure financing. Indeed, between 1997 and 2004, they received only a small share of private investment and Africa attracted less non-recourse debt than other regions. Moreover, most of the bond financing in Africa during this period was for South-African projects through local currency issues in the domestic capital markets.

In recent years, commercial banks in developing countries have gained increased exposure to non-recourse project financing in loans clubs or syndicates led by major international banks. Yet, due to their difficulties to mobilize long-term financing, their overall ability to extend long-term loans in local currency to infrastructure PPP projects is significantly impeded (Sheppard et al., 2006). Moreover, bond and secondary markets are embryonic or non-existent in most developing countries and thus cannot offer financial instruments and risk mitigating tools which are required for infrastructure projects. Even though since the mid-90s many developing countries have implemented structural reforms to further deepen their financial sectors, they may have not yet reached the level of development that would significantly catalyze private investment in infrastructure.

To the best of our knowledge, very few empirical analyses have conducted a systematic investigation of the role of the banking sector and stock markets in attracting

[5] South Africa is an exception in the Sub-Saharan African region with a relatively well-developed financial system capable of providing long-term local currency funding for infrastructure projects (Calitz and Fourie, 2010).

private investors in infrastructure projects. Furthermore, most of the studies investigating the determinants of private investment in developing countries have considered private capital flows to the economy as a whole or to all infrastructure sectors, which may make it difficult to draw sector-specific policy implications. In this study, we focus on the energy sector on which we collected data up to 2007, consider first the impact on private investors' decisions to enter this sector of the development of the financial sector as a whole and then investigate the relevance of distinguishing between the banking sector and the stock market in the analysis.

3. SOME RELATED WORK

Let us give a brief account of the findings of some representative studies that are related most to our work before moving on to presenting our empirical strategy. When analyzing the determinants of private investment in the overall economy during the 1970-2002 period for the case of Ghana, Frimpong and Marbuah (2010) find that inflation, real interest rate, and openness have a significant effect on private investment flows both in the short and long run. In contrast, the level of public investment and constitutional law seem to impact private investment only in the short-term while external debt does in the long-term. Pargal (2003) examines the effects of the regulatory framework on private investment in infrastructure in nine Latin American countries from 1980 to 1998 and finds that the liberalization of the investment regime is the most significant institutional determinant of private investment.

In their investigation of the determinants of private investment in infrastructure using a panel dataset on 40 developing countries from 1990 to 2000, Banerjee et al. (2006) highlight that property rights and bureaucratic quality improve private investment while, somewhat surprisingly, countries with higher levels of corruption attract more private participation in infrastructure projects. They argue that bribery may be a way for private investors, multinational corporations in particular, to gain deals or benefit from private gains. More directly related to our work, these authors find that although the development of stock markets has a positive sign its effect on private investment is not statistically significant.

Exploring the factors that influence PPP in infrastructure projects in low and middle income countries using a dataset that spans the 1990-2003 period, Hammami et al. (2006) provide evidence that public debt, high demand and market size, macroeconomic stability, and institutional quality all have a significant impact on PPPs. In particular, less corrupt countries with more effective rule of law receive more private financing. At a more macro level, the analysis of the determinants of private capital flows in 61 developing countries over the period 1970-2003 performed by Kinda (2008) shows a significant positive relationship between physical infrastructure and the level of development of the banking sector as reflected in the volume of credit granted to the private sector.

Kirkpatrick et al. (2006) and Basilio (2010) report similar results for low and middle-income countries (LMICs) using data that span the 1990-2002 and 1990-2007 periods respectively. Kirkpatrick et al. (2006) find that foreign direct investment (FDI) flows significantly increase with good governance and regulation whereas they decrease with exchange rate volatility. Basilio (2010) draws attention to the positive role played by the participation of multi-lateral development agencies (MDAs) on private investors' contribution to infrastructure projects' funding. The author also points out that political risk has an adverse effect on private participation. Unexpectedly, domestic banks' liquid assets are found to dampen the contribution of private investors to project financing, thereby suggesting that some countries rely on foreign investment to compensate local financial institutions' lack of lending capacity.

4. THE DATA

To investigate the importance of a country's financial sector's development on private participation in its energy sector projects' financing, we collected data on the 56 developing countries in Latin America and the Caribbean, Asia, Middle East and North Africa, and Sub-Saharan Africa shown in Table 1 below. Out of these 56 countries, 41 are middle income countries (MIC) with active enough financial sectors so as to allow us to capture any potential effect of overall economic and financial development on private participation.

