Doctoral Thesis (Abridged)

# A Strategic Analysis on the Effects of Contract-type on Contract Termination in Public-Private Partnerships in Sub-Saharan Africa

# （サブサハラ・アフリカ地域の PPP 事業における契約解除問題の戦略分析）

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# Abstract

The termination of a contract in a public-private partnership (PPP) before the expiration and fulfilment of the pre-specified terms and duration is a topic that raises a number of questions. This study examines how theories on contracts, transaction costs and industrial organizations contribute to the understanding on the problem of contract termination in public-private partnerships. The study starts with a review of the definitions of a public-private partnership, and the factors that have led to their greater use in the provision and operation of public infrastructure services in sub-Saharan Africa, and the world in general. It then examines the problem of contract termination, and the various perspectives on the determinants of contract termination. Using a formal analysis of the holdup and underinvestment problem, the study illustrates the mechanism through which the partners' respective investments and contributions affect the social surplus of a PPP, and how the social optimality or sub-optimality of the partners' investments and contributions emanate from the specifies that characterise the configuration of the partners' payoffs and entitlements in the PPP contract. The formal analysis in the study led to the identification of the contract-types that are vulnerable to the inefficiencies that result from the holdup and underinvestment problem. Using the rough sets theory and the logic of explanatory power, the study generated a set of decision rules that are then used to assess the explanatory relevance of contract-type and other attributes in the respect of contract termination in a PPP. A multiple regression model was also used to assess the statistical relationship between contract termination (the dependent variable) and contract-type, a project's sector and the nationality of the project's sponsor. The results of the study's empirical analysis identify contract-type as a significant factor in the explanation of contract termination in PPPs. Besides having higher certainty coefficient, the result of the study indicates that the measures associated with the decision rule that are based on contract-type were less sensitivity when compared to the other explanatory attributes. In addition to the empirical analysis, the study used two case studies (the Tanzanian Railways Limited and the Nigerian Telecommunications Limited) to facilitate the understanding on the problem of contract termination in a PPP in real life contexts. A main relationship in the findings of the two case studies and the empirical analysis lies in the identification of how the successful implementation of a PPP depends on the problems that are associated with the contract-type.

# 1 An Introduction to PPPs and Contract Termination

## 1.1 Overview

This chapter explains the meaning of public-private partnerships and the factors that have led to its greater use in the provision and operation of public infrastructure services around the world. Besides explaining the problem of contract termination in public-private partnerships, the chapter also contains a summary of various perspectives on the determinants of contract termination. Some of the highlights of the review include, the inconclusive nature of extant studies on contract termination, a specification of the study's main objectives, and the factors that motivated the study's focus interest in strategic analysis. The chapter concludes with some remarks on the study's significance, the justification of the study's methodological orientation, and an outline of the thesis.

## 1.2 Public-Private Partnerships

In general, "the term public-private partnership (PPP) does not have a legal meaning and can be used to describe a wide variety of arrangements involving the public and private sectors working together in some way" (World Bank, 2009, p. 6). In this study however, a PPP is defined as a contract between a private investor and a government or public authority for the provision of infrastructure services. It is a process through which a government or public authority confers on a private investor or firms the rights to design, finance, build, rehabilitate, operate and maintain a public infrastructure for an agreed period of time. It is basically a means that facilities the participation of private investors in the provision of public infrastructure services.

Besides the usual assumptions on the economic and social importance of infrastructure, there are various practical and theoretical reasons that make a study on PPP quite apt and motivating. In practice, when faced with budget constraints, the challenge of maintaining depreciating infrastructures, and the need to meet growing demand for the development of new ones, many countries have increasingly relied on mobilizing private investment through public-private partnerships. Encouraging private

investment in infrastructure development has become a top priority in the agenda of many governments in both developed and developing countries.

There are many studies on the benefits of a PPP (McQuaid, 2000; Li & Akintoye, 2003; Edkins & Smyth, 2006; Shen et al., 2006; Cumming, 2007; and Tang et al., 2009). In general, the rationales for Public-Private Partnership are often based on the benefits of competition, the efficiency of private ownership, and the notion of collaborative advantage. Other often cited reasons include the challenges of public budget constraint, and the benefits of task bundling.

As a matter of fact, the notion of competition (one of the earliest justifications for a PPP) is traced to the seminal studies on the benefits of concession and competition. Based on this view, a PPP is seen as a means that can increase investments and competition in the provision of public utilities (Demsetz, 1968). It is further argued that:

> "When competition in a market is infeasible, such as for a natural monopoly, it may be feasible to have competition for the right to supply a market. (In the background is a desire to move away from the inefficiencies engendered by regulation by substituting competition.) It might be possible to organize such competition for the market if inputs to supply the market were available to bidders at competitively determined prices and if there were no collusion so that the outcome of the competition was indeed competitive" (OECD, 2006, p. 17).

Notably, the main contention is that, the introduction of competition through concessions in natural monopolies (a status that most state enterprises enjoy) can be beneficial to public service delivery. Similarly, Parker and Keith (2003) note that, since a PPP bidding process often involves cost-efficiency incentives, the private sector would typically align their bids towards lower cost and timely delivery. In such a case, a PPP is seen as a process that exposes formerly protected public-service delivery systems to competition. By so doing, the "government is able to save money by securing the provision of services at the lowest possible cost" (Domberger & Jensen, 1997, p. 68).

Another similar contention in the literature regarding the importance of a PPP is that, private sectors have higher incentives to perform, given their vulnerability to

competition and bankruptcy. This view is essentially based on the assumption that many public enterprises are often immune to competition and bankruptcy, unlike their private counterparts. Based on this view, Domberger and Jensen (1997) study the effects of competition in public service delivery, using the concept of a 'contestable' market. The main conclusions in the study are that, a PPP facilitates the introduction of "contestability" in the provision of infrastructure services, and that such competitions in service delivery can generate efficient "outcomes in terms of price and output" (Domberger & Jensen, 1997, p. 69).

Other often-cited justification for a PPP include, the challenge associated with a government's budget constraints, and the benefits of task bundling. With respect to budget constraints, Clark and Root (1999) note that the move towards public-private partnerships emerged as a method by means of which governments utilize private sector investment capital to revitalize public services. As an example, ADB (2007) notes that maintaining an appropriate level of infrastructure in the society requires a lot of funds. As a result, most governments have come to see their limited financial capacity as a justification for the mobilization of private finance. This view is also supported by the contention that "efficient use of scarce public resources is a critical challenge for governments—and one in which many governments fall far short of" (ADB, 2007, p. 3).

With particular reference to developing countries, Harris (2003) notes that, "public sector monopolies tended to be plagued by inefficiency and failed to expand services to meet rapidly growing demand. Many were strapped for resources because governments succumbed to populist pressures to hold prices below costs" (Harris, 2003: 3). In addition, Harris (2003) argues that in the 1990s, the provision of critical infrastructure in some developing countries was marred by persistent inefficiency and corruption. These in turn constrained the adequate provision of services to existing consumers, and the expansion of services to new areas. Consequently, the annual losses from inefficiencies and poor pricing policies by the early 1990s were projected to equal the annual investment in infrastructure. On the basis of these losses and poor performance, a main contention was that, providing continued support for these "loss-making public enterprises" was an option that governments could not continue to continue with. The formation a PPP was thus seen as a means that could lead to greater efficiency (Harris, 2003).

In Sorrell's (2007) estimation, the extent of cost reduction with respect to private provision comes from technical *efficiency*, market incentives and competitive bidding. Regarding technical efficiency, Sorrell (2007) argues that many public enterprises lack the expertise to manage some complex projects in the midst of multiple responsibilities. In addition to the contention that government provision may shield staff from the market incentives, Sorrell (2007) contends that, "limited competition provides scope for inefficiency and monopolistic pricing." In addition, the scope for inefficiencies is said to hinge on the absence of performance incentives within the contract or the incredibility of the threat of switching to another public enterprise.

Other aspects emphasized in respect of private efficiency include references to the benefits of task 'bundling' (Martimort and Pouyet, 2008). The main point emphasized in this regard is that, in comparison with traditional procurement, a PPP is often typified by the bundling of two or more tasks together. Under such arrangements, the concessionaires are aware that their failure in the initial tasks (such as construction) may affect their performance in the implementation of other tasks (such as maintenance) in the project life cycle. It is argued that the combination of different phases in a project life cycle into a single package can increases efficiency, and whole-of-life costs reduction. In this way, the concessionaires' are motivated to consider long-term efficiency and costs in their choices (Iossa and Martimort, 2008).

