Public-Private Partnership (PPP) In Nigeria: A Game Theoretic Conjecture of Low-Level Equilibrium in the Power Industry

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Abstract

Given the strategic nature of the relationship between government (state) and the private agents in the provision of electricity infrastructure in Nigeria under a public-private partnership (PPP) framework, a game theoretic framework was used to analyze the economic outcome from the relationship existing between them. Based on the game, as far as the government was able to commit the private agent to staying into the PPP agreement, the private and government returns to capital were in equilibrium and maximized at 19½%. But when the private agent is able to undercut the PPP agreement, he will earn the double (26%) of what the government gets (13%) as the returns on capital. The disequilibrium worsens when government lacked capacity to monitor their private counterpart. When such situation persists, the private earns 78% return on capital while the government's share will decline to a paltry 3¼%. These outcomes suggest that PPP projects in Nigeria as currently operated maximizes private benefit than the social welfare of the citizenry and represents a contributory factor for the low-level of per capita energy equilibrium.

Keywords: public private partnership, game theory, low-level equilibrium, power industry

1. Introduction

Game theory has become an important tool for analyzing strategic relationships in Economics. Given the strategic nature of the relationship between government (state) and the private agencies in the provision of power infrastructure in Nigeria under a public-private partnership (PPP) framework, attempt was made in this study to model the long run outcome from the conjecture. In the past three decades, PPP scheme have become a popular alternative in many countries for the funding of critical government infrastructure and sustaining economic activities. The last one decade has seen a renewed interest in the use of the PPPs to attract significant funding and expertise from the private sector to develop infrastructure and provide services on behalf of government with improved operational efficiency. The innovation is a long-term contractual arrangement where government taps the financial, human and technical resources of the private sector for the delivery of infrastructure and services traditionally provided solely by government. The arrangement ensures that there is a significant degree of risk-sharing between the public and private sectors.

From a political perspective, it is in the best interest of government to want to provide and expand access to energy and power infrastructure in Nigeria because of the pivotal impact it has on national productivity and social welfare. However, the extent to which the provision can be made is limited by availability of fund which is the reason why the private agencies are sought for in partnership by the government. Owing to the capital intensive nature of most public projects, it is desirable that the government and private agents collaborate in the funding of critical infrastructure. By seeking the intervention of the private agents, government seeks to maximize the return on her investment and the efficiency of the private sector capital. In view of this, the government ensures that the private intervention cost of the project is not greater than the own cost of fund. This study observed in the greater part of the PPP projects embarked, the government pays higher than her effective cost of fund. In the majority of the PPP in the power sector, the private sector brings in their expertise as well as the fund, while government harnesses the expertise and efficiencies that the private sector brings in. Government intervention comes in the form of providing policy direction, monitoring and evaluation of the implementation and performance of the projects. A key specific point of reference in the power industry of Nigeria is the recent electricity reform of 2013 which saw to the handing over on November 1, 2013, of the power infrastructure for the distribution of electricity to 11 privately-owned distribution companies while government

provides the regulatory oversight through Nigerian Electricity Regulatory Commission (NERC). With nearly two years into the PPP in the power industry, the emerging outcomes showed that power supply have not improved significantly with the additional supply coming at increased cost. This study traces the long run implication of the deployment of PPP approach in the funding of power infrastructures. The rest of this study is organized as follows. Section II discusses the background to PPP implementation in the Nigerian power industry. In sections III and IV, we discuss the economies of PPP initiative and appraise the performance of the electricity sectors in terms of generation, transmission and distribution of energy in Nigeria. Further, we optimize a model of optimal contract for the study in section V. Section VI concludes the study.