As shown in the appendix, summary statistics show enough variance in the data so that selectivity bias shouldn't be of a major concern. This said, given data availability constraints and relatively low overall activity of stock markets in developing countries, our empirical results on key policy effects should be taken as "upper-bounds." The most prominent LMICs with active domestic banks in the project finance market are China, India, Malaysia, South Africa, and Thailand. Moreover, a number of these countries implemented sound reforms of their energy and financial sectors during the period covered by our sample in an attempt to attract more private capital.

Table 2 below gives the list of variables on which data have been collected and the expected effects of the explanatory variables. More detailed information on these variables is given in Table A1 in the appendix. The dependent variable of our analysis "Private participation in energy projects" is from The World Bank Public-Private Infrastructure Advisory Facility (PPIAF) database and labeled privpart. For a given country, this variable represents the total investment commitments with private participation in electricity generation, transmission, and distribution projects, on the one hand, and natural gas transmission and distribution projects, on the other hand. Investment amounts are measured at the time of the signature of the Private Participation in Infrastructures (PPI) contract.

Table 1. Countries in the Sample

Country	World Bank Region	World Bank income group
Albania	Europe & Central Asia	Lower middle income
Algeria	Middle East & North Africa	Lower middle income
Argentina	Latin America & Caribbean	Upper middle income
Armenia	Europe & Central Asia	Lower middle income
Bangladesh	South Asia	Low income
Belize	Latin America & Caribbean	Upper middle income
Bolivia	Latin America & Caribbean	Lower middle income
Brazil	Latin America & Caribbean	Upper middle income
Cambodia	East Asia & Pacific	Low income
Cameroon	Sub-Saharan Africa	Lower middle income
Chile	Latin America & Caribbean	Upper middle income
China	East Asia & Pacific	Lower middle income
Colombia	Latin America & Caribbean	Lower middle income
Costa Rica	Latin America & Caribbean	Upper middle income
Cote d'Ivoire	Sub-Saharan Africa	Low income
Dominican Republic	Latin America & Caribbean	Lower middle income
Ecuador	Latin America & Caribbean	Lower middle income
Egypt	Middle East & North Africa	Lower middle income
El Salvador	Latin America & Caribbean	Lower middle income
Gabon	Sub-Saharan Africa	Upper middle income
Georgia	Europe & Central Asia	Lower middle income
Ghana	Sub-Saharan Africa	Low income
Grenada	Latin America & Caribbean	Upper middle income
Guatemala	Latin America & Caribbean	Lower middle income
India	South Asia	Lower middle income
Indonesia	East Asia & Pacific	Lower middle income
Jamaica	Latin America & Caribbean	Upper middle income
Kazakhstan	Middle East & North Africa	Lower middle income
Kenya	Sub-Saharan Africa	Low income
Latvia	Europe & Central Asia	Upper middle income
Lithuania	Europe & Central Asia	Upper middle income
Malaysia	East Asia and Pacific	Upper middle income
Mexico	Latin America & Caribbean	Upper middle income
Moldova	Europe and Central Asia	Lower middle income
Morocco	Middle East & North Africa	Lower middle income
Nepal	South Asia	Low income
Nigeria	Sub-Saharan Africa	Low income
Pakistan	South Asia	Low income
Panama	Latin America & Caribbean	Upper middle income
Peru	Latin America & Caribbean	Lower middle income
Philippines	East Asia and Pacific	Lower middle income
Senegal	Sub-Saharan Africa	Low income
South Africa	Sub-Saharan Africa	Upper middle income
Sri Lanka	South Asia	Lower middle income
Tanzania	Sub-Saharan Africa	Low income
Thailand	East Asia and Pacific	Lower middle income
Tunisia	Middle East & North Africa	Lower middle income
Turkey	Europe & Central Asia	Upper middle income
Uganda	Sub-Saharan Africa	Low income
Ukraine	Europe & Central Asia	Lower middle income
Uruguay	Latin America & Caribbean	Upper middle income
Venezuela	Latin America & Caribbean	Upper middle income
Vietnam	East Asia & Pacific	Low income
Yemen	Middle East & North Africa	Low income
Zambia	Sub-Saharan Africa	Low income
Zimbabwe	Sub-Saharan Africa	Low income