Finally, with reference to the notion of "collaborative advantage", Huxham and Vigan (2000: 293) argue that, the benefits of PPP centres on the fact that it facilitates the achievement (i.e., of large-scale projects) of things that would have been difficult or impossible without the use of both public and private resources. Based on this perspective, a PPP is often defined as a cooperative venture that harnesses the expertise and resources of the public and private sectors. The ultimate goal of a PPP is to meet clearly defined public needs. In view of these expectations, there is therefore a need for a study that addresses any factor that can lead to botched PPP or the problem of contract termination in a PPP.

## 1.3 The Issue of Contract Termination in a PPP

By definition, a PPP contract is considered terminated if the private sector exits from the project before fulfilling the contract terms. Besides this general definition, the occurrence of contract termination in a PPP is associated with the following set of

events. Usually, upon the termination of the contract, the private investors are forced to sell or transfer their entire economic interests back to the government. In addition, the investors would have to remove all management and personnel or staff from the project in question. Following the revocation of the license or repudiation of the contract, the investor would also have to cease the project's operation, service provision or construction (Harris et al., 2003).

In view of the merits associated with increased private investment in public infrastructure and the problems associated with the untimely cessation of a project's and/or construction and operation, the termination of a PPP contract can be a discouraging experience. In most cases, contract termination can lead to a project's abandonment, delayed construction or non-completion, and the additional costs associated with the further deterioration of an uncompleted project. The termination can also lead to protracted disputes and court cases. More so, when a contract is terminated, the formation of another partnership can be troublesome, giving the trust issues that the initial termination would raise. Generally, the consequences of contract termination can be costly. Based on some of these aforementioned negative fallouts, contract termination in a PPP is arguably an issue that deserves a careful study.

Notably, discussion on the determinants of contract termination in a PPP have been shaped by references to exogenous socio-economic shocks and factors (Harris et al., 2003; Harris and Kumar, 2009; Hammami et al., 2006; Burger et al., 2009; Renato, 2009). A common explanation in this regard is that, such economic shocks stifle the finances that are necessary for the successful fulfilment of a PPP contract. As Burger et al (2009) notes, the likely effects of crisis in the economy on PPPs can include higher costs of credit, revenue cash flows shortfalls, decreased return rates, and unanticipated exchange rate volatilities. In particular, reductions in the rates of return (as result of lower demand) have been identified as factors that are very detrimental to a partnership's debt-servicing capacity and overall profitability. In response to such crisis, it has become imperative to design policy measures that can mitigate the attendant challenges associated with a financial crisis. Apart from renegotiation, such measures have included the introduction of various fiscal stimulus packages, minimum revenue guarantees, exchange rate guarantees, and other forms of insurance.

In addition to the issues associated with exogenous socio-economic shocks and factors, issues related to strategic behaviour have equally received some mention. As an example, Russell et al. (2006) contains a framework that shows the host of factors

that could drivers and inhibit the implementation of a PPP project. Figure 1 depicts the main factor in Russell et al. (2006).

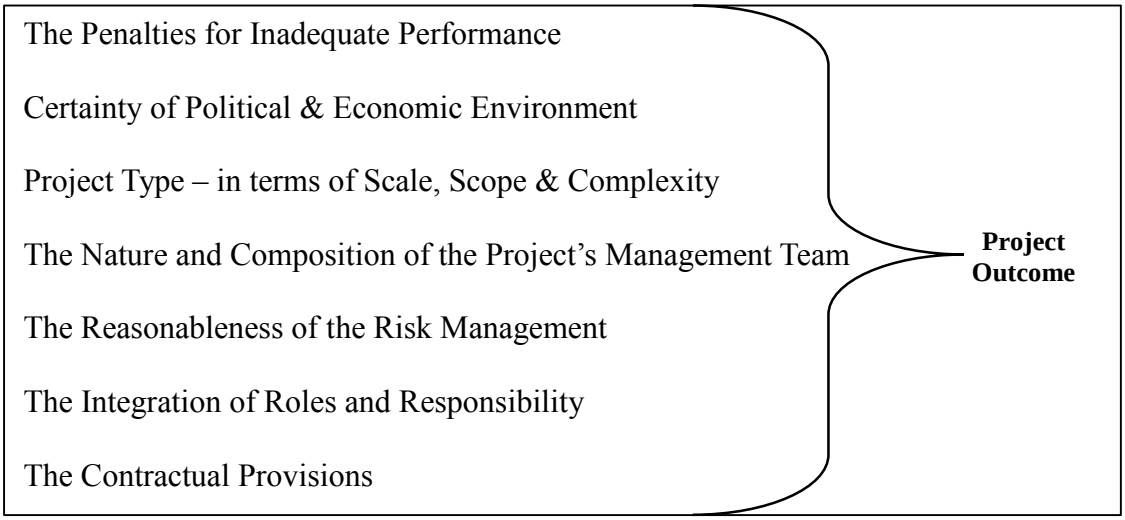


**Figure 1: Factors that affect Project Performance**

(Adapted from Russell et al., 2006, p. 1530).

Observably, Figure 1 shows the different factors that can affect the implementation of a PPP project. Some of the highlights of the conceptual framework in Russell et al. (2006) include: the role of a project's type (in terms of scale, scope and complexity), the nature and the composition of the project's team (in terms of their expertise and motivation), the risks associated with the uncertainties in the socio-political and economic environment, and the assignment of risk and penalties. Although not clearly stated in Figure 1, some of the issues mentioned in Russell et al. (2006) are overly endogenous, particularly those related to contractual provisions and the integration of roles and responsibility. The framework can thus be rightly referred to as an expanded version of the possible determinants of contract termination.

As with Russell et al. (2006), Renato (2009) has come up with a framework (as depicted in Figure 2) that shows the interaction between contract's outcome and a host of factors that emanate from macro-economic conditions, political risk, contract design, etc.

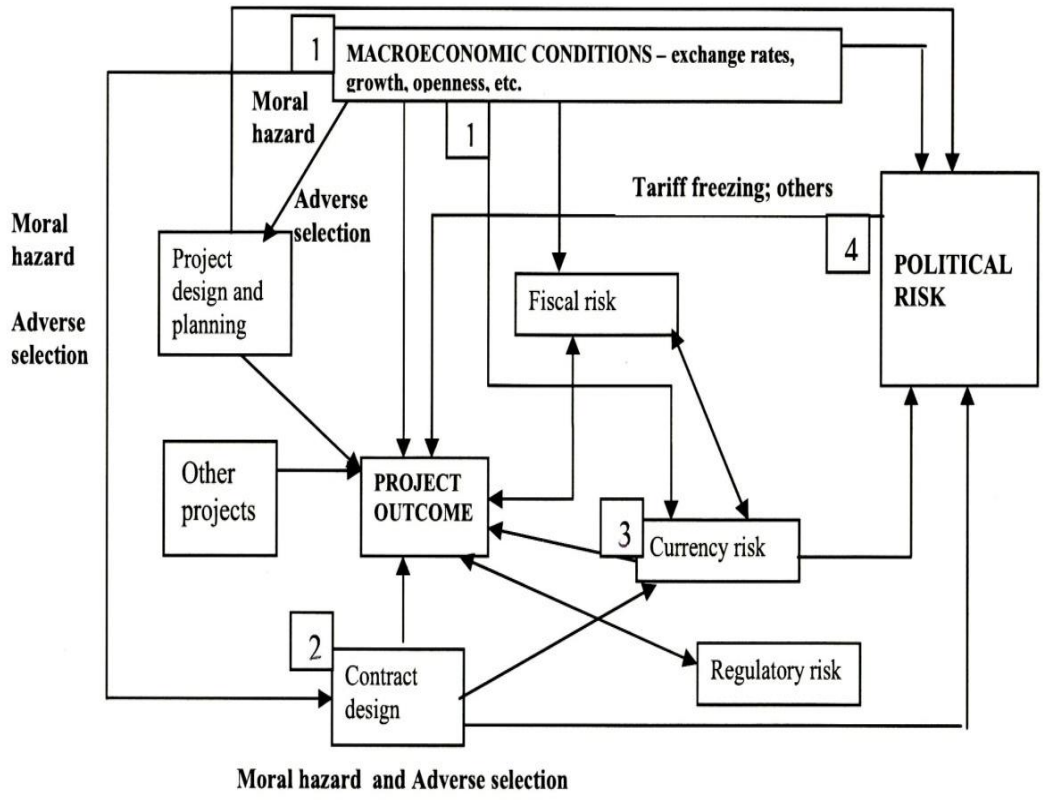


**Figure 2: The Divers of PPP Distress and Termination**

(Adapted from Renato, 2009, p. 12).