2. Brief Background to PPP in Nigeria's Power Industry

The Nigerian power industry is faced with a number of problems. The problems include inadequate power generation capacity, inefficient transmission and distribution facilities and usage of capacity, ineffective regulation, high technical losses and vandalism, and inappropriate industry and market structure. At the centre of the power sector crises is the electricity sector which has remained perennially underdeveloped for the over five decades it had been managed by the state authority. In effect, optimal harnessing of electrical energy had remained a challenge due to lack of foresight and inadequate investment on the part of the government to revamp the sector. For a country as much as over 170 million populations with a worrying index of youth unemployment[1], the lack of electricity constitute a major constraint to creating the enabling environment necessary for development.

Given the nature of the power industry, most investments are capital intensive and take longer gestation periods. For instance, the construction of a typical power plant takes about 6-8 years to complete before it starts generating new energy. For a gas-fired power plant, the gestation period is shorter and may take up 2-3 years. Given the foregoing background, the National Electric Power Policy was initiated in 2001 which led to the Electric Power Sector Reform (EPSR) Act of 2005. Prior to the enactment of Electricity Power Sector Reform Act (EPSRA, 2005), the Federal Government of Nigeria (FGN) was responsible for the policy formulation, regulation, operations (including generation, transmission and distribution), and investment in the power sector. However, in order to address the poor performance of the sector, the government amended the then prevailing laws (on Electricity and the Nigerian Electric Power Authority (NEPA) Acts) in 1998 to remove the state monopoly and encourage private sector participation. The National Electric Power Policy of 2001 specified the reform agenda, while the EPSRA of 2005 provided the legal basis for the unbundling of NEPA, the formation of successor companies and the eventual privatization. In effect, NEPA changed to be known as Power Holding Company of Nigeria (PHCN – the initial holding company) which was unbundled into 18 successor companies. The companies comprise of 11 distribution companies, 6 generating and 1 transmission companies. The 11 distribution companies undertake the wiring, sales, billing, collection and customer care functions within their area of geographical monopoly, while the generating and transmission companies generate and transmit the power generated to the distribution companies for onward availability to the households and consumers. A PPP is used to define a long term contractual agreement between the public sector (Federal, State or Local Government and the private sector (profit making organizations).The representation of PPP in this study is used to explain a kind of contract between the state authority and a private agency, in which the private agent provides a public service or project and assumes substantial financial, technical and operational risk in the project. The financing of a project through a PPP enables that a project is completed sooner or made a possibility in the first place. For a typical PPP projects in Nigerian power industry, government participation exists mostly in kinds (notably the transfer of existing assets) and/or via a capital subsidy outlay which may be a one-time or multiple time grant. The most of the PPPs were negotiated either as individually or as one-off deal. For the successful bidders, each was granted a license over a geographic area, and is subjected to extant regulations.

3. The Economics in the use of PPPs Funding

Countries across the world recognize that availability of adequate infrastructure is a key determinant of growth potential (Engel, Fischer, and Galetovic (2010), and Ehlers (2014)). However, the use of the PPP arrangement in funding critical government infrastructure has shown mixed results in many economies (Barlow, Roehrich, and Wright (2013)). This recognition is based on considerations of efficiency in cost, equity and fiscal prudence (Sehrawat and Nachiket, 2006). For instance, Barlow, Roehrich and Wright (2013) observed that PPPs increase efficiency at higher costs. For most of what is concerned, the private investors are expected to approximate the government rate of return (for example, the treasury/bond rate or the monetary policy rate. In the greater part of the PPP cases, the private rate of return were always

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[1] According to the National Population Commission (NPC), over 50% of the population is made of youth (defined as individuals of ages between 15 and 34, NPC (2013)). Back since 2012, the NBS had put the figure at 54% (NBS, 2012). The Central bank of Nigeria (CBN) in 2014 had argued that the figure might have increased to 80% lately (Mahmood, 2014). What is worrying in all of these statistics is that as the youth population grows, so does the unemployment rate.