Table 2. Variables and Designation

Variable	Designation	Expected effect
	Private participation in energy projects	
privpart	Natural logarithm of investment commitments (2010 USD) with private participation in energy projects	
	Financial sector development	
liqliab	Domestic banks liquid liabilities to GDP: measures the absolute size of the banking sector based on liabilities	Positive
smt	Stock market turnover ratio calculated as the ratio of value of shares traded during a period to average market capitalization: measures markets' efficiency	Positive
findev	Overall financial development index: calculated as the 1st principal component of variables liqliab and smt	Positive
	Institutional quality and risk	
countryrisk	Country risk index: measures political, financial, and economic risk. Ranges from 0 to 100 and the higher the rating the lower the risk	Negative
corruption	Corruption index: ranges from 0 to 6 and the higher the score the less corrupt the economic system	Ambiguous
exchrisk	Exchange rate (stability) risk index: ranges from 0 to 10 and the higher the score the lower the risk	Ambiguous
laworder	Law observance index: ranges from 0 to 6 and the higher the score, the better the legal environment	Positive
	Control variables	
gdp	Natural logarithm of real GDP (2000 USD, lagged)	Positive
inflation	Natural logarithm of inflation rate (%, lagged)	Negative
intrate	Real interest rate (%)	Ambiguous
tdlosses	Electricity transmission and distribution losses (% of output): measures the technical the technical efficiency of the electricity network	Positive

Projects are classified in four categories, namely, concessions, divestitures, greenfield projects, management contracts, and lease contracts. A given project is said to have private participation if a private company or investor bears a share of the project's operating risk and we consider projects where private parties have at least 25% participation, except for divestitures which are included with at least 5% of equity owned by private parties. The choice of our dependent variable was essentially dictated by data availability. Indeed, although the variable privpart makes no distinction between public or private financing sources and between domestic or foreign investment, it is, for the best of our knowledge, the only proxy of private participation in infrastructure that is consistently available for panel data analysis. Investment volumes are expressed in 2010 USD and we take the natural logarithm of these volumes.[6]

[6] A more suitable dependent variable would have been private investment in energy projects as a share of GDP, controlling for the volume of public investment to examine any crowding-in or crowding-out effect. Unfortunately, these data are not consistently available for a reliable econometric analysis and investment with private participation as a share of GDP is negligible for our sample countries with relatively little

The selection of control variables was mainly motivated by the need to be able to compare our results to those of existing empirical work and by data availability. The independent variables of main interest are grouped under the label "Financial sector development" and extracted from The World Bank's Financial and Structure database. As pointed out earlier, strengthening the capacity of developing countries' financial sectors so they can extend debt and equity financing instruments denominated in local currency in competitive terms is crucial to accelerating the private sector's involvement in infrastructure.

In this paper, we seek to test the hypothesis that financial development has contributed to the improvement of the energy sector's attractiveness to private investors in developing countries. The index findev measures the overall development of a country's financial sector and is calculated as the first principal component of variables that represent the depth of the banking sector, liqliab, and that of stock markets, smt, respectively. The variable liqliab represents the liquid liabilities of domestic banks as a share of GDP while smt is a market turnover ratio equal to the quotient of total value of traded shares to average market capitalization. Our motivation for using these financial variables' first principal components is parameter parsimony. We should however note that, although they are increasingly used for infrastructure projects financing, bond markets are excluded from our analysis.

In addition to these financial variables, we use some indicators of a country's institutions' quality and risks taken from the International Country Risk Guide (ICRG) database. Indeed, the development of a country's institutions matters for the proper implementation of financial reforms, hence for financial development, which itself is closely related to economic development. The set of variables grouped under the label "Institutional quality and risk" includes countries' level of economic, financial and political risk (countryrisk), exchange risk (exchrisk), degree of corruption (corruption), and observance of law (laworder). High political, financial, and economic risks are factors that may prevent investors from participating in the funding of infrastructure projects. Furthermore, a high exposure to exchange risk may discourage foreign investors especially if domestic financial sectors are not developed enough to offer suitable risk-hedging instruments. In contrast, a well-functional legal system is expected to boost private investors' participation in energy projects as it ensures contracts' enforcement and property rights' protection.[7]

However, it is difficult to predict how investors will react to corruption. Indeed, private investors may be willing to avoid corrupt investment environments as corruption can be expected to increase business uncertainty and operational inefficiencies and raise the cost of doing business. According to the Multilateral Investment Guarantee Agency (MIGA, 2012), corruption is one of the most important factors that may prevent middle

variation (see table A2 in the appendix).

[7] Kaufman et al. (2009) have constructed a more recent dataset on institutional quality but using it would substantially reduce the efficiency of our estimators, as the data are only available starting end of 1996.

to long-term foreign investment in developing countries. However, not entering a market is not always an attractive option for multinational firms, especially in the case of infrastructure sectors where the first entrant can earn a monopoly position. Furthermore, investors may bribe countries' local officials to further protect their investment (Banerjee et al., 2006).