In relation to the role of the factors in Figure 2, it is argued that "a nation's capacity and readiness to undertake PPP in infrastructure depends on a number of risk factors that are specific to the country" (Renato, 2009, p.1). Specifically, a PPP project's outcome (in terms of distress, failure or termination) is attributed to the macroeconomic environment, currency risks, and political risks. On the one hand, it is argued that "macroeconomic channels of risk are those primarily related to exchange rates, growth, openness, fiscal imbalances, etc."(Renato, 2009, p. 20), while political risks refers to the actions taken by government executives, sudden changes in investment laws, expropriation, etc. In addition to the factors associated with the macro-environment, the figure has also identified some issues (moral hazard and adverse selection) that are related to contract design. Given the pervasive role that the duo - adverse selection and moral hazard are associated with in principal agent modelling and transactions costs

economics, it is argued that they can equally create potentially serious incentive problems that contribute to the vulnerability of PPP projects.

## 1.4 Summary of the Research Objectives

The main objectives of the study are summarised as follows:

i. To formalize the connection between contract-type and the factors that lead to contract termination in a PPP;
ii. To identify the forms of PPP contracts that makes the society better off or worse off; and
iii. To identify how participants' interpretation of a contract's termination in actual cases corroborate the deductive consequences of the formal model

## 1.5 The Need for a Strategic Analysis

The type of additional study that is needed to achieve the study's objectives has a lot in common with Williamson's (1985, p. 529) *"*microanalytics*"- a* methodology for studying the impact of the transaction cost features of a contract in transactional failures (Williamson, 1985, p 533). Based on this perspective, first, one can rightly define a PPP as a transaction, or a contractual relation between the public and the private sector. This definition makes the analysis of contractual problems in a PPP more amenable to the microanalytics methodology – a process that will entail the examination of "the contracting process in great detail … to discern the types of difficulties" that will likely result in the course of the partnership. Significantly, in addition to the use of empirical works, the main unit of a microanalytics methodology is the transaction itself, and how its specificities shape parties' incentives and opportunities to the transaction in question. Moreover, it is argued that, an important element of a contractual relationship "is the willingness of the persons to contribute their individual efforts to the cooperative system" (Barnard, 1938, p. 139). As further argued, inadequate incentives can lead to a dissolution or non-cooperation. As a result, "in all sorts of organizations, the affording of adequate incentives becomes the most definitely emphasized task in their existence" (Barnard, 1938, p. 139).

In line with the basic assumptions in transaction-cost economics, one of the main contentions regarding the suitability of the microanalytics approach is that

"studying transaction detail typically reveals contending interests among the parties to a transaction; the microanalytic approach explores the parties' political and strategic actions as a game" (Gibbons, 2010: 266). Consequently, it is argued that the decisions that lead to premature contract termination can be seen as an outcome of contentions in the respective interests of the partners, since most of such decisions and contentions end up in various investment dispute settlement forums. One can also argue that such contentions are likely to arise, based on the shape of "incentives and opportunities" in the partnership.

Since the main purpose of a PPP contract is to facilitate an exchange between the host government and the private investor in infrastructure, from a transaction cost perspective, a PPP contract termination can be referred to as a transactional failure. In this regard, it can be argued that such problems are sometimes best explained by reference to these two factors: the nature of the transaction, and the combination of a set of human attributes and incentives. Regarding the latter, Williamson (1973) notes, "in as much as economics is a social science concerned with exchange" the pervasive effect of (largely non-technical) human factors is perhaps unsurprising (Williamson, 1973: 316). In summary, the concepts of bounded rationality, information asymmetry and opportunism are used to capture some of the additional problems that can lead to a transactional failure. Essentially, the effects of these factors are common in the study of some of the problems that in arise in economic transactions. The dimensions and implications of these factors in relation to the nature of PPP transactions are further explained as follows.

**Bounded Rationality**

The term rationality has come to "denote a style of behaviour that is appropriate to the achievement of given goals, within the limits imposed by given conditions and constraints" (Simon, 1972: 161). Thus, the problem associated with bounded rationality feeds on the inefficiencies and inappropriate actions that are associated with a PPP contractor's imperfect information or knowledge about the possible quality or state of any of the factors that impact on the project's success and implementation.

In general, theories of rational behaviour "are based on the idea that an individual decision maker makes an optimal choice from some given set of alternatives" (Hoy et al., 2011: 227). Formally, optimal choices are defined in terms of the minimization or maximization of some objective. Moreover, a partners' optimal

decision can be referred to as a solution to some constrained optimization problem. Implicitly or explicitly, a partners' optimization will involve a "sound" knowledge of the linkages and relationship between the variables and parameters in the decision-making problem that the partnership presents. As with many real-life decision-making problems, it is important for the partners to take into account the entire factors and constraints that can affect the achievement of the partnership's objective. In such a case, an imperfect knowledge about the factors and constraints would an undermining effect. This requirement for prefect information inevitably leads to the questions of how to identify all the conditions and constraints (contingencies) in the environment that can affect the objectives in the partnership, and how to mitigate the constraints that emanate from the limitations in the partners' information processing capacity.

Regarding these two questions, the general assumption in the literature (Simon, 1972; Aumann, 1997; Rubinstein, 1998) is that, there is no such thing as perfect knowledge when risks and uncertainty are involved. This is the main tenet of the bounded rationality assumption. At best, the assumption of perfect knowledge is replaced with some assumption on the probability distributions of the relevant parameters in the partners' decision-making problem. Hence, it is argued that:

> "In situations where complexity and uncertainty make global rationality impossible, …optimization becomes approximate optimization – the description of real-world situations is radically simplified until reduced to a degree of complication that the decision maker can handle" (Simon, 1972: 170).

As a result, the partners' decisions and the design of the contract that would guide the transaction may end up involving a simplification of the real-world problems in a manner that will permit the application of formal optimization models. In addition to the use of approximation, some of the endogenous factors that have elements of uncertainty would have to be defined in the terms of state space and probability distributions, while those that are relevant but beyond the partners' control would be taken as given. On the whole, some element of the partners' decisions (particularly those that impact on actual risks and payoff) may depend on some imperfect information. Also, since the decisions on some of the PPP contract's terms are somewhat based on approximations; in the long run, the decisions that appear best in

the approximated world (under the partners' assumptions and incomplete information) may turn out to be sub-optimal in the real world.

Consequently, the theory of bounded rationality is associated with these three inter-related issues: uncertainty, complexity and incomplete information. These are referred to as the three barriers on perfect rationality. Respectively, there may be uncertainty about some aspects of the partnership or the connection between each term specified in the PPP contract and the possible consequences that could result. Likewise, incomplete information captures the fact that the partners may not have a perfect knowledge of all the contingencies in the project's environment. Finally, even if all the relevant contingencies are known, another problem concerns the limitations of the partners' information processing capacity. In addition to the contract, the design and implementation of the project can also embody some forms of complexity and uncertainty. As argued in Williamson (1973: 317), complexity captures the limits in "the capacities of individuals to receive, store, retrieve and process information without error." Thus, if one defines the partners' decision as the choice of the set of strategies that will guide the achievement of their respective objectives in the partnership, then, the problem of bounded rationality resides in the fact that the partners may have incomplete information about the future consequences of their initial decisions.

In sum, as with any long-term contract, bounded rationality could also lead to incomplete PPP contracts. Specifically, as a long-term contract that is implemented under uncertainty, complexity and incomplete information, the terms of the PPP contract may exclude some unanticipated future contingencies. In addition, the adequacy of some of the safeguards to both foreseen and unforeseen future contingencies may be difficult to ascertain in advance. Thus, ex-post haggling – as an adaptive, decision-making process may become necessary in the course of the partnership. In the worst-case scenario, the ensuing haggling may give rise to disputes, incompatible claims and contract termination.

