
A Practical Review of Mechanism Design: How Implementable is it Within the Nigerian Context? Investigating the Role of PPP on Social Outcomes in Nigeria

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According to statistics of the Federal Ministry of Works Nigeria (2012), total road network in Nigeria currently stands at approximately 195,000 Kilometers, with the Federal, State and Local Governments responsible for 22, 21 and 51 percent of this network respectively. In another report, The Central Bank of Nigeria (2011) also states that Nigeria needs to invest at least 100 billion dollars on roads in the next ten years. This study explores how social needs are realized within the public private participation (PPP) scheme in Nigeria. The study also situates public private partnership, in the Nigerian procurement and project operation context. The study's objectives are achieved by revisiting the mechanism design paradigm (through reviewing the historical evolution of Public Private Partnerships (PPPs) in Nigeria) and its impact on social goals as developed by Tirole and Maskin (2008), within the Nigerian context. Data

on credit provided to the private sector as a percentage of GDP were used as proxies for PPP involvement from 1960 to 2010 although some years of data were missing. The method of estimation used included ordinary least squares, linear mixed effects models and seemingly unrelated regression estimation methods, which all allow for the investigation of relationships between a set of unrelated weakly exogenous variables, with the mixed effect method particularly suitable for iterative optimization processes. The findings show that cost implication concerns and the choice of the social function has an effect on PPP. It was also found that the electoral process which determines the social function mattered in the project selection stage and had significant effect on the PPP formation process.

Keywords: PPPs, Social Needs, Project Delivery and Mechanism Design

JEL Classification: L 14

Introduction

In this section we introduce the subject of our study. Lots of papers continue to emphasize the cost reduction advantages of involving the private sector in meeting social needs. While many studies have investigated the advantages of Public Private Partnerships (PPPs) in general, few have actually tried to capture variables of interest for further quantitative and empirical investigation as we do in this study. Few if any have tried to measure PPPs using data for domestic credit provided to the private sector as a percentage of GDP. No study to the best of our knowledge has tried to also investigate the international context of private involvement on social goal realization in Nigeria as we do in this study.

Since domestic claims on government as a percentage of GDP is continually on the increase in Nigeria (World Bank (2010) statistics), it is clear that government will continue to look for alternative ways to fund social projects such as roads, bridges and other cost implicative social needs due to budget limitations. Furthermore with increased strains in existing infrastructure owing to high population growth in Nigeria (World Bank Statistics, 2010), more pressure is on government to deliver public goods

(infrastructures) within a short space of time and to do so in an efficient manner.

Afolabi (2011) and United Nation 2011 Report, also states that Nigeria needs to invest between 15.9 to 17 billion dollars approximately over the next decade in order to attain its goal of becoming one of the top twenty most competitive nations by 2020. As of now Nigeria only invests about 5 percent of her GDP yearly on infrastructure, while spending an average of 90 billion on consumption which are mainly on food related imports, electronics, automobiles and other household utilities. There is also strong evidence that budget financing is also very volatile and not likely to meet crucial infrastructure expenditure requirements. Furthermore, Nigeria's import bill is also having a negative effect on its foreign reserves which have continually been on the decline since the third quarter of 2013¹.

To address Nigeria's infrastructural deficits, PPP serves as the appropriate mechanism that is designed for providing these social projects, particularly for a government charged with the responsibility of providing social goods but is faced with limited budgetary allocation. The Public private partnership provides a model (a mechanism or model designed for maximizing a social choice function) for public procurement based on long term relationship between the private and public sector for improved service delivery. It often involves a situation where the public sector (usually government), will involve the private sector (firms) in the delivery of service (which might be a public good or service). It is also a cost minimizing scheme that promotes efficiency and speedy delivery of public goods.

While Public Private Partnership became popular in the early 1980s in Britain the actual inception date of PPP collaboration in Britain is unknown (Davis, Motte and Hall (2003)), evidence from World Bank Statistics show that private participation in public projects dates back to earlier times, however the nature of such participation were not clearly defined.

This study investigates the effect of social needs on private public participation in Nigeria and secondly the effects of the choice of the social choice function on project efficiency in Nigeria. Data is obtained from the World Development Indicators of the World Bank, for a period of 51 years (1960 to 2010), although some years of data are missing. The method of

¹ See CBN report 2013

estimation relied on is the ordinary least squares, maximum likelihood estimation (Linear Mixed Effect Estimation (LME)) and the seemingly unrelated regression (SUR) estimation, which is an iterative process based on the premise that the sample moments will tend to that of the population distribution under the assumption that distribution normality holds. The rest of the paper is divided into the scope and objectives of study, review of literature, stylized facts on social needs and PPPs, theory and methodology, empirical analysis and results and finally the concluding sections.

Scope and Objectives of the Study

In this section we state the scope and objective of the study. The study revisits the mechanism design² and Public Private Participation Paradigm and presents empirical evidence on the impact of budgetary constraint and the social choice function on Public Private Partnership in Nigeria, by investigating the practical implementation of the theory of mechanism design as proposed by Maskin (2008). The objectives of the study include:

- a) To determine the extent to which cost implications such as budgetary constraints drive PPP formation and frequency in the Nigeria social infrastructural development context
- b) To examine critically the impact of the PPPs on the social choice function in the Nigeria infrastructural development sector.
- c) To determine the extent to which social needs, project efficiency and private sector interest affect Public Private Partnerships in Nigeria.
- d) Finally to determine the effect of private and public sector interest on PPP formation and project Efficiency in Nigeria.