The last four variables falling under the label of "Control variables" in Table 2 are taken from The World Bank World Development Indicators (WDI). The first variable, gdp, stands for real GDP in 2000 USD and measures overall economic development. One would expect that countries with higher GDP should be more appealing to private investors since higher income implies higher purchasing power and projected demand for infrastructure and should increase investment capacity (Banerjee et al., 2006; Pargal, 2003).

The second variable, inflation, is the overall inflation rate in the economy taken as a measure of macroeconomic stability. High inflation is likely to have a negative effect on private investment through both firms' willingness to contribute to infrastructure financing and consumers' ability to pay for services (Banerjee et al., 2006). Moreover, combined with political and financial risk, macroeconomic instability worsens investment uncertainty. As they are likely to be endogenous in our models, we use one-year lagged gdp and inflation as independent variables.

The third variable, intrate, is real interest rate whose effect on private investment is somewhat difficult to anticipate but foreseen to be negative. Indeed, viewed as the opportunity cost of engaging in an investment activity, an increase in real interest rates may make potential investors retreat from infrastructure projects for more profitable ones, which would lead to a decrease in private investment (Gjini and Kukeli, 2012; Pargal, 2003). However, real interest rate can also be viewed as the cost of capital in which case high rates may lead to lower credit to the private sector, hence less deep financial sectors and lower private financing of infrastructure projects.

The fourth and last control variable, tdlosses, captures transmission and distribution losses in the power network as a share of total output, which is meant to measure the level of quality and efficiency of the infrastructure stock. The effect of this variable may be ambiguous as low technical efficiency can draw more private participation but a relatively poor quality of the existing network may also discourage investors (Banerjee et al., 2006).

Table A2 given in the appendix presents some descriptive statistics of the data. We see that, on average, the countries in the sample received 1% of GDP in investment with private participation during the 1990-2007 period of study, with the highest share being for Bolivia in 1998 (27%). Simple correlation coefficients, in particular between the variable representing investment in energy projects with private participation and independent variables, are given in Table 3 below. The variables that are in a strong (linear) relationship with private participation as captured by a relatively high correlation coefficient are findev, smt, gdp, intrate, and exchrisk.

Table 3. Correlation Coefficients

	privpart	findev	liqliab	smt	gdp	inflation	intrate	tdlosses	corruption	countryrisk	exchrisk	laworder
privpart	1.00											
findev	0.25	1.00										
liqliab	0.04	0.76	1.00									
smt	0.31	0.76	0.15	1.00								
gdp	0.56	0.41	0.16	0.43	1.00							
inflation	0.12	-0.26	-0.35	0.01	0.05	1.00						
intrate	0.25	-0.12	-0.13	-0.06	-0.10	-0.10	1.00					
tdlosses	-0.08	-0.18	-0.25	0.03	-0.26	0.10	-0.06	1.00				
corruption	0.03	-0.09	-0.03	-0.07	0.01	0.20	-0.15	-0.20	1.00			
countryrisk	0.01	0.20	0.40	-0.01	0.27	-0.23	-0.20	-0.31	0.18	1.00		
exchrisk	-0.28	0.11	0.19	0.04	0.08	-0.28	-0.21	0.00	-0.18	0.62	1.00	
laworder	0.11	0.20	0.18	0.16	0.06	-0.08	-0.05	-0.13	0.24	0.47	0.16	1.00

This therefore suggests that countries' level of economic and financial development, as well as the level of their interest rates and their exposure to exchange risk may be important determinants of private participation in their energy projects. In contrast, overall country risk, the prevalence of corruption and the electricity network's technical quality do not seem to be directly related to private investors' commitments in developing countries' energy projects. It is also worth noting that multicollinearity does not seem to be an issue, for the correlation coefficients of the independent variables are relatively low.

We however realize that these correlation coefficients give only some naïve indications on the sign and the magnitude of the relationships between our variables of interest. Consequently, we further investigate the robustness of these relationships for the case of the financial variables of interest in this study by means of causality tests. More specifically, we ask whether there exists a causal relationship between private participation in energy projects, the variable privpart, on the one hand, and the variables that proxy financial development, namely, liqliab, smt, and findev on the other hand. To this end, we apply a standard Granger-type causality testing procedure suited for panel data (Hurlin and Dumitrescu, 2012; Zemcík, 2011).

This procedure is built to test with a Wald statistic the "homogenous non causality (null) hypothesis" that a variable x does not cause a variable y. The alternative hypothesis encompasses the possibility that there exists a subset of individuals in the sample with a causality relationship among its elements and another subset without. The results, which are presented in Table A3 in the appendix, confirm the existence of a causal relationship that runs from smt and findev to privpart while opposite causal relationships hold for all the financial variables. These results therefore suggest that these financial development variables may be included as predictors of private participation in energy projects in the econometric regression analysis to which we now turn.