higher than the government's even when most or all of the income risk associated with the project was borne by the government. It would have been expected that government cost of debt be cheaper than the debt provided to finance PPP projects by the private (that is, the weighted average cost of capital (WACC) on the projects) since a PPP represent a form of outside funding for the government. In making a comparison between government's cost of debt and the private-sector WACC, it was observed that government can sustainably fund most of the projects at a cost of finance equal to the risk-free borrowing rate without recourse to the private sector were there to be efficiency in the sourcing of her debts. A government debt will likely be efficient when borrowing level is within prudent limits[2]. Adopting a PPP measure at lower debt ratio presents an inefficient option for any government as the funding costs (bond yields/treasury bill rate) will be lower than the private sector financing cost (Yescombe, 2007). When a PPP project is properly structured, the efficiency gain from the private sector involvement is supposed to compensate for any additional costs that government incurs over and above own funding cost. The deployment of PPP in any economy depend many more on the efficiency from the process more than the comparison between the public cost of debt and the private rate of return.   Economic debates have focused on the value of money from the projects implemented more than reductions in debts. While governments in industrial and developed countries may continue operating infrastructure because of the high value the citizenry derive from the system, the developing countries, faced with budget constraints and with poor index of value for money from public investments must focus on regulating and facilitating infrastructure delivery services by the private firms. This shift will offer the promise of more efficient investment in the operation of infrastructure services, as well as the potential to shift the burden of new investment from public budgets to the private sector.

4. The state of the Nigeria's Electricity industry after the reform

The performance of the electricity industry from the time of the implementation of the 2005 and 2013 reforms have shown marginal and sluggish developments. The main ingredients of the two reforms were to deregulate and commercialize the provision of electricity in Nigeria. The reforms aimed at improving the overall efficiency through restructuring, private sector participation and competition. Of the two reforms, the 2005 Act was aimed at providing a legal basis for the privatization of the power industry and establishing of a new regulatory structure, while the 2013 exercise actually effected the handing over of the power infrastructure to the private agents. Since the latest reform, electricity supply in Nigeria still remained epileptic. This dismal performance by the sector has provoked a wide range of debates with the stronger voices overtly urging the scrapping of the current power sector reform altogether (Ogbonnia, 2015). While the scrapping cannot be said to be the solution, a way out is on the redirection of the policy towards the maximization of the public welfare as against corporate profits. Due to the importance of electricity in human welfare and the obvious complexities with privatization, investors taking over the infrastructure are supposed to be up to the task. After the handing over of the ownership to the private owners, the investors were discovered to be lacking in the financial capacity to increase investments to add new generation capacities to the grids, continued in the inadequacy of supply and non-metering of customers (with the associated outrageous estimated billing) and non-declaration of Transitional Electricity Market (TEM) among others. As at May 30, 2014, power supply in the first 6 months after the handing over averaged at about 3,200 megawatts, against the projected 9,062 megawatts by NERC (see Sambo, 2008). The investors had sourced short tern funds from the money market and were very interested in the rapid repayment of the loans. Thus, with the huge shortfall, the revenue expected by the distribution companies became far less than the projected and worsened the incentive for the new investment that was expected into the power industry. The poor generation broke the value chain as the distribution companies failed in generating enough revenue to replace bad transformers, implement new metering plans and also upgrade infrastructure. So, with very low supply of electricity (which was caused by inadequate gas supply to the power plants), all the projections went down and the dismal performance in the power industry continued into the years. The reform concentrated on gas-to-power.   With most of the gas infrastructure being localized in the volatile axis of the country, any illegal tampering of the gas pipelines in the areas sadly throws the nation into darkness. De-emphasizing gas-to-power is strategic. A careful implementation of the reform policy could boosts power generation in different parts of the country as well as also help to overcome overdependence on natural gas and the unending chicanery with pipeline vandalism which the operators had held to as a major reason for the prolonged underperformance.