History of Private Finance Initiative and PPP in Nigeria

In this section we present a brief review on how the PFI process which has been modestly successful in the Oil sector is gradually being introduced as PPP in infrastructural development in Nigeria, arguing that PPP has in fact

² Mechanism design- provides the platform through which social goals can be executed to obtain the desired outcome using PPP. Mechanism design can be defined as a game of two or more players (reverse game in most cases) with divergent interest whose interaction work out together towards the realization of the project or social outcome generally regarded as the social choice function which needs to be maximized.

been an ongoing thing in Nigeria but has been limited to the oil and gas sector.

Private finance initiative (PFI) the earliest form of PPPs has been in existence in Nigeria since the 20th century although most of this collaboration had been in the upstream oil and gas exploration sector. However it was commonly referred to as the private finance initiative, one of the earliest of such public private venture was the granting of concessions to the Nigerian Bitumen Corporation owned by British National Simon Bergheim in 1906 for the exploration of oil in Nigeria.

According to Obasi N.K. (2003) and Afolabi (2011) Simon Bergheim had previously made an argument based on his geological knowledge of the southern Nigeria terrain, that oil existed in southern Nigeria, the next year in 1907 the Southern Nigerian Colonial Government set up the Southern Nigerian Mining Regulation Ordinance of 1907 granting Nigerian Bitumen Corporation sole monopoly. His death in 1913 six years after the first mining concession led to a delay in further oil exploration activity until the Shell D'Arcy Oil company now known as the Royal Dutch Shell plc was granted sole concession to explore oil in Nigeria in 1937, drilling 13 bore holes in two years around the Owerri axis without any success of striking oil. Stalled by World War II further oil exploration activities were not carried out until 1951.

Oil was first struck in commercial quantity in 1956 in Oloibiri in present day Bayelsa State and also in Afam Rivers state in that same year. Massive construction of oil pipelines to Port-Harcourt commenced the same year with the first commercial exports from both oil wells taking place in 1958. With the success of Shell Petroleum Company other mining concessions were granted, these included for instance the granting of mining concession to Mobil Oil Producing in Nigeria's Sokoto basin, Benue trough and some fringes of the Niger Delta.

After disappointments in striking oil in the Sokoto Basin and Benue Trough it moved to the Benin-Dahomey basin where it drilled four oil wells between 1959 and 1961 (Obasi, 2003). Independence in 1960 also led to intensive oil explorative activities, the sole rights of Shell were also withdrawn with Shell only retaining 50 percent of its concessions in the Niger-Delta region. It is important to highlight at this point that over the years with the memoranda of understanding signed with oil companies in

Nigeria, it can be clearly seen that private sector initiative were the concept that led to the success of initial oil exploration activities in Nigeria.

A list of other private finance initiative agreements signed with the Royal Dutch Shell plc as far back as the late 1960s include for instance the utilization of the Liquefied Natural Gas in electricity generation through the supply of gas to private companies in Aba and electricity generating plants in Ughelli (for the Ughelli gas power station) which was Owned by the then Electricity Company of Nigeria. In recent times Shell sale of gas currently exceeds 10 billion Naira yearly, with Shell currently supplying gas, to former government owned Utorgu and Alakiri power plants.

Other forms of such public private venture include the NNPC, Shell, Elf, Agip joint venture signed in April 1998 costing over 68 billion dollars for harnessing 18 million standard cubic feet of gas and reducing gas flaring through the Odidi Associated Gas gathering project from five flow stations (i.e. the Odidi 1, Odidi 2, Egwa 1, Egwa II and Batan flow stations) see Obasi N.K (2003) for further details.

Today the success of these joint partnership is only been transferred to other sector of the Nigerian economy, particularly the socio infrastructural development sector. For instance, the Lekki-Epe 50km expressway upgrade, maintenance and expansion for instance is handled by the Lekki Concession Company, it uses the build operate and transfer method of infrastructural delivery (BOT), it is mandated to handle vital road infrastructure for the Lekki peninsular of Lagos, this concession is initially granted for a 30 year period.

The second Niger Bridge construction has also been awarded as a concession using the Design Build Fund Operate and Transfer (DEBFOT) infrastructural delivery model with funding to be provided by the Federal Government and the World Bank with 40 billion Naira, coming from the SURE-P (Subsidy Reinvestment and Empowerment Programme), Federal funds and others funded through the private sector. Other projects include Tin Can island port operation concession between Five Star Logistics and the Federal Government Nigeria.

All PPP projects at the Federal level are handled by the infrastructural Concession and Regulation Commission of Nigeria, the commission is responsible for all PPP awards and regulation, the list of sectors where they supervise infrastructural projects currently include power generation/transmission and distribution, building of roads bridges and

ports, railways construction, gas and petroleum infrastructure, health care facilities sectors etc see Afolabi (2011) for further discussions.

Review of Literature

In this section we review past and current literature on the study. Hurwicz L. (1960) and Hurwicz and Reiter (2006) state that design problems are often associated with two factors, the goal and the mechanism for achieving the goal which is usually unknown. It also argues that it is a reverse game theory problem, since the goals which are the end results are often known but not the mechanism.

Hurwicz (1960) also state some basic features of the game, which includes a case where the game designer chooses the game structure but does not inherit one and the fact that the game designer is only interested in the outcomes of the game. Hurwitz and Reiter (2006) also described mechanism design as a private information game in which one of the agents usually called the principal chooses the play offs structure of the game see also Harsanyi (1967). The agents in this structure receive secret information from the game structure containing relevant pay offs such as cost, quality, preferences etc. After this report the principal and agents will derive some defined utility.