5. EMPIRICAL ANALYSIS

To evaluate how important the development of a country's financial sector is to private investors' decision to enter this country's energy sector, we specify regressions where the natural logarithm of the real volume of investment with private participation in energy projects in 2010 USD is the dependent variable. Part from financial variables, the set of right-hand variables of these regressions comprises variables that capture some important features of the sample countries' macroeconomic and institutional environment defined in Table 2. Of particular interest to us is the role that country risk and the quality of institutions have played in building private investors' confidence.

The empirical strategy is organized around two objectives. First, we investigate whether or not the development of a country's overall financial sector is a good predictor of private participation in its energy sector projects' funding. Then, we further explore the effect, if any, of the financial sector's level of development on private participation by examining the relative weight of the banking sector and the stock market. We tackle the first objective by means of regressions of the following general form that we refer to as the "baseline model" in the remainder of the paper:

$$privpart_{it} = \alpha_0 + \mu_i + \alpha_1 findev_{it} + \sum_{k=1}^{8} \gamma_k X_{it,h} + \varepsilon_{it}, \quad (1)$$

where the indices $i = 1, 2, \cdots, 56$ and $t = 1,\ 2, \cdots, 18$ refer to the country and the year respectively, μ_i is an unobserved fixed-country effect term, the variables $privpart$ and $findev$ are as defined in the previous section, α_0 is a constant term, α_1 is the coefficient associated with the financial development index $findev$, the X_hs are the control variables that are presented in Table 2 under the labels "Institutional quality and risk" and "Control variables," the γ's are their respective coefficients, and ε is an error term.

To achieve the second objective, we disaggregate the measure of overall financial development into its banking and stock markets components as measured by the variables $liqliab$ and smt defined in the previous section. The following general equation is then specified:

$$privpart_{it} = \alpha_0 + \mu_i + \alpha_2 liqliab_{it} + \alpha_3 smt_{it} + \sum_{k=1}^{8} \gamma_k X_{it,h} + \varepsilon_{it}. \quad (2)$$

Given the time-series-cross-sectional nature of our data, we may fit a fixed-effects (FE) or a random-effects (RE) model to these data. While the FE estimator is consistent, it is well known that the RE estimator is more efficient. For the purpose of our analysis though, we discriminate between these two specifications by means of a Hausman test. This test is based on the assumption that in case of no correlation between explanatory variables and the random effects both FE and RE estimators are consistent but FE is not efficient. The results of such a test are reported in Table A4 in the appendix and suggest that a RE specification is more appropriate for our data as we failed to reject the null

hypothesis of no fixed effects. We also tested for the presence of time effects in our models and failed rejecting the null hypothesis of no time effect.[8]

We take the natural logarithm of variables privpart, gdp and inflation to reduce their variations and make them normally distributed. As pointed out earlier, we use one-year lagged values of macroeconomic variables to rule out endogeneity and adjustment lags. We also tested whether our variables contain a unit root through an Im-Pesaran-Shin or Fisher-type unit root test and failed rejecting stationarity. A Durbin-Wu-Hausman test allowed us to confirm explanatory variables' non-endogeneity. Finally, the models are estimated using standard errors that are robust to heteroskedascity and autocorrelation of the error term.

Table 4 below gives the RE parameter estimates of the baseline equation (1) that looks at the effect of the financial sector as a whole while Table 5 reports the estimation results of equation (2) that seeks to disentangle the effects of the banking sector and the stock market. Part from the parameter estimates, these tables report the number of observations actually used in the estimation, Obs., the coefficient of determination, R^2, and the Wald statistic for testing overall goodness-of-fit, W. We note that, because the cross-sectional dimension (number of countries) largely dominates the time-series dimension (number of years) in our data, the values of the R-squared are rather low. However, the values of the Wald statistic show that our models fit quite well the data. We indicate by *, **, and *** respectively significance at the 10%, 5%, and 1% level.[9]

The results of the regression model presented in Table 4 mostly confirm our main intuition. Indeed, the index $findev$, which synthesizes the degree of development of the financial sector, is significantly and positively related to the private participation variable, $privpart$, as could be foreseen based on our preliminary correlation and causality tests (see Tables 3 and A3). This says that the level of development of a country's financial system counts in the decision of private investors to participate in its energy projects. Part from this interesting result, from Table 4 we also see that a 1% increase in gdp yields a 0.46% increase in the volume of investment with private participation. This is consistent with the relatively strong linear relationship between variables gdp and $privpart$ (see Table 3) and with the empirical literature that often claims that higher projected demand and consumers' ability to pay for energy infrastructure services is appealing to private investors (see Basilio, 2010; Kirkpatrick et al., 2006; Pargal, 2003 among others).