**Information Asymmetry**

Studies on the problems that could arise from information asymmetry (e.g. Bolton and Dewatripont, 2005; Williamson, 1973; Katz, 2005) generally focus on adverse selection and moral hazard. Usually, these hazards are examined in the context of a principal-agent relationship. In the context of a PPP however, the problem of adverse can be said to have occur when the one of the partners in the PPP hides some information about

their ability to perform certain tasks in from each other. Likewise, the occurrence of a moral hazard problem would refer to situations where one of the partners is uninformed of what the other partner does – particularly when the other partner's actions are hidden or unverifiable. Based on the definition of an optimal decision as a solution to a constrained optimization problem, the main problem that arises in the context of information asymmetry in a PPP feeds on the possibility that one of the partners may have an incentive to withhold some of the information that are necessary for the other partner's optimization program.

Thus, the "strategic disclosure of asymmetrically distributed information" (Williamson, 1973: 317) can be referred to as an effective constraint on optimality of the partners' decisions in a PPP. At the extreme, a decision that is taken under asymmetric information may even turn out to be irrational or highly detrimental to the successful implementation of the partnership. Accordingly, a major contention in this regard is that, informational problems can constrain a PPP. In addition, it is argued that, "if the parties have asymmetric information regarding some aspects of their exchange, the better informed party may prefer to leave an issue unraised for strategic reasons" (Katz, 2005: 172). Another general conclusion in this regard is that, the un-verifiability associated with information asymmetry can create incentives for cheating and free riding in a PPP. As argued in Holmstrom (1979), the incentives for such contractual damaging tendencies often arise when the relationship between hidden actions and the ensuing outcome are uncertain.

Notably, adverse selection and moral hazard problems are common in PPP literature and public-procurement in general. As an example, based on the conceptualization of a PPP as a principal-agent relationship (the government being the principal, and the private investor - the agent), a PPP is referred to as a framework that allows the government to delegate some institutional public functions to the private. As with every principal agent relationship, the private investor can get a concession to use a public property as in the course of the delegation. In return, the private receives a compensation for delivering the stated services on behalf of the government. Given this principal-agent framework, the problems that are inherent in *non-verifiability* and *observablity* have been identified. With reference to adverse selection, reference is made to the possibility that an inefficient bidder in a PPP project may have an incentive to cheat to win a competitive PPP bid. Furthermore, in Bull's (2006) "Costly Evidence Production and the Limits of Verifiability", reference is made to how complicated it

can be to apportion blames when things go wrong in a PPP, especially when uncertainty is involved in some aspects of the partnership. Likewise, Martimort & Pouyet (2008: 18) contend that the delegation of public facility infrastructure development is apparently vulnerable to moral hazard, given the difficulty that is involved in the verification and quantification of a project's actual intrinsic qualities.

Concerns about the problems that arise from information asymmetry are the main basis for various mechanisms on contractor screening and risk allocation in a PPP. These often include the incorporation of appropriate measures that will curb the partner' incentives to resort to activities that are inimical to the other partner's objectives.

**Opportunism**

By definition, opportunism is referred to as "an effort to realize individual gains through a lack of candour or honesty in transaction" (Williamson, 1973: 317). It comprises of all selfish actions that are inimical to the achievement of a partnership's overall objectives. Simply put, the recourse to opportunism can be referred to as a hallmark of the self-interestedness that characterizes economic actors.

An interesting point regarding the problem of opportunism refers to the fact that occurrence of opportunism is somewhat dependent on information asymmetry, the emergence of an unforeseen event or the emergence of an exploitable circumstance. As with many long-term contracts, it is possible for the partners to integrate some flexibility and a range of gap-filling procedures that will facilitate the re-adjustment of the incomplete contract to emerging contingencies in the partnership. However, the implementation of new changes or adjustments will not necessarily preclude the possibility of additional incentive problems. The re-adjustment process may still embody the holdup problem or some easily exploitable opportunities. Due to uncertainty and bounded rationality therefore, the prevention of the occurrence of the circumstance that are conducive for opportunistic behaviour a PPP transaction may be impossible. In other words, the opportunities for opportunism may be difficult to prevent. At best, one can look at how the opportunities are exploited, as well as the factors that will inform a partner's disposition towards such opportunities.

**The Nature of investments in PPP**

It is generally assumed that most contractual problems will become less sever in the absence of opportunism. Interestingly, opportunistic behaviour is a problem that

usually arises during contract execution, when initial investments in the transaction are sunk. This makes opportunistic behaviour a rallying point of the main incentive problems that could result from bounded rationality and asymmetric information. In turn however, the severity of opportunistic behaviour will rely heavily in the nature of investments in a PPP.

First, the notion of *asset specificity* captures the vulnerability a partner's initial investment to opportunistic behaviour in a PPP. The main insight in this regard is that, investments in specialized assets are easier to holdup. As a common feature of infrastructure projects (e.g. power plant, bridges and railway), asset-specificity reflects the fact that most of the expenses incurred in a PPP may be of little or no use outside the partnership. In addition to the nature of the products (public goods), the physical attributes of such projects alone make transferring them to alternative uses or buyers virtually impossible. In essence, even if it is possible for a partner to transfer a PPP asset to other uses, it will be difficult however to find the right market or alternative buyers. Hence, in as much as the value of an infrastructure project "in other uses is by definition much smaller than the specialized use for which it has been intended" (Williamson, 1979: 240), an investor in a PPP is effectively held-up or locked-into the partnership to a significant degree. In such a case, opting out of the partnership may result in losses or some undesirable cost implications.

Moreover, there are two main risks that result from the length of the partnership. Unlike spot contracts, the long-term nature of a PPP contract may necessitate some adjustments in the terms of the contract, in response to changing circumstance. Furthermore, most of the "sunk" expenses in a PPP are made in lieu of future return. Due to the strategic implications of assets specific, the benefits of the "sunk" investment can only be realized as long as the partnership is maintained.

## 1.6 Remarks and the Structure of the Thesis

Summarily, the significance of this study is based on the negative effect of contract termination on the promotion of private investment in infrastructure projects, the inconclusive nature of the existing studies on the problem of contract termination (particularly in sub-Saharan Africa), and the need for a theoretical perspective. A general conclusion that one can draw from the foregoing is that, beyond the problem of macro-economic and political variables, there are a host of other factors that can

enhance the possibility of contractual problems in a PPP. In other words, the study of contract termination in a PPP will be incomplete if the difficulties that are inherent in a strategic relationship are ignored. Most of the additional factors that the study expands into reside on the difficulties that could arise from the nature of the partners' incentives in a PPP. This justifies the micro-analytic perspective. Thus, the main significance of this study lies in its theoretical perspective: its focus on the nature of incentives and payoffs in a PPP, and the contentions that can result therefrom.

The thesis comprises of seven chapters. The current chapter introduces the study's general background, the main objectives and research questions, a review of existing literature, and the study's significance. The second chapter elaborates on the study's scope and rationale. The third chapter explains the research design and the study's approach. Other issues covered in chapter three include the study's method of methods of quantitative and qualitative analysis. The fourth chapter presents the results of the empirical analysis on contract termination. The fifth chapter contains a formal analysis on how contract-type affects a PPP. It focuses mainly in the study's theoretical framework, the holdup model, and a proof of a formal proof of the possible connections between contract type and the realization of inferior outcomes in public-private partnerships. Chapter six contains the qualitative findings from an analysis of two cases that contextualize the problem of contract termination. The seventh chapter, the conclusion, recaps the study's main findings, contributions and the recommendation for future studies.

# 2 An Elaboration of the Research Scope and Rationale

## 2.1 Overview

This chapter elaborates on the scope of the study – in terms of some of the interesting trends of public-private partnerships in Sub-Saharan Africa. The chapter also summarises some of the highlights of contract termination in the region, and how such highlights fit into the broader literature on the questions of differential vulnerability. It then concludes with a summary of the observed patterns of differential vulnerability, and some preliminary remarks on the factors that seem to drive such trends.