Hurwicz and Reiter (2006) also further insights into the game time extensively, stating that mechanism design game are characterized by the following; a structure where the principal commits to a mechanism $Y(\theta)$ that has an outcome Y , the agents report their type, e.g. possibly dishonestly or some type of portfolio and the mechanism is executed and the agents receive a payoff at $Y=(\theta')$ which is utility of the principal and possibly described as the optimal social choice.

Under this strategy in implementing social goals the designer will have to consider the following the designer i.) will design $Y(\theta)$ that implements the social choice function ii.) try to find the mechanism $Y(\theta)$ that maximizes some value criterion e.g infrastructure projects or procurement. The social choice function can now be defined as $f(\theta)=x(\theta')$ Where $f(\theta)$ is the social choice function and $t(\theta)$ is the transfer function which is equal to $x(\theta)$ which is the project outcome that the principal induces the agent to pick through motivation or other forms of payoffs due to it transfer function and θ' is the optimal social choice from which the

principal derives his utility (or see Hurwitz and Reiter (2006) for further discussion)

Lewis and Sappington (1988), Hart and Holmstrom (1987) and Laffont and Tirole (1989) all examine a reputation model where the extent of under-investment and cost overruns are function of length and the relationship between the principal and agents and state that while relationships might be a condition for the guarantee of appropriate investment issues of cost overruns such as changes in technology do not cause agency problems since they result to upgrading or downgrading cost simplification. However the issue of cost underestimation in order to secure contracts present challenges for the principal who might need to support the agent.

Loeb and Magat (1979) study mechanism design and used it to examine cases of regulated contracts where there exist no social cost of leaving rent to agents thereby ignoring the social cost of public funds in their model. They also argue that it is necessary to award agents the whole net consumer surplus to a good investment.

Sappington (1982) also study the regulated contracts and introduces the social cost of public funds which were neglected in the study by Loeb and Magat (1979). Other papers e.g. Baron and Myerson (1982) after studying the adverse selection problem intensively argue that when an agent cannot be observed the social optimal price an agent is allowed to charge often exceeds its Ramsey levels.

Others such as Chiang (1998) also study the moral hazard problem and find that the power of incentive decreases by n -fold when the number of principal increases from 1 to n for a risk adverse agent. Laffont and Tirole (1993) discuss the adverse selection and moral hazard problem under a single model and state that a social optimal contract case makes the agent to invest efficiently and derive a positive rent while an inefficient case give an opposite outcome.

Tsai (2007) state that the mechanism design literature often considers a linear payoff contract where there is a fixed payoff and performance- based payoff component. Allowing linear contracts to be replicated using two incentive schemes price cap and cost of services in regulated contracts. The study by Mathios and Rogers (1989) also study the effect of price cap and cost of services on average intra state telephone rates

and find that states that adopted the price cap strategy had a lower rate than those that adopted the cost of services strategy.

This paper investigates the effect of the social choice (social needs) on PPP formation in Nigeria. It also investigated facts that affect the social choice function within the Nigeria public contracting scheme. Past Works such as Afolabi (2011) have only enumerated the advantages of PPP for project delivery by reviewing historical successes in Australia, the EU and North America. Few papers have attempted to study PPP within the private sector by including project development through the forms of private finance initiatives in the pre 1990s to recent times when PPP have now gained the required recognition as we do in this study.

Stylized Facts on Needs and PPPs in Nigeria

In this section we present trends and facts on PPP in Nigeria. Trends show that public private partnership in Nigeria actually gained momentum from the early 1980s and has suffered considerable setbacks since the late 1990s till date.



Figure 1: Public Private Partnership Overtime

Note: This is captured using the ratio of domestic credit provided to the private sector as a percentage of GDP. It depicts the level of private sector involvement in the public procurement and infrastructural development sectors in Nigeria.

There also appears to be increased partnerships from the late 2000s (2007 to be precise). This is largely attributable to the recent efforts by government to deliver on social goals and the increasing domestic claims on government, making government to act systematically to shrink its domestic debt profile.

Trends also show that public participation in social goal delivery has been high for Nigeria in general. With major decreases recorded only for the 2007 global financial crisis period. Sharp increases are also noticeable for late 2000s till (2009 to 2012) date with increase in public allocation and growth driven spending.

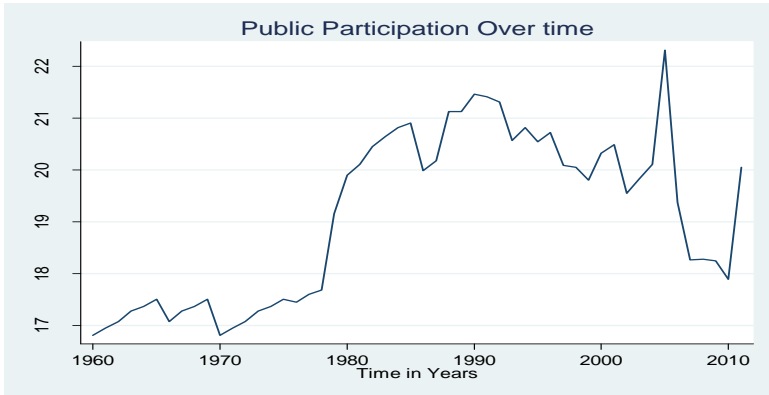


Figure 2: Public Involvement in Projects Overtime

Note: This depicts government spending in Nigeria as a percentage of GDP over time. It was used to depict government spending allocation for procurement and project execution purposes.