[8] Detailed results are available from the authors upon request.

[9] To account for potential dynamics in private participation, we also examined some models that included the lagged dependent variable as an independent variable applying the Arellano-Bover (1995) and Blundell-Bond (1998) system-GMM. The results did not show any evidence of a significant effect of the level of past private participation. We also attempted to improve the models' goodness-of-fit by applying a "multiple imputation" procedure for filling missing data (von Hippel, 2007), but the results obtained (available from the authors upon request) were inconclusive.

Table 4. Overall Financial Development ($findev$) Regression Parameter Estimates

Variable	Coefficient	Std. error
$findev$	0.11*	0.07
gdp	0.46***	0.11
$inflation$	-0.15*	0.09
$intrate$	0.04***	0.01
$tdlosses$	0.05***	0.02
$corruption$	-0.07	0.13
$countryrisk$	0.07***	0.02
$exchrisk$	-0.28***	0.07
$laworder$	0.10	0.14
$intercept$	0.41	2.59
Obs.	256	
R^2	0.36	
W	83.34***	

Another result that shows is that a one point percent increase in the inflation rate diminishes private participation by 0.15%. This suggests that macroeconomic stability is a signal that private investors use in their decision to participate in energy projects in developing countries, an observation made by Banerjee et al. (2006). Also consistent with Banerjee et al. (2006) and Kirkpatrick et al. (2006), we find that higher electricity transmission and distribution losses are associated with higher private participation, hinting that private investors' interest is stronger for countries with higher needs for additional energy provision. It is worthwhile noting that the empirical literature often assumes that the efficiency of networks is also a reasonable proxy for the quality of public investment.

Moreover, we see that countries that are less politically, economically, and financially risky tend to attract more private investors into energy projects. Hence, economic and political instability tend to create an adverse climate for investment. We also note that the variable laworder, which measures the quality of the legal system, has the expected (positive) sign but is not statistically significant. Likewise, although the variable corruption is not statistically significant, it has the same sign as in Banerjee and al. (2006) who conclude that more corrupt countries draw more private participation. This result may also be a consequence of sophisticated price adjustment mechanisms regulating either PPA agreements or end users' power tariffs.

In contrast with Pargal (2003) though, we find that an increase in real interest rates leads to an increase in the volume of investment with private participation. Similarly, the analysis shows that private participation tend to increase with exchange rate risk, hence contradicting an idea sometime put forward in the empirical literature (see, e.g., Kirkpatrick et al., 2006) that high volatility of exchange rate should dissuade foreign private investors from committing to energy projects. Although in line with our preliminary correlation tests, these results deserve a few comments. First, investors willing to participate to these projects' financing may rely on instruments available in international financial markets to hedge risks associated to energy projects.

Second, interest rate and exchange risks are often born by the off-taker or end users in PPPs. Furthermore, PPPs usually include a contractual insurance coverage to mitigate risks, especially those that cannot be controlled by participating parties. For instance, risks coverage is often a pre-condition to banks' contribution to a PPP (OECD, 2014). This explanation is supported by the positive and significant effect of financial development on private participation (see Table 4) as a more developed financial sector offers more equity and debt instruments and risk-hedging tools, thereby improving the attractiveness of energy projects to private investors.

Third, as mentioned earlier, if the interest rate is viewed as the cost of capital, our result only illustrates the property of a standard downward-sloping demand function. Fourth, it is important to bear in mind that around 80% of the investment in developing countries' infrastructure projects comes from foreign investors and that some form of public intervention may be desirable to foster their participation in case an acceptable risk/return profile cannot be achieved. Hence, our result may reflect the fact that these investors have been benefiting from governments and international development agencies guarantees to improve perceived risks (Basilio, 2010). Given that our analysis does not distinguish public and private investments, the most obvious form of public intervention is financial back up.

Finally, although the effect of the variable corruption is not statistically significant in our analysis, the literature provides some empirical evidence that bribery to win large PPI deals and gain important private returns at the expense of public interest may also explain why foreign investors can still choose to contribute to energy projects despite a high exchange risk or the availability of other seemingly more profitable projects (Banerjee et al., 2006). Note that the sign of the coefficient associated with the variable corruption found in our analysis does not contradict the implications of these studies.

The results found so far confirm our conjecture that the development of the financial sector is important to private investors' decision to commit in energy projects in sample countries. To determine which of the banking sector or stock market matters the most, we disaggregate the index $findev$ into its $liqliab$ and smt components and regress the variable that measures energy projects' investment commitments with private participation on these variables, controlling for the institutional and macroeconomic environment. Equation (2) is thus estimated using the same methodology as previously and Table 5 below presents the results obtained.