## 2.2 Scope of the Study: PPP in Sub-Saharan Africa (SSA)

The extent of the area and cases that this study deals with is PPP in Sub-Saharan Africa. The data used in the study is based on the 47 countries with PPP projects in region (from 1990 to 2012). There are various factors that motivated the scope of the investigations. Some of the main reasons relate to the centrality of infrastructure to the development of Sub-Saharan Africa, and the roles that PPPs play in the region. Besides, the region embodies a number of interesting developments. As an example, the Sub-Sahara is the region for some of the ten fastest-growing economies in the world. Notably, "economic growth in Sub-Saharan Africa (SSA) continues to rise from 4.7 percent in 2013 to a forecasted 5.2 percent in 2014. According to the World Bank's new Africa's Pulse, there a consensus that "this performance is boosted by rising investments in natural resources and infrastructure, and strong household spending" (World Bank, 2014). Despite the regions impressive growth (in terms of average rate of economic development in SSA), poor physical infrastructure has continued "to limit the region's growth potential. Significantly more infrastructure spending is needed in most countries in the region if they are to achieve a lasting transformation of their economies" (World Bank, 2014). The region also lags behind in its ability to attract greater private investment in the infrastructure sector, in comparison with other developing regions. These led to the conclusion that increased private investments in infrastructure will play a significant role in the achievement of the region's development targets in the coming years.

### 2.2.1 Regarding Sub-Saharan Infrastructure Deficit

The reports of a number of international development organizations indicate that "Africa lags well behind other developing regions in access to infrastructure services" (Banerjee et al. 2008, p. 1). As an example, Banerjee et al. (2008) estimate on the availability of infrastructure services in the regions indicates that access to electricity and pied water connections is a little more than 20 and 12 percent, respectively. Moreover, given the concentration of basic infrastructure services to upper income residences and the richest segments of the population, some concerns have been raised in relation to the inequality of access.

In general, it is noted that "nowhere is lack of infrastructure more crucial and potentially transformational than in Sub-Saharan Africa" (Gutman et al. 2015, p. 1). Internationally, the region seems to lag behind other regions in most measure or indicators of infrastructure access and coverage. The differences are particularly large in the electricity generation and distribution, as well as in terms of paved-road density. As the World Bank (2014) notes, "unreliable and expensive electricity supply and poor road conditions continue to impose high costs on business and intraregional trade." Some of the factors that escalate the cost of providing infrastructure services in Sub-Saharan Africa are attributed to "the small scale of production, the reliance on suboptimal technologies, or the inefficient management of resources" (Foster & Briceno-Garmendia, 2010, p. 49). In addition, the unreliability of power supply has helped deepen the reliance of many homes and businesses on small-scale diesel generation: a more expensive option "that can cost up to $0.40 per kilowatt-hour in operating costs alone—about three times higher than countries with larger power systems" (Foster & Briceno-Garmendia, 2010, p. 50)

Based on the hypothesized strong relationship between a country's infrastructure stocks and economic growth, there is a general consensus that deficiencies in infrastructure is one of the main factors holding back the development of Sub-Saharan Africa. A main support for this consensus in relation to the experience of Sub-Saharan Africa relates to the findings of detailed cross-country studies (Escribano, Guasch, & Pena, 2010) on the relationship between infrastructure and the performance of private firms in an economy. Using a survey on the region's investment climate, it is argued in "most African countries, particularly the low-income countries, infrastructure is a major constraint on doing business and depresses firm productivity by about 40 percent" (Foster & Briceno-Garmendia, 2010, p. 44). The insufficiency of

infrastructure generally acts as an effective limiting factor to the growth of most of the countries in the region.

The multiplier effects of the region's infrastructure deficit outside the business community has also been recognized. As an example, besides impeding investment climate and business profitability, the insufficient provision of electricity in the region is also associated with some other important issues. Specifically, electricity supply is an important factor that hinders safe handling of vaccines and medications in hospitals and the preservation of food at homes. Electricity supply also limits the number of hours that students can invest in reading after sunset. Likewise, by increasing the time and money that it would take to move goods and people, deficits in the region's transport sector have helped constrain the economic integration of many isolated rural communities and their products. Deficits in the water sector have also been associated with the spread and transmission of some public-health issues.

### 2.2.2 On the Challenge of Infrastructure Financing in SSA

The challenge of addressing the region's infrastructure gap has been a top priority on the agenda of a number governments, international donors and multilateral organizations. A comprehensive regional analysis initiated by the World Bank to guide domestic policy reforms, the prioritization of the region's infrastructure investment needs and the development of "a baseline against which future improvements in infrastructure services can be measured" (Gutman et al. 2015, p. 1) estimates that the region needs an annual investment of $93 billion over a 10 year period to address its infrastructure gap. Specifically, it is argued that:

> "Meeting Africa's infrastructure needs and developing cost-effective modes of infrastructure service delivery will entail a substantial program of infrastructure investment. In addition to building new infrastructure, existing facilities must be rehabilitated and maintained. The estimated spending needs are $93 billion a year (15 percent of the region's GDP)—more than twice the 2005 estimate by the Commission for Africa. The burden on their economies varies dramatically per income group, ranging from 10–12 percent of GDP for middle-income and resource-rich countries to 25 percent of GDP for low-income non-fragile states

> and 36 percent for fragile states" (Foster & Briceno-Garmendia, 2010, p. 43).

A breakdown of the needs analysis indicate that a third of the $93 billion per annum would go to the rehabilitation, operation and maintenance of the existing infrastructure, while the rest goes to new capital investments. In addition, more than 40 percent of the annual expenditure would go to the energy sector. The region is expected to install a minimum of 7,000 megawatts of new generation capacity per annum to keep up with target and demand. About 20 percent of the annual spending is expected to go to the transport sector. Likewise, about 20 percent of the expenses is associated with new investments in water supply and sanitation.

Observably, the largest infrastructure need in the region lies in the power sector. This need encompasses both the installed electricity generating capacity and distribution. There are various measures that seem to capture the acuteness of the sector's insufficiency. As an example:

> The 48 countries of Africa (with a combined population of 800 million) generate roughly the same amount of power as Spain (with a population of 45 million). Power consumption, which is 124 kilowatt-hours per capita per year and falling, is only 10 percent of that found elsewhere in the developing world, barely enough to power one 100-watt lightbulb per person for 3 hours a day. Africa's firms report that frequent power outages cause them to lose 5 percent of their sales; this figure rises to 20 percent for firms in the informal sector that are unable to afford backup generators." (Foster & Briceno-Garmendia, 2010, p. 52).

The size of the installed capacity somewhat explains the huge investments that the power generating subsector requires. In particularly, the installed power generating capacity in in the region is expected to increase by more than 10 percent per annum to address the region's energy crisis.

Besides the energy sector, the poor state of the region's transport infrastructure (in terms of its ability to facilitate the movement of goods and services locally and internationally) has also been recognized. New investments in this sector is expected to

address the costs and inefficiencies associated with rural-urban connectivity, the rehabilitation of railways systems, and the installation of new transport networks that would link all capital cities, seaports and international borders in the region. Notably, the creation of a transport network that can provide

> "Adequate regional, national, rural, and urban road connectivity complemented by adequate rail, port, and airport infrastructure will require significant spending—$18 billion a year, half of which is related to maintenance. Investment requirements are driven primarily by spending needed to upgrade the category of existing assets (for example, from a gravel to a paved road), to improve the condition of existing assets (from poor to good or fair condition), and to expand the capacity of existing assets (for example, from one lane to two lanes)" (Foster & Briceno-Garmendia, 2010, p. 56)

Table 1 summarizes the Infrastructure Spending Needs for Africa, as proposed in the needs analysis initiated by the World Bank.