Private participation in project execution is also gaining momentum particularly since the build transfer and operate strategy were beginning to gain grounds in the procurement and socio infrastructural development sector. This is largely driven by high returns on investment and ongoing engagement of private firms in maintenance and operation of socio infrastructural projects e.g. the Lekki-Epe express way completed in 2011 and operated by the Lekki Concession Company (LCC).

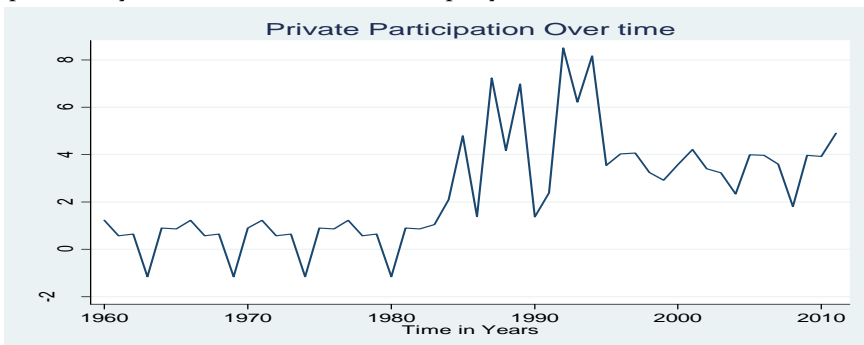


Figure 3: Private Participation in Projects Over Time

Note: This is the aggregate private capital outflow as a percentage of GDP. It depicts private firm's potential to engage in capital intensive socio infrastructural development activities.

Demand for social infrastructure (termed needs) is also on the increase with considerable decline in infrastructure over time. Nigeria continues to experience considerable decline in infrastructure depicting a strong increase in social needs and poor delivery in public procurement and project execution procedure policy of the Nigeria government. Increased need also means increased demands on government to fulfill electoral promises and live up to its expectations of providing public goods for the country's citizens.

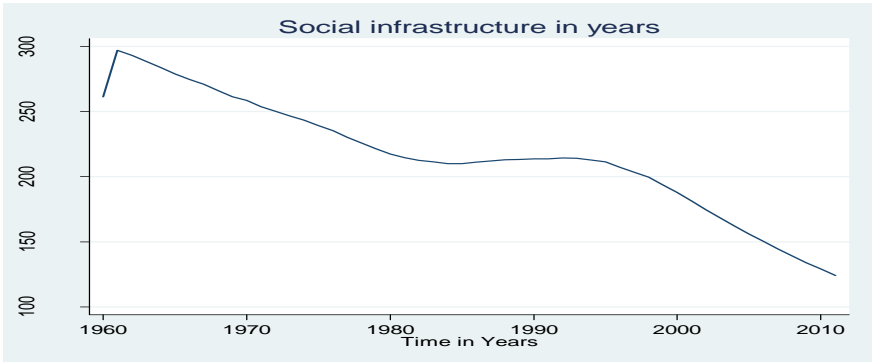


Figure 4: Social Infrastructural Quality in Nigeria Overtime

Note: This depicts the state of infrastructure overtime in Nigeria. It currently depicts infrastructural decadence and unavailability showing how the quality of infrastructure has deteriorated owing to years of neglect by government and development agencies.

Social spending is also affected by shrinking budgetary allocation and other issues of inflation and exchange rates related problems, reducing the power of the Naira and further weakening the social goal realization effectiveness of the Nigerian public procurement agencies.

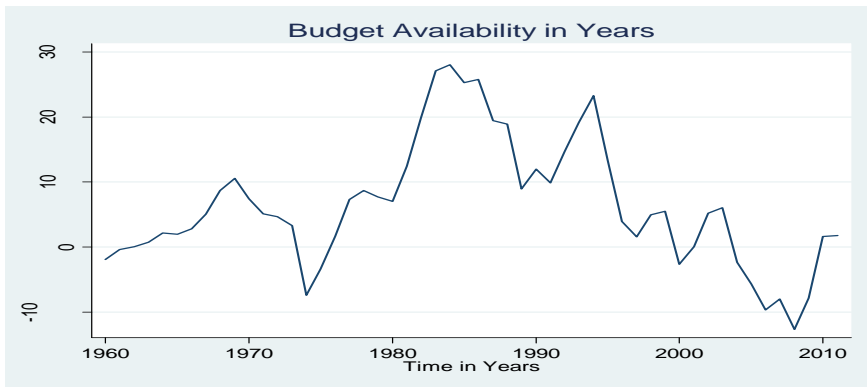


Figure 5: Budget Allocation Availability for Socio Development in Years

Note: Signs of budgetary strains are clearly noticeable overtime in the Nigeria financial allocation for socio infrastructural development. This is probably attributable to increased claims on government as a percentage of its total gross earnings making government to have less and less revenue for capital expenditure after debt servicing.

There also appears to be significant improvement in project execution and efficiency, as shown below with recorded increases from the year 2000 till date. This is attributable to democratic governance and more transparency in the public bidding and contract award process.

Time for signing memoranda of understanding is also getting shorter, as clearer definition and more experience of PPP is being gained less and less time appear to be needed to effect a PPP process, the implication of this is that less time to complete project in an efficient manner are under way since MOUs no longer pose a source of delay for public and private agencies considering going into such partnerships.