Table 5 shows that developing countries with a deeper banking sector received more investment with private participation for their energy projects. It appears then that the channel through which the positive effect of overall financial development on private participation in energy projects demonstrated earlier is transmitted is the banking sector. Indeed, consistent with Banerjee et al. (2006) and Kinda (2008), the coefficient associated to the variable liqliab is statistically significant with a one-point increase of the volume of domestic banks liquid liabilities as a share of GDP yielding a 1.1% increase in investment with private participation in energy projects.

The coefficient associated with the variable that measures stock market efficiency,

smt, turns out not to be significant suggesting that, given the embryonic state of most developing countries' stock markets, the attractiveness of their financial systems to private investors basically dwells on the quality of their banking sector. Indeed, one expects domestic funding of large-scale projects to be more banks loans-based, which explains the higher share of foreign investment in developing countries' infrastructure projects (Kirkpatrick et al., 2006). This suggests that a banking sector that permits to mobilize savings hence has a good lending capacity to the private sector, encourages private investors' participation in developing countries' energy projects.

Table 5. Banking Sector and Stock Markets Development ($liqliab$ and smt) Regression Parameter Estimates

Variable	Coefficient	Std. error
$liqliab$	1.11**	0.46
smt	-0.08	0.14
gdp	0.47***	0.11
$inflation$	-0.14	0.09
$intrate$	0.04***	0.01
$tdlosses$	0.06***	0.02
$corruption$	-0.04	0.14
$countryrisk$	0.06***	0.02
$exchrisk$	-0.27***	0.07
$laworder$	0.11	0.14
$intercept$	-0.24	2.60
Obs.	256	
R^2	0.37	
W	82.96***	

As in the previous analysis, our results show that overall country risk has a significant adverse effect on private investors' commitment in energy projects. We also note that the effects of the corruption index and the indicator of countries' legal system's effectiveness remain statistically insignificant. The results that high interest rate and exchange risk do not discourage private participation in energy projects' funding also shows in this more disaggregated regression. Countries' wealth, as measured by countries' real GDP, continues to be a key determinant of private participation while inflation is no longer statistically significant. The results also show that objective needs for more efficient networks (with less energy losses) draw private participation in energy projects.

6. CONCLUSION

By incorporating some key variables reflecting the level of development of a country's financial sector in the set of potential predictors of the volume of investment

in energy projects with private participation, our objective in this paper was to highlight the important role played by the financial sector in attracting private capital. We analyzed a dataset consisting of observations on 56 developing and emerging countries for the 1990-2007 period characterized by intense liberalization and foreign direct investment. Overall, our results confirm our conjectures but some results, related to risk, are not consistent with some of the findings of the empirical literature and those are given some interpretation.

Our empirical analysis showed that the development of a country's financial sector is a good predictor of the volume of investment with private participation flowing into this country's energy sector. More specifically, a well-established and well-functioning banking sector is found to improve the business environment in developing and emerging countries and hence foster private participation in energy projects in these countries. As expected, economic development, macroeconomic stability, institutional quality and economic, financial, and political risk are also found to influence private investors' decisions to enter the energy sector. Likewise, our findings highlight that investors' interest is rather for countries with higher needs of additional energy provision.

The estimation results also show that high exchange risk and interest rates do not seem to discourage investment with private participation. The most obvious explanation of this result is that investors willing to participate to these projects' financing rely on instruments available in international financial markets to hedge risks associated to energy projects, in particular when the financial sector is developed enough to offer more equity and debt instruments and risk-hedging tools, thereby improving the attractiveness of energy projects to private investors. Moreover, investors may benefit from guarantees from the public sector and international development agencies to improve perceived risks or insurance contracts that usually accompany PPPs, especially when an acceptable risk/return profile cannot be attained. Even though the empirical evidence is not strong, our results do not contradict the existing literature that suggests that bribery to win large PPI deals and gain important private returns at the expense of public interest may also explain why foreign investors can still choose to contribute to energy projects despite a high exchange risk or the availability of other seemingly more profitable projects (Banerjee et al., 2006).

Although our proxy of private participation, the dependent variable in this study, allows drawing only indirect conclusions, an interesting implication of our empirical analysis is that, in their effort to attract private investment into the energy sector, policy makers in developing countries should give great consideration to deepening their domestic banking sectors and developing stock markets. One clear benefit that developing countries could expect to tap from reforming their financial sectors is to draw private investment that lacks so much in their infrastructure industries. This can be achieved by putting in place sound institutional frameworks to ensure the proper implementation and sequencing of financial reforms, by promoting a properly regulated intermediation system such as pension and mutual funds, and insurance companies to

mitigate perceived risks, and by bringing to market sound and bankable projects. Islamic finance and diaspora bonds are also increasingly viewed as solutions to bridge infrastructure funding gaps in developing countries (see, e.g., Gumede et al., 2012).