**Table 1: Infrastructure Spending Needs for Africa, 2006–2015**

**(In US$ billions annually)**

| Sector | Capital Expenditure | Operation & maintenance | Total Needs |
|---|---|---|---|
| ICT | 7.0 | 2.0 | 9.0 |
| Irrigation | 2.7 | 0.6 | 3.3 |
| Power | 26.7 | 14.1 | 40.8 |
| Transport | 8.8 | 9.4 | 18.2 |
| Water Supply & Sanitation | 14.9 | 7.0 | 21.9 |
| **Total** | **60.4** | **33.0** | **93.3** |

(Foster & Briceno-Garmendia, 2010, p. 57)

One of the main issues associated with the feasibility of these annual investment needs is that, despite the differences between the capacities of lower income and resource-rich countries, meeting the investment target would require lots of fund. For some of

the lower-income countries in the region, the target appears unrealistic, amounting to as much as 25 to 37 percent of the GDP. In response to this obvious challenge, the World Bank and the region's development agencies have initiated series of programmes that focus on possible financing initiatives (Gutman et al. 2015). As an example, the New Partnership for Africa's Development (NEPAD) initiated the Programme for Infrastructure Development in Africa (PIDA) in 2011 to identify and assess key region's cross-border infrastructure investments over the period of 2012-2040. Similarly, the World Bank, in collaboration with the African Development Bank (AfDB), developed the Africa Infrastructure Country Diagnostic (AICD) in 2011 to provide a detailed series of infrastructure investment needs and finance in the region. Additionally, a G-8 Summit established the Infrastructure Consortium for Africa (ICA) to guide and facilitate public and private investment in the region's infrastructure. The African Development Bank (AfDB) also established the Africa Infrastructure Fund in 2013. The fund aims to serve as a platform for mobilize new investments in the region's infrastructure (Gutman et al. 2015). Domestically, many of the governments in the region have established corresponding programmes and units that aim at attracting more investments in their infrastructure.

### 2.2.3 The Roles and Significance of PPP in SSA

In view of the funding requirements, it is argued that with the right mix of incentives and measures, "attracting more private sector investment is one option" (Creamer, 2009). Despite some earlier reports on how other developing regions surpass sub-Saharan Africa in terms of attracting private investment in infrastructure development (World Bank, 2009), the extent of private investment in the region's infrastructure tends to be increasing and promising. Notably, "all major sources of external financing have appreciably increased their annual commitments. From $5 billion in 2003, commitments have risen to almost $30 billion per year in 2012." In addition, PPP "has been the largest financing source since 1999—accounting for more than 50 percent of all external financing. Its overall level has remained remarkably stable and unaffected by the recession in 2008" (Gutman et al. 2015, p. 17). In general, PPP investment in Sub-Saharan Africa is continues to grow, despite the decrease in global PPP investment in to low- and middle-income countries. As an example, PPP investments in sub-Saharan Africa "grew by 9.5 percent on average over the past 10 years—almost double the region's GDP growth rate of 4.5 percent. PPP accounts now for almost 1 percent of

regional GDP. In 2013, PPI in all of Sub-Saharan Africa grew by 16 percent to reach $14.9 billion (from $12.8 billion in 2012), its highest level since the financial crisis in 2008. In contrast, PPP in low- and middle-income countries fell 24.1 percent to $150.4 billion in 2013 from $181.3 billion in 2012" (Gutman et al. 2015, p. 18). Albeit, the telecom sector accounts for an unfair size of private investment in the region's infrastructure. Figure 3 shows the distribution of PPP projects in Sub-Saharan Africa by sector.

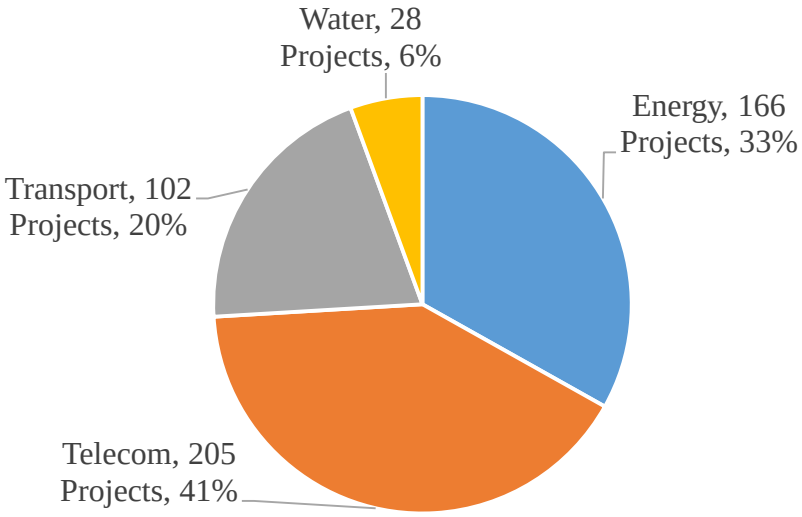


**Figure 3: Number of PPP Projects in SSA (1990-2014)**

(World Bank/ PPIAF, 2015)

As Figure 3 indicates, the telecom sector accounts for about 41 percent of the PPP projects in sub-Saharan Africa. In terms of investments, the telecom sector also dominates, accounting for 72 percent of the investment commitments, while the energy and transport sector accounts for about 15 and 12 percent respectively. This leaves the water sector with the minimal share of less than 1 percent. Besides the concentration of private investment in the telecom sector, the spread of the investment seems to concentrate in a few countries. Specifically, investments concentrated mainly "in Nigeria and South Africa, with each of these countries accounting for more than a quarter of total investments in the region" (World Bank/ PPIAF, 2011) In addition, Gutman et al. (2015) note that, PPP investments in South Africa and Nigeria "have accounted for over 80 percent of PPI investments in the energy sector, 95 percent in

transport, and about 60 percent in telecommunication" (Gutman et al. 2015, p. 20).

In sum, the huge gap between investment needs and actual investments have led to the establishment of many initiatives that aim at attracting more PPPs and private investments. The concentration of the actual investments in a few countries and sector have given rise to some critical questions on how to extend the opportunities for more private investment in other countries and sectors. A substantial part of the focus has been on mechanisms that seem to minimize the risk of private investment in the infrastructure sector. Particularly, it is argued that one of the main outstanding challenges centers on "monitoring and enforcing contract commitments, especially those pertaining to investment commitments which have caused distress in a number of ongoing projects and explain some of the contract cancellations" (Mutambatsere, 2014: iii). It is further noted that that "some of the factors affecting project performance include disputes over the sharing of project costs in operations where pre-project costs are covered by the private partner, and failure to fully meet investment targets set out in concession agreements" (Mutambatsere, 2014: 20).

## 2.3 Contract Termination and Questions of Differential Vulnerability

There are various factors that make the study of contract termination in Sub-Saharan Africa quite apt and motivating. Besides the general observations made in relation to the region's infrastructure poverty and greater reliance on private financing, there are some contentions that PPP projects in the region may be more vulnerable to termination in comparison with the other developing regions. As an example, it is argued that, "other things equal, a project's being in the water sector increases the likelihood of cancellation by more than 8 percentage points and its being in Sub-Saharan Africa by almost 9 percentage point" (Harris & Kumar, 2009, p. 3). Another contention raised in this regard concerns the conclusion that "projects in Sub-Saharan Africa might have significantly higher cancellation rates because of weak institutional capacity" (Harris & Kumar, 2009, p. 4).

Generally, in the study of contract termination in PPPs, questions of differential vulnerability are tied to the assumption that the termination of partnership would depend on its exposure to any or some underlying factors. Research questions in this regard are often motivated by the need to empirically evaluate the hypothesised effects of the absence or presence of certain determinants in actual cases of contract

termination. Based on the progress made in this regard,, one general comment in the literature is that empirical explanations is challenging (Renato, 2009, p. 9), given the difficulty associated with the direct measurement and comparison of each project's specifics in a global scale. Additionally, in view of some inconsistencies and variations in the rates of a PPP's vulnerability or adaptability, the generalizability of an explanation for contract termination also embodies some challenges. As an example, Harris and Kumar (2009) also observe that, "the occurrence of a macroeconomic shock (measured by depreciation in exchange rate) increases the likelihood of project cancellation from less than 5 per cent to more than 8 per cent, controlling for other variables" (Harris and Kumar, 2009: 3). However, in relation to the effects of macro-economic shocks and currency risks that occurred in Brazil (in 1999), Argentina (in 2002) and the Dominican Republic (in 2003) on contract termination, Renato (2009, p. 7) observes that many of the terminated contracts are energy projects.

More so, Harris and Kumar (2009) note that unlike port and natural gas related PPP contracts, "projects in the water and sewerage sector are most prone to cancellation … since this was significantly higher than the overall rate of cancellation" (Harris and Kumar, 2009, p. 2). Based on the aforementioned examples, it is easy to see that some partnerships are more susceptible to termination than others, irrespective of the prevailing macro-economy. As a result, the empirical study of contract termination in PPPs have given rise to more questions than answers.