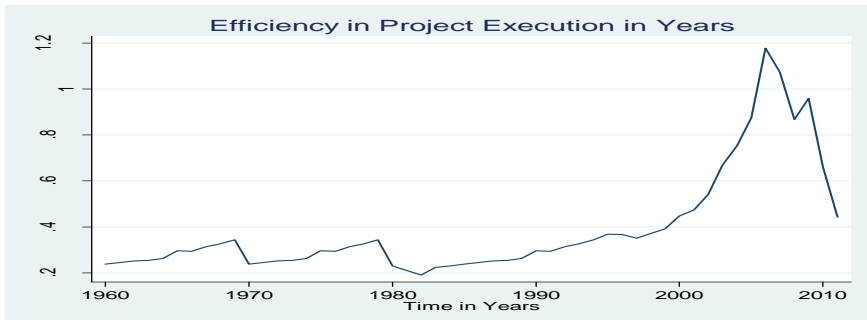


Figure 6: Efficiency in Project Execution over Years

Note: Efficiency in project execution is also on the increase with noticeable increases for late 1990s to 2007. A decrease in the 2000s (i.e. from 2008) is attributable high inflationary trends inadequate transparency in contract awards, high level of uncertainty in the Nigeria business environment and contract under-estimation in the Nigerian bidding process making contractor to find it difficult to deliver projects as at when due.

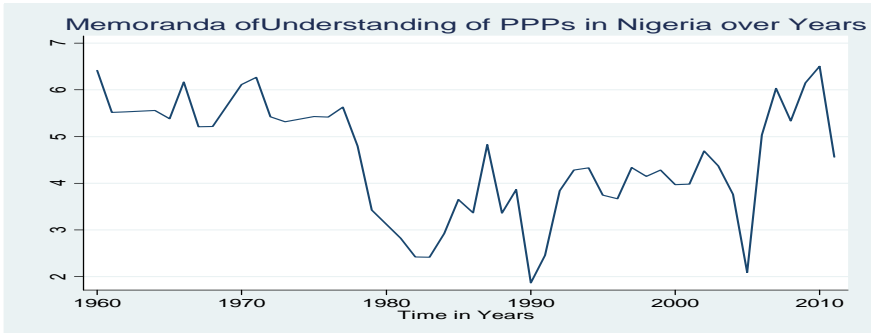


Figure 7: Public Private Composition of Memoranda Overtime in Nigeria

Note: The ratio of private to public interest is also increasing making private sector participation appears to be on the increase, more incentive for private firms also mean they are less averse to signing MOUs for the PPP process in general. Issues of more understanding and increasing benefits of the PPP process is also reducing delays in MOUs signing making MOUs quality to be steadily on the increase presently.

Sources of Data

All data for Nigeria were obtained from the World Development Indicator of the World Bank for the period of 1960 to 2010 a period of 52 years.

Table 1: List of Variables and Description

Variables	Sources	Abbreviations	Description
Public Partnerships	World Bank Data	PPP	Aggregate domestic credit in USD provided to the private sector as a percentage of GDP
Infrastructure/Capita	World Bank Data	Needs	Road length in kilometers as a percentage of population
Budget Constraint	World Bank Data	BC	Aggregate claims on government as a percentage of GDP
Private Participation	World Bank Data	PP	private capital outflow as a percentage of GDP

Private Sector Interest	World Bank Data	PSI	Aggregate private sector net outflow in constant USD
Government Interest	World Bank Data	GI	Government spending as a percentage of GDP over time
Memorandum of Understanding	World Bank Data	MOU	Percentage private to public sector interest in project executed overtime measured using private sector outflow over government spending overtime.
Liquidity to Liability Ratio	World Bank Data	LLR	Government liquidity to liability ratio
Delivery Cost	World Bank Data	DEC	PPP delivery cost (PPP times inflation)
Project Delivery	World Bank Data	PRJ	Country specific budgetary allocation times possible constraints to project delivery such inflation
Project Efficiency	World Bank Data	EFF	Institutional measures which account for regulated contracts and oversight of the contract award, supervision and quality assurance standards
Foreign Investment in PPP	World Bank Data	FORIN	Foreign Investment Inflow as a percentage of GDP

Note: All data are obtained from Central Bank of Nigeria (CBN) data and the World Bank world development indicator (WDI) data unless otherwise stated. The abbreviation USD represents United States Dollars. We also acknowledge the use of Datamarket of Iceland to access World Bank Statistics.

PPP is the aggregate domestic credit provided to the private sector as a percentage of GDP, budget constraint is also the aggregate claims on government as a percentage of GDP, and project efficiency was captured using institutional measures which account for regulated contracts and oversight of the contract award, supervision and quality assurance standards.

Private participation in projects was measured using private capital outflow as a percentage of GDP. Private sector interest is also aggregate private sector net outflow in constant US dollars. While MOU is captured as the percentage of private to public sector interest in project executed overtime which was measured using percentage of private sector outflow to

public participation overtime. Delivery cost is the project delivery cost which could be a function of project construction overtime that is obtained by multiplying PPP cost times inflation. All data are obtained from the Central Bank of Nigeria statistics and the World Bank data unless otherwise stated.