Indeed, financial reforms and liberalization should result in an increase in the size and liquidity of financial systems, which would in turn increase the amount of credit granted to the private sector (McKinnon, 1973; Shaw, 1973). Furthermore, these reforms are expected to help reduce the cost of capital and improve the sector's efficiency (Chinn and Ito, 2006). By allowing both domestic and foreign investors to benefit from more risk-hedging instruments and hold more diversified portfolios, financial markets' opening can make long-term investment more attractive for infrastructure projects financing (Bekaert and Harvey, 2000; Bekaert et al., 2005). However, although the recent financial crisis is excluded from our analysis time span, it has reopened the debate on the costs and benefits of financial liberalization and has somewhat eroded policy makers' enthusiasm for full financial liberalization without proper regulation (Ang and McKibbin, 2007; Broner and Ventura 2010; Stiglitz, 2000). Furthermore, the crisis's severe negative impact on PPP, namely the important drop in the number and value of projects reaching financial closure, reinforces our conclusion that a robust economic and financial framework is essential for sustainable infrastructure projects.

This analysis also provides useful insights to feed into the debate on the key factors that may help improve infrastructure financing and servicing in developing countries and contribute to further research on the net effects of perceived risks and corruption using a more precise measure of private investment volumes when it is available. More work is needed to assess the impacts of infrastructure sectors' regulatory institutions' characteristics on private participation. Indeed, the data that would allow us to explore these issues are only available for some regions (Andres et al., 2009; Kirkpatrick et al., 2006). In a future research, we will investigate the existence of yet another benefit steaming from the policy reform of the financial sector, namely, a positive externality that this reform exercises on the performance of the infrastructure sector's reforms themselves.

APPENDIX

Table A1. Content of Variables and Data Sources

Variable	Content	Source
privpart	Natural logarithm of total investment commitments with private participation in energy projects adjusted to consumer price index (2010 USD).	The World Bank Public-Private Infrastructure Advisory Facility (PPIAF) database.
liqliab	Domestic banks liquid liabilities as a share of GDP: measures the absolute size of the banking sector.	The World Bank Financial Development and Structure database (2007).
smt	Stock market turnover ratio calculated as the ratio of value of shares traded during a period to average market capitalization: measures the efficiency of the stock market.	Idem.
countryrisk	Composite country risk rating reflecting political, financial, and economic risk ranging from 0 to 100 (the higher the rating the lower the risk).	International Country Risk Guide (ICRG) database.
exchrisk	Exchange rate (stability) risk variable ranging from 0 to 10 (the higher the value, the lower the risk).	Idem.
corruption	Corruption index ranging from 0 to 6 (the higher the score, the less corrupt the economic system).	Idem.
laworder	Index with a "law" component assessing the strength and impartiality of the legal system and an "order" component assessing popular observance of the law. This index ranges from 0 to 6 (the higher the score, the better the legal environment).	Idem.
gdp	Natural logarithm of real GDP in 2000 USD (lagged).	The World Bank World Development Indicators (WDI) database.
inflation	Natural logarithm of inflation rate (%, lagged)	Idem.
intrate	Real interest rate (%).	Idem.
tdlosses	Electricity transmission and distribution losses (% of output).	Idem.

Table A2. Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
privpart	410	15.17	2.03	8.66	22.36
privpartgdp	473	0.001	0.02	0.00	0.27
findev	626	-5.60e-10	1.07	-1.28	6.51
liqliab	889	0.038	0.24	0.05	1.30
smt	685	0.29	0.51	0.00	5.01
gdp	1003	23.81	1.69	19.65	28.53
inflation	940	2.29	1.44	-3.09	9.64
intrate	786	12.24	32.84	-91.72	572.94
tdlosses	949	16.92	8.98	0.00	68.95
corruption	868	2.58	0.90	0.00	5.00
countryrisk	868	64.67	8.49	33.33	82.33
exchrisk	878	7.81	2.18	0.00	10.00
laworder	868	3.20	1.12	0.00	6.00

Table A3. Causal Relationships

	$findev$	$liqliab$	smt
financial variables → $privpart$	Yes	No	Yes
$privpart$ → financial variables	Yes	Yes	Yes

Table A4. Hausman Test: Fixed vs. Random Effects

	H	Prob > H
Model (1)	10.53	0.31
Model (2)	12.29	0.27

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