Part of the irony (in terms of the realization of more questions than answers) seems to stem from the indeterminacy and the gaps that surround the nature of link between the hypothesized factor and the event of contract termination. As an example, the rationalization of the effect of some macro-economic indicators can be controversial. On the one hand, it is argued that good economic performance can lead to the initiation of ambitious projects, optimism bias or the under-estimation of fiscal related risks, and project failure. Specifically, it is argued that "ironically, strong growth and rigid currency regimes before projects start to operate heathen risk, as they can lead to adverse selections or proponents and moral hazard in project design" (Renato, 2009, p. 1). As such, it is argued that a poor macro-economy provides a good incentive for cautious investments, risk analysis and realistic financial projections. On the other hand, it is equally argued good economic performance is good for project financing and a project's rate of return. In addition to these conflicting views, the unique relationship between the macro-economy and certain PPP projects or sectors is yet to be formally

rationalized. A modest attempt in this regard refers to the argument that the uncertainties and unanticipated events that result from macro-economic shocks can provide an excuse for politically motivated risks and response. However, this explanation does not seem to address the question of what makes some projects become vulnerable. This brings us to another remark in Markard (2011) that there are several underlying differences and features that make sectors more vulnerable than others. Particularly, it is argued that "in some respects, infrastructure sectors are quite different from other sectors and that these particularities matter, especially if there is an interest to initiate and govern transformation processes toward a specific end" (Markard, 2011: 107). The general conjecture in this regard is that, these hidden disruptive features dictate the way that projects in certain sectors react to external events.

Equally more fascinating is the fact that the absence of an economic or financial crisis does not necessarily imply that contracts are termination-proof. As an example, regarding the rates and patterns of a PPP contract termination in countries in Sub-Saharan Africa, the main conclusion in the literature is that: "the results are less easy to explain" (Harris and Kumar, 2009, p. 4). This conclusion is based on the absence of any major macro-economic shock or financial crises in the sub-region. Contrary to what could have been a likely explanation, the analysis found no significant relationship between the probability of contract termination and a country's institutional quality (in terms of governance indicators). Actually, one of the conclusions in this regard is that, "surprisingly, many of the World Bank's indices of governance quality lead to perverse outcome. Thus, new governance standards must be used to judge PPPs" (Renato, 2009, p. 1). More surprisingly, a different study on post-contractual problems and bargaining in a PPPs in Latin America and the Caribbean observe that "it is not clear how institutional quality variables should behave, as a number of channels involving the quality of the bureaucracy and the possibility of capture can be envisioned" (Guasch, Laffont and Straub, 2006: 4).

Given the inconclusive nature of the explanations in the existing studies (regarding the main drivers of contract termination in PPPs), a main consensus in literature is that, "other factors are clearly at work" (Harris and Kumar, 2009: 3). This conclusion suggests that the tolerance of a PPP contract may have varied from category to category as a result some yet to be identified connections and conditions. Invariably, any satisfactory explanation would require some additional analysis. This calls for an expansion of the scope of the explanatory variables, and the explication of the

dependence mechanisms, to minimize the omission of important attributes and connections. Sample questions to address in this regard include: why are some PPP projects more vulnerable to termination than others? What are the lessons and implication for theory and practice, particularly in relation to the choice of implementation models?

In relation to the questions raised above, this study aims at formalizing the connection between contract-type and the factors that lead to contract termination in a PPP. Besides the need for a logical analysis and explication of the dependence mechanisms, this study's focus on the effect of contract-type is specifically motivated by the author's observation of some evidences of differential vulnerability in the actual cases of contract termination. Figure 4 summarises this preliminary observation.

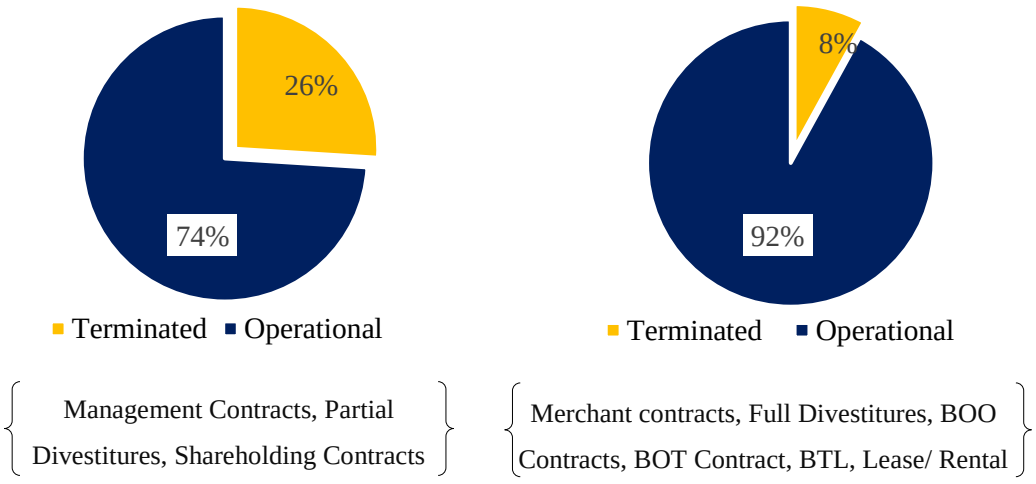


**Figure 4: Preliminary Observations on Differential Vulnerability to Termination**

The observation summarised in Figure 4 is based on PPP projects that reached financial closure in Sub-Saharan Africa in the period between 1990 and 2012. World Bank's Public Private Partnership Group and the Public-Private Infrastructure Advisory Facility (PPIAF) database on Private Participation in Infrastructure (PPI) was used as a basis for information gathering in relation to the observation in Figure 4. As the classification in Figure 4 indicates, there is a possibility that some models of PPP are more susceptible to termination that others. In this regard, the study empirically explores this observation and attempts to provide some theoretically grounded explanation for them, using a formal analysis, and the specificities in the operational definitions of the PPP models.

Also, the classification in Figure 4 implies that it is generally assumed in this study that it is possible to distinguish and group PPP implementation models on the basis of some shared characteristics (such as asset ownership, the allocation of control rights and operating and maintenance obligations, the contract's duration, and the degree of control allocated to the public and private partners). As an example, in a BOT model, the private partner usually builds, owns and operates a project at their own risk for a longer-term before transferring the facility to the government at the end of the contract. In a management contract model however, the private partner typically undertakes to operate and run a public-owned enterprise with the public for a shorter period while ownership and investment decisions remain with the public.

In general, despite the specificities that may characterise the name of each implementation model, a cursory look two at the two groups of contracts displayed in Figure 4 can reveal some cross-cutting properties. Specifically, the first set of PPP models (i.e. the management contracts, the partial divestiture, etc.) typically involve the use of a contractual arrangement that involves grants both the public and private partners some degree of control rights over the project's management and major decisions regarding the project's daily operations. In such PPP models, it is common for the private partner jointly run and operates the facility "with" the public partner. This is the main basis for the classifications. In contrast, the second set of PPP models (i.e. BOO, BOT, Full Divestitures, etc.) involve the use of contractual arrangements that allocate the risks and responsibility for the project's operation and management to the private partner. In such models, the private partner usually do not run and operate the facility with the public-partner.

As with conventional systems of classification, the inter-relationships of the implementations models and the way through which they could exacerbate or add to the problems that lead to contract termination are further explored and investigated in the study. The relationship between the common theoretical properties of these PPP implementation models (in terms of risk allocation, the payment mechanism and the holdup problem) and the strategic issues derived from the formal analysis would then form a basis for the explanation of the effect of contract-type on contract termination.

# 3 The Research Approach and Methods of Analysis

## 3.1 Overview:

The study of strategic behaviour in teams and partnerships can be quite theoretical. With particular reference to the theory of industrial organization, Tirole (1998) notes that, "at first sight, even a theorist should regret the very high ratio of theory to evidence in a field in which theoretical models are often lacking in generality and in which practical implications are so crucial" (Tirole, 1998: 3). In reality, this imbalance or weak link between theoretical models and evidence is sometimes based on the nature of the data necessary for a complex econometric analysis. In view of this problem of data limitation, the use of selected case studies has become quite attractive and prominent. In this study's methodology, a great effort is place on circumventing some of the limitations associated with data availability, using rough set theory, the logic of explanatory power analysis, a formal analysis and case studies. The combination of these methods gave rise to very interesting insights that helped overcome the data limitation problem. The practical contributions of this mixed approach is be quite significant in terms of positive theory and analysis.