Table2: Descriptive Statistics

Variable	Observations	Mean	Std. Dev	Min	Max
Public Private Partnerships (PPP)	52	20.46	13.02	-1.60	49.90
Budget Constraint	52	6.38	9.74	-12.66	28.02
Private Sector Participation	52	2.43	2.31	-1.15	8.50
Private Sector Interest	52	4.96	2.47	0.32	11.06
Government (Public) Interest	52	5.71	8.25	2.00	4.90
Needs (Social Goal)	52	216.16	43	124.1	297.1
Project Efficiency	52	0.39	0.23	0.19	1.18
Delivery Cost	52	41.35	54.99	0.71	153.90
Memorandum of Understanding	52	1.33	2.02	-3.60	6.70

Source: Authors compilation (from WDI dataset of the World Bank and other sources)

Theory and Methodology

In this section we discuss the theory and method used in the study. There is currently little or no empirical work on public private partnership (PPPs), few if any exist where public private partnerships (PPP) has been implemented using data. In this study we make a case for PPP by drawing on activities of private finance initiatives (PFIs) as explained by Obasi N. (2003) and Afolabi (2011) in Nigeria since the 1930s. Since data is only available from the early 1960s, we were compelled to extrapolate data for about three years. In explaining the awards of contracts it will be worthy to state that while agents (private sector) should be supervised for efficiency, the principal (government) is also likely to be bedeviled by renting seeking official who

implement its goals which could affect the bidding or concession process making the contract system to have a lot of hidden information. Based on these, we can therefore state that:

- The PPP formation process will be a function of budget constraints which will force the principal (government) to seek some alternative source of funding social projects
- Social goals might in fact not be fully addressed using the PPP as a mechanism with government rent seeking officials weakening the bidding and concession process resulting to poor working relations.
- Finally social needs will also be a function of budget constraints and will have cost implications due stringency of funds forcing the principal government in this case to seek for private partnership in realization of social goals to stem wastages.
- Finally social goals will also be determined by mechanical design for social goal realization which will be a function of many hidden behavior of both the agent and the principals official type.

We identify all major factors that might affect the PPP formation process and those that will affect the provision of social needs and argue critically that both PPP and social needs will depend on these critical factors. The theory presented is one in which public private partnership will depend on a host of factors that include: government budget constraint (BC), social needs (SC), project delivery cost (DEC), private participation (PP), private sector interest (PSI), government interest (GI), memorandum of understanding (MOU), and project efficiency (EFF). In other instances, we include liquidity to liability as a proxy for PPPs and expect to obtain the same results.

We also evaluate the effect of PPP on the social choice function in this case social needs to determine if PPP was actually optimizing the social choice function which we argue to be the goal in the provision of social infrastructure. Therefore PPP will be a function of budget constraint (BC), social needs (SC), project delivery cost (DEC), private participation (PP), private sector interest (PSI), government interest (GI), memorandum of understanding (MOU), and project efficiency (EFF) which can be expressed below as

$$PPP f(BC, SC, DEC, PP, PSI, GI, MOU, EFF)$$

PPP can now be expressed as a decreasing function of six factors which include social needs ($SC \leq 0$), cost of delivery or delivery cost ($DEC \leq$

o), private sector interest ($PSI \leq o$), government interest ($GI \leq o$), memorandum of understanding ($MOU \leq o$), and project efficiency (EFF) and an increasing function of budget constraint ($BC \geq o$).

And social needs (SC) will be a decreasing function of budget constraint ($BC \leq o$), public private partnerships ($PPP \leq o$), project delivery cost ($DEC \leq o$), government interest ($GI \leq o$), memorandum of understanding ($MOU \leq o$), and project efficiency ($EFF \leq o$) and an increasing function of private participation ($PP \geq o$) and private sector interest ($PSI \geq o$).

$$SC f(PPP, BC, DEC, PP, PSI, GI, MOU, EFF)$$

Social choice i.e. Needs (SC) can also now be expressed as a decreasing function of budget constraint ($BC \leq o$), public private partnerships ($PPP \leq o$), cost of delivery or delivery cost ($DEC \leq o$), government interest ($GI \leq o$), memorandum of understanding ($MOU \leq o$), and project efficiency (EFF).

The first set of model to be estimated using ordinary least squares (OLS) and linear mixed effect optimization estimation (LME) will now be expressed below while OLS will produce efficient estimates once the classical assumption of the linear regression model hold. Linear mixed effect estimation method allows us to find relationship between a set of unrelated variables.

$$(1.) \quad PPP_t = \beta_0 + \beta_1 X_t + \beta_2 BC_t + \varepsilon_t$$

$$(2.) \quad SC_t = \beta_0 + \beta_1 X_t + \beta_2 PPP_t + \varepsilon_t$$

We also write the equation for the simultaneous equation model estimated in equations 3 and 4, estimated using the seemingly unrelated regression estimation method which is based on the premise that solving two equations simultaneously will produce consistent and reliable estimates since their error interact with one another thereby minimizing bias.

$$(3.) \quad PPP_t = \beta_0 + \beta_1 X_t + \beta_2 BC_t + \varepsilon_{1t}$$

$$(4.) \quad SC_t = \beta_0 + \beta_1 X_t + \beta_2 PPP_t + \varepsilon_{2t}$$

In the linear model in equations 1 and 2 and the simultaneous equations model in 3 and 4 we include the variable year to capture year effect where X_t is the set of other exogenous variables in each case listed in

the model specification. We do not believe that the above stated model will be mis-specified since we also take the first difference of all explanatory variables and state the public private partnerships and social needs will depend on our list of exogenous variables from past periods since we do not expect immediate factors to affect both of them allowing us to account for multi-co linearity and autocorrelation in variables (however we only account for just one lag). The variable year accounts for annual changes in government concession regulations and contract bidding process that might affect PPP in years and it also accounts for changes in public goods utility which we describe by social needs in years which will affect demand for public projects.