5. A model of Optimal Trading Contract

In this section, we situate a non-cooperative game between two economic agents: the government and the private[3]. The two agents are joined by a game on maximizing the return on capital invested on a PPP project. The public good is such that the capital outlay required is beyond that that can be optimally contributed by the state; thus prompting the private

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[2] A debt-to-GDP ratio of 60% is quite often noted as a prudential limit for developed countries, and 40% for developing and emerging economies (IMF, 2010)

[3] The private orientation is profit. As far as the private agent is concerned, he seeks to maximize as much profit as possible in any of the PPP contract.

agent to be contracted. For the typical PPP project in discourse, we assume that both the state and the private contribute equal amount of capital outlay for the implementation of the project. Further, it is assumed that the economics in the partnership with the private sector is that the marginal cost of fund be at most not greater the government cost of fund. In measuring government cost of fund, two rates can be suggested: the monetary policy rate (MPR) or the treasury bill rate (TBR). The MPR and the TBR have averaged 13% and 11% respectively since January 2015. In Nigeria, the MPR defines the baseline prices of money across the financial market and generates greater impact than the TBR. The MPR has also been more stable in the last five years than the TBR. For the private cost of fund, we consider the prime and maximum lending rates. The two lending rates averaged 16.84% and 26.3% respectively in the first quarter of 2015 (CBN, 2015). For the game analysis, we chose the approximate value of 26%. Because of the contractual costs involved in the initiation of a PPP project, we assume the gap between the prime and maximum lending rates to represent the effective cost of initiating a PPP project, such that the ideal private cost of fund should be the prime lending rate. Based on a PPP framework, government may chose to **enforce** the commitment of the private sector to the full implementation of a project after it has been initiated or **stay out**. In the other way, the private agent may **stay in** (comply) or **undercut** the agreement. By undercutting the agreement, the private agent earns in addition half of the private cost of fund.

Given the foregoing analogy, the game matrix will offer the following outcomes:

Table 1. A conjectural Payoff matrix from a power sector PPP project

		Public	
		Enforce (%)	Stay out (%)
Private	Stay in	19½, 19½	32½, 6½
	Undercut	26,13	39,6½

Source: Estimated

Here, each agent is trying to maximize the return on its capital. As far as the government enforces the private agent to staying into the agreement, the private and the government returns to capital is in equilibrium. Both agents will earn 19.5% each as the reruns to capital respectively, and this will be profitable to the government and maximize the citizens' welfare. However, the private agent will never play such strategy with the government and as a result will seek to undercut the agreement to maximize his returns. In as much as the government could not enforce the private agent to stay in, disequilibrium occurs; with the private agent securing higher return to capital than the private agent. In effect, the private will earn double (26%) against 13% by the government when there is enforcement by the government thought the private choose to default. In the situation where government decides to stays off from enforcing the contract, the return to its capital will worsen to 6.5% while the private's gain rises further to 32.5%. The payoff for the government becomes worse once it decides to stay out, leaving the private agent to dominating the PPP projects. For instance, in the case of the sale of the electricity distribution companies (discos), the investors were subsequently upon sales guaranteed a multi-year tariff order, operative from June 2012 through 2015 on the fixed cost and cost of per kilowatt of electricity charged to further the private incentive in the takeover. Government weak stance gives rise to lower level equilibrium, which we interpret to lead to poor citizens' welfare. In the analysis pursued, focus was made on a partial opponent case[4]. Based on the game, Nash equilibrium for the players is for the private agent to persistently undercut while government enforces commitment. The lower-left cell is not only a Nash Equilibrium; it is also a dominant strategy. Were this to subsists, the private and the government would earn 26% and 13% respectively as the returns on their capital. These rates coincide with the effective cost of funds for each agent. In competitive game as this, non-cooperation with the partner is always the best move. The game essentially showed that it is in the best interest of the private agent to undercut agreement to maximize profit. Given the weak institutional stance of the government and capability to enforce commitment, the citizens stand to gain less in any PPP embarked under such circumstance.

We can look at the idea of the returns on investment from another perspective. A higher return on investment implies that it will take shorter period for the private agent to recoup investments and diminish the citizens' welfare.