Empirical Analysis, Results and Discussions

In this section we argue intuitively why the PPP formation process and social goal realization are a function of budget constraint and the PPP design process and present the results of the regressions and finally discussion on the implications of these results for the PPP process and social needs (government optimal social choice).

We present a logical argument by stating an ideal situation where government attempts to address social needs by executing projects through its public works department and finds that as time goes by rent seeking officials begin to drive up cost of project execution. It then sets up a bidding process due to the fact that overtime its liquidity liability ratio has increased significantly, in an attempt to seek alternative methods of project financing and maintenance through private partnership where efficiency is likely to be derived from the private sector profit maximization tendencies, to stem wastages and result to efficient allocation of limited resources.

The results are presented in tables 3 to 6 the results of the ordinary least squares (OLS), linear mixed effect (LME) and the seemingly unrelated regression (SUR) estimates are all the same in tables 3 to 5. Budget constraint was forcing government to private help in the social goal attainment. The two measures for budget constraint aggregate claims on government and liquidity to liability ratio were having a positive effect on PPP see Table 3. Needs were found to be having a negative effect on the PPP formation process.

This was likely due to the time of setting up a partnership needs were not likely to be met due to bureaucracy surrounding the PPP formation process see Table 3. Project efficiency is also another factor that might affect the PPP formation process efficiency in executing projects was also a concern to government since private sector firms were probably profit maximizing.

PPPs were also found to have a negative effect on social goals in Nigeria depicting the method of the design were weak and were probably not in public interest. Finally in Table 6 the results are presented for the SUR estimation using three different measures of capital which depict government capital burden and one which depicts foreign investment into Nigeria particularly for infrastructural development. Results show that foreign investment had no effect on PPP formation and were not driving infrastructural development in the Country. Private partnership was also found to encourage PPP and had a positive effect on needs. Government interests were found to have a negative effect on PPPs and needs see table 6. PPP was also probably being affected by other factors since the variable year was not significant in some instance for the PPP regression see Tables 3 to 6 implying that there are other factors such as government procurement policy and its indigenization policy that were affecting the PPP process that our model failed to capture which is a major limitation of the study.

All the set objectives of the study are realized:

- a) It was found that cost implications such as budgetary constraints which include increased claims on government were driving PPP formation and frequency (positively) in the Nigeria social infrastructural development context
- b) It was also found that the PPP process was having a negative effect on the social needs in the Nigeria infrastructural development sector depicting that project delivery through PPP, were probably slow.
- c) Social needs and project efficiency were having negative effect on PPPs, probably making the MOUs design longer with the inclusion of clauses of stringent oversight and the demand for high quality project rollout at minimal cost. Private sector partnership was also having a positive effect on the PPP formation process.
- d) Finally there were no evidence of the effect of private sector interest on PPP formation and efficiency however government interests had

a negative effect probably due to rent seeking government officials handling the bidding and concession process.

Table 3: Impact of Impact of Budget Constraint on the PPP Formation Process

	1 (OLS)	2 (LME)	3 (SUR)
Variables	PPPs	PPPs	PPPs
Budget Constraint (claims on government)	1.29*** (0.16)	1.29*** (0.16)	1.29*** (0.14)
Private Participation	-0.27 (0.62)	-0.27 (0.62)	-0.27 (0.54)
Private Sector Interest	0.55 (0.56)	0.55 (0.56)	0.55 (0.49)
Government Interest	-6.08 (1.44)	-6.08 (1.44)	-6.08 (1.25)
Social Needs	-0.56*** (0.09)	-0.56*** (0.09)	-0.56*** (0.08)
Efficiency	-9.66 (6.85)	-9.66 (6.85)	-9.66 (5.93)
MOU	1.03 (1.28)	1.03 (1.28)	1.03 (1.11)
Foreign Investment	0.01 (0.05)	0.01 (0.05)	0.01 (0.04)
Year Effect	Yes	Yes	Yes

Observations	40	40	40
R-squared	0.905		

Table 3 presents the results of the impact of budget stringency (aggregate claims on government as a percentage of GDP) on PPP formation using ordinary least squares (OLS), linear mixed effect regression (LME) and seemingly unrelated regression respectively (SUR). All standard errors are in parentheses with *** p<0.01, ** p<0.05, * p<0.1 depicting 1%, 5% and 10% significant levels respectively.

Table 4: Impact of Liquidity to Liability Ratio on the PPP Formation Process

Variables	1	2	3
	(OLS) PPPs	(LME) PPPs	(SUR) PPPs
Liquidity to liability Ratio	0.67** (0.29)	0.66** (0.29)	0.66*** (0.255)
Private Participation	1.49* (0.79)	1.49* (0.79)	1.49** (0.69)
Private Sector Interest	-1.44* (0.79)	-1.44* (0.79)	-1.44** (0.70)
Government Interest	-3.13 (1.46)	-3.13 (1.46)	-3.13 (1.29)
Social Needs	-0.38 (0.29)	-0.38 (0.29)	-0.38 (0.252)
Efficiency	-44.71*** (14.32)	-44.71*** (14.32)	-44.71*** (12.61)
Foreign Investment	0.12 (0.08)	0.12 (0.08)	0.12* (0.07)
Year Effect	No	No	No
Observations	40	40	40
R-squared	0.75		

Table 4 presents the results of the impact of budget stringency (government liquidity to liability ratio a different measure of budget constraint with the results being the same depicting that the results are robust and our model not mis-specified) on PPP formation using ordinary least squares (OLS), linear mixed effect regression (LME) and seemingly unrelated regression respectively (SUR). All standard errors are in parentheses with *** p<0.01, ** p<0.05, * p<0.1 depicting 1%, 5% and 10% significant levels respectively.

Table 5: Impact of PPP on Needs

Variables	1 (OLS) Need	2 (LME) Need	3 (SUR) Need
Public Private Partnerships PPP	-0.41** (0.15)	-0.41*** (0.15)	-0.41*** (0.13)
Foreign Investment	0.12 (0.09)	0.12 (0.09)	0.12* (0.07)
Private Participation	2.34** (1.11)	2.34** (1.11)	2.34** (0.96)
Private Sector Interest	2.55*** (0.82)	2.55*** (0.82)	2.55*** (0.71)
Government Interest	-4.75* (2.53)	-4.75* (2.53)	-4.75** (2.19)
Memorandum of Understanding	-5.50** (2.22)	-5.50** (2.22)	-5.50*** (1.92)
Project delivery	0.01 (0.02)	0.01 (0.02)	0.01 (0.02)
Cost of Completing Projects	-0.14 (0.11)	-0.14 (0.11)	-0.14 (0.09)
Year Effect	Yes	Yes	Yes
Observations	40	40	40
R-squared	0.96		

Table 5 presents the results of the impact of PPP on needs (the optimized social choice function) using ordinary least squares (OLS), linear mixed effect regression (LME) and seemingly unrelated regression respectively (SUR). All standard errors are in parentheses with *** p<0.01, ** p<0.05, * p<0.1 depicting 1%, 5% and 10% significant levels respectively.

Table 6: Foreign Interest Effect on The PPP formation Process and Social Goals Realization

Variables	1 (SUR) PPPs	2 (SUR) Needs	3 (SUR) PPPs	4 (SUR) Needs	5 (SUR) PPPs	6 (SUR) Needs
Budget Constraint	1.26*** (0.15)	1.74*** (0.29)				
Liquidity/ Liability Ratio			0.83*** (0.20)	-0.84*** (0.24)		
Foreign Interest					0.11 (0.07)	0.12 (0.07)
Private Participation	-0.02 (0.62)	0.50 (1.02)	1.34* (0.77)	2.77*** (0.88)	2.996*** (0.85)	3.02*** (0.95)
Private Sector Interest	0.85 (0.52)	2.23*** (0.72)	-1.67*** (0.64)	2.07*** (0.74)	-1.11 (0.74)	1.95*** (0.70)
Government Interest	-1.32 (1.50)	-2.61 (2.33)	-1.66 (2.15)	-5.36** (2.24)	-4.94** (2.24)	-5.91*** (2.18)
Social Need	-0.54*** (0.07)		-0.04 (0.13)		-0.74*** (0.14)	
Efficiency	-0.86 (5.41)		-25.27*** (8.81)		-31.37*** (8.95)	
MOU	0.46 (1.34)	-0.57 (2.21)	-1.59 (1.99)	-5.85*** (2.03)	-5.51*** (1.90)	-6.86*** (1.89)
Project Delivery	-0.01 (0.01)	-0.01 (0.02)	0.003 (0.02)	0.004 (0.02)	0.01 (0.02)	0.02 (0.02)
PPP		-1.35*** (0.17)		0.05 (0.16)		-0.56*** (0.13)
Delivery Cost		-0.005 (0.05)		-0.01 (0.07)		-0.10 (0.09)
Year Effect	Yes	Yes	No	Yes	Yes	Yes
Observations	48	48	46	46	40	40
R-squared	0.86	0.97	0.78	0.97	0.67	0.96

Table 6 presents the results of the impact of PPP on needs (the optimized social choice function) and the impact of budget stringency on PPP formation. The effect of foreign investment in the infrastructure sector were also evaluated on needs and the PPP process using ordinary least squares (OLS), linear mixed effect regression (LME) and seemingly unrelated regression

respectively (SUR). All standard errors are in parentheses with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ depicting 1%, 5% and 10% significant levels respectively.

Conclusions

PPPs were found to be currently driven by budget limitations for social project execution, It was also found that due to enormity of social needs which have to be met in Nigeria, and since the PPP formation process takes time, needs were probably reducing the use of PPP in project execution in Nigeria. Due to need to satisfy electoral demands the PPP formation process were probably being affected since it takes time causing needs to have negative effect on PPP showing that the electoral process mattered in PPP design.

PPPs were also found to need efforts in the planning stages since poor planned and designed projects will lead to non-attainment of social goals, which also resulted to PPP having a negative effect on social needs in Nigeria. The implications of our results are that the PPP process in Nigeria were generally not well implemented and were not having positive effect on social goal attainment also the MOUs surrounding PPPs were probably weak and were exerting negative effects on PPPs and on the provision of social needs see Table 6.

The findings support past work by Lewis (1986), Hart and Holmstrom (1987) and Laffont and Tirole (1989) who all examine a reputation model where the extent of under-investment and cost overruns are function of length and the relationship between the principal and agents and state that while relationships might be a condition for the guarantee of appropriate investment issues of cost overruns such as changes in technology which they state do not cause agency problems are also important, since they result to upgrading or downgrading cost simplification and state that the issue of cost underestimation in order to secure contracts present challenges for the principal who might need to support the agent. This was true since how efficiently project are executed will depend on cost factors, our results show that project efficiency had a negative effect on PPPs depicting that firms were probably under reporting cost in the bidding stage. The policy implication of the study is that more transparency in the bidding and public concession process will be required to make PPPs live up

to the expectations of the society and finally managing projects effectively, could also improve social goal attainment in a significant manner.

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