For the private agent, shorter period reduces risks on investment given the probability that going to election at every four years could mean the termination of an extant project. To the private agent, the risk is very costly and he seeks to recoup cost as fast as possible. For the government, she seeks to implement large and massive project within the shortest possible time so as to score political points and increase the chances of remaining in the office for a second term[5]. But this likelihood on its own is a gamble. In effect, the political ambition of government impact and sometimes

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[4] The pure-opponent zero-sum case suggests strictly that what one opponent loses the other gains. But in the partially opponent case, both agent though competing for same incentive, are not tied to a strictly mutually exclusive payoffs.

[5] Nigerian political system operates a single term of four years and re-electable for the maximum of two terms.

override the economic decisions that is made. The citizen's are usually the end beneficiary of government investment such that the returns to the government mirror the feedback to the citizens' welfare. We set up a two-stage game model in this section to deal with the sharing of the gain from a project financed under a PPP arrangement. This specification allows for the possibility of a semi collusive market where firms compete in a long run variable, such as capital investment, and collude with respect to a short run variable, such as quality or welfare (Ma, 2005). This framework is inspired by Roller and Sickles (2000) and Dixon (1986). In the first stage, we assume that the agents decide their returns on capital investment in the first stage and based upon the decision, they chose their strategy in the stage two. The game theory analysis attempts to determine the nature of equilibrium in an electricity market where private interest dominates the public interest. The private agent is motivated by profit maximization and the state by welfare maximization. For a typical PPP contract, we assume that it will take a minimum of 6 years for any new investment to begin to generate power. The private agent desires that this period be shorter and as a result determined to undercut it. Were the private agent to succeed in undercutting the duration, he will gain double the return for his investment while halving the citizens' welfare. It is at the point where power is generated and distributed to the masses that welfare is affected. Table 2 shows the game matrix.

Table 2. Private-Public payoff matrix

		Public	
		Enforce (%)	Stay out (%)
Private	Stay in	19½, 19½	32½, 6½
	Undercut	52,13	78,3¼

Source: Estimated

In comparing table 1 and 2, the private agent will double the gain in each of the instance that he undercuts the PPP agreement while the citizens' welfare worsens. By the private agent undercutting the citizens' welfare, the structure of the game strategically changes from competitive to zero-sum game. Because the private prefers winning to tying, and the citizens are disadvantaged in terms of protecting themselves from moral hazard on the part of the private agent, embarking on PPP projects have become a strictly game. Based on the game, the private earns 52% on the capital were there to be government intervention. This yield increases to 78% when there is no government commitment. Lack of government can be interpreted in two ways: the government is weak in the enforcement of the contract or have incentive to stay out so as to obtain some kickback from the private agent. Given the much prevalence of the latter likelihood, and the size of the gain to be made, it will be rational for the government to perpetually stay out and the citizens' welfare suffer. As far as the private stayed in into the contract, the private profit was maximized and the citizen's welfare diminished. The inability of government to enforce commitment of the private is the major crux of the lower level of equilibrium in the power sector.

6. Conclusion

The adoption of a PPP model by the Nigerian government in the construction and operation of electricity infrastructures is dominated by private profit maximization over socially beneficial intention of the government. In a game theoretic conjecture of the payoffs from the PPP projects, the private agents were discovered to be disposed to undercutting the PPP agreement rather than staying in. Essentially, undercutting the agreement helps to maximize private profit. As far as the government enforces the private agent to staying into the agreement, the private and the government returns to capital is in equilibrium. Based on the game, as far as the government was able to commit a private agent to staying into PPP agreement, the private and government returns to capital were in equilibrium (19½%). When the private agent undercuts agreement, he earns double (26%) of what government gets (13%) as the returns on his capital. The disequilibrium worsens when government stay off totally from monitoring the private sector. Were such to happen, the private agent gains 78% while the government's share declines to 3¼%. This study suggests that PPP projects in Nigeria tend to maximize private benefit than the social welfare. In line with the argument of Barlow, Roehrich and Wright (2013), PPPs in Nigeria were observed to increase efficiency only at higher costs.

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