In terms of organization, this chapter starts with a specification of the nature of the research problem. It then proceeds to elucidate on the research purpose and methodology. Next, it describes the type of literature and data that were used of in the course of the study. Subsequently, it elaborates on the research design and the steps and sub-steps used to analyse the data. It then concludes with a discussion on the study's statistical and qualitative analysis.

## 3.2 The Nature of the Research Problem

In a PPP, contract termination takes place when a private investor exits from the partnership before fulfilling the contract's terms and objectives. Depending on the terms and provisions in a given PPP contract, there are certain legitimate reasons that can lead to the event of contract termination in a PPP. Irrespective of the choice of words or language, one can broadly classify the terms and conditions that form the basis for contract termination into exogenous and endogenous factors. On the one hand,

exogenous factors include all macro events (such as economic shocks, wars, force majeure and natural disasters) that constrain the partners' ability to achieve the goals of the contract. These are typically defined in terms of an "excusable cause" clause in a contract.

Besides the factors that are reasonably beyond the partners' control, there are other legitimate grounds for contract termination. These include all acts of omission and bad faith (i.e., fraud, mistakes, unlawful acts or corrupt practices). Unlike the exogenous factors, these issues typically result from a partner's fault or negligence. By extension, such grounds usually include all acts that can jeopardise the commercial purpose of the PPP contract, as well as any action that potentially "deprive the party not in default of" (Ashurst, 2012: p. 2) some substantial benefit. Hence, the notion of outcome (in terms of some optimality criterion) is a key issue involved in the application of the contract termination clauses that pertain to default or non-performance. With particular reference to the PPP, it is therefore common to define default or non-performance in terms of the realization of an inferior, a substandard or a defective outcome. In this regard, the outcome of PPP projects is generally expected to be free from certain forms of inefficiency or shortcomings.

Apart from those factors that are based on the assumption that one of the partners has demonstrably failed to act to in the best of the social goal, a PPP contract can be terminated in response to a partner's convenience. By definition, termination for convenience is a **"**standard clause in government contracts, which gives the government the right to unilaterally terminate the contract at any time with or without giving any reason. The contractor is generally entitled to a negotiated settlement for an equitable recovery of costs and losses incurred" (Business Dictionary).[1]

Two facts are visible in the on-going review. The first fact concerns the role of default or poor performance on contract termination. Specifically, all the grounds (with the exception of termination for convenience) are tied to the realization of an inferior outcome. The second fact can be stated as follows: it is impossible to deny the existence of multiple factors that can impinge on the partners' actions and decisions in relation contract termination. This nature of the research problem (i.e., the possibility of causal complexity) necessarily informed the need for a research methodology that can facilitate the use of multiple perspectives in the study.

[1] http://www.businessdictionary.com/definition/termination-for-convenience.html

In terms of scope, given the focus of the existing studies on the exogenous factors, it also became logical to argue that all the factors pertaining to the issue of contract termination in a PPP are yet to be explored. Such a partial or incomplete view necessitated this study's focus on factors that could arise from the partners' actions and inactions.

## 3.3 The Research Purpose

The purpose of this research is largely exploratory. The relevance of this purpose is based on the absence of a clearly established theory or hypothesis on contract termination in the literature. This purpose also influenced our reliance on both case studies and secondary data and the available literature in the course of this research. Specifically, using the available information and literature, the study aimed at gaining a deeper insight into the problem of contract termination. The study thus explored the possibility of using the technical literature on contract theory and industrial organization to formalise some questions that can facilitate a more definitive research and investigation. In this regard, using a holdup model and the specific performance mechanism, the study examines how partners are likely to behave under different contractual configurations, the meanings that the partners will attach to each other's behaviour, and the issues that may ensue therefrom. Basically, the study aimed at getting some formal insight on what goes on in a PPP and how widespread the problem of termination is. Using the technical literature on contract design, the author developed some set of questions on specific aspects of a PPP contract that seem worth exploring..

Based on the research purpose, the study adopted the grounded theory approach. There are many features that inform the aptness of the grounded theory in exploratory inquiries. As Babbie (2007) notes, exploratory studies are the main basis for grounded theory. Apart from being essential when a researcher is trying to break a new ground, an exploratory research usually provides new insights into a topic of research. Particularly, "exploratory studies are typically done for three purposes: (1) to satisfy the researcher's curiosity and desire for better understanding, (2) to test the feasibility of undertaking a more extensive study, and (3) to develop the method to be employed in any subsequent study" (Babbie, 2007: 88).

## 3.4 The Grounded Theory Approach

The grounded theory is the methodology developed as a reaction to the undue permeation of the natural science positivism in most social science inquiries. The position of this methodology is based on the view that the issues dealt with in most social science research are quite different from the subject matter dealt with in the natural sciences. Specifically, in developing the methodology, Glaser and Strauss (1967) challenged the prevalent assumptions of the grand theory (i.e., the notion that the only purpose of social research is to test pre-existing and universal theories of social behaviour). As Suddaby (2006) notes, Glaser and Strauss developed the methodology "as a compromise between extreme empiricism and complete relativism by articulating a middle ground in which systemic data collection could be used to develop theories that address the interpretative realities of actors in social settings" (Suddaby, 2006: 634).

Specifically, the use of the grounded theory in this research rests on its aim of achieving a middle ground between deductive and inductive research approaches. It also hinges on the fact that the study's primary goal of eliciting a fresh understanding about what is observed in the data. Specifically, the target was to turn the raw data on cancelled PPP contracts into something that enhances the understanding about some of the issues involved in PPP contract termination.

Regarding the suitability of this methodological approach in the scheme of the author's research objectives, Martin and Tuner (1986) note that, the grounded theory "is best used when no explicit hypothesis exist to be tested, or when such hypotheses do exist but are too abstract to be tested in a logical, deductive manner" (Suddaby, 2006: 636). Furthermore, the grounded theory is also most appropriate when researchers face a complex social phenomenon from which they seek to discover new ideas through the process of observation and interpretation. In this regard, using the methodology facilitated the identification of new conceptual categories and classifications that are capable of explaining some of the issues observed in relation to contract termination. The principles of this methodology formed the basis for the study's use of the technical literature, the study's philosophical orientation, as well as some of the analytic techniques used in this study.

## 3.5 The Use of Technical Literature

The study involved the use of the technical literature on contract theory, transaction-cost economics and the industrial organization to provide an initial direction for the research. The use of these technical literature is based on the contention that a grounded theory's ability to achieve "a middle ground between a theory-laden view of the world and an unfettered empiricism" (Suddaby, 2006: 635) very much relies on the use of extant theory and literature. Specific insights derived from these are summarised as follows.

i. Insights from contract theory provided a basis for the theoretical connection the author made between the concepts of holdup, underinvestment and poor performance (or the realization of a sub-optimal outcome) in a PPP.

ii. Insights from Transaction cost economics provided the basis for the operationalization of governance of contractual relations and the associated problems in a PPP. It also facilitated the definition of contract termination as a failed transaction or exchange between the host government and the private investor and the hypothesis on how such failures could emanate from the effects of largely human factors.

iii. Finally, given the centrality of performance and outcome optimality in typical clauses on contract termination and 'cure notices', the practical implications of the insights gained from the "structure-conduct-performance" in the theory of industrial organizations facilitate the establishment of a logical connection between holdup and underinvestment and a PPP's viability.

Clearly, the contributions of these three theories in this study are interwoven in such a way that, they are best taken together rather than in isolation. In general, they were in the study to develop provisional answers and issues to look out for in the course of the study. They also served the purpose of enhancing the study's theoretical relevance. The author also used them to identify the conceptual areas and issues involved in a contractual relationship. In addition, the author used them to formulate some important questions regarding the role of the partners optimizing behaviours on how they invest

in the partnership. Some insights were also borrowed from the industrial organization literature to operationalize the strategic parameters that emerged in the formal analysis of the holdup and underinvestment problem.

Furthermore, the author used the technical literature to direct the study's focus on the more abstract properties that various PPP share in common. This use facilitated the study's ability to go beyond the specifics of the raw data in the PPP database.

The author also used the insights and concepts drawn from the technical literature to facilitate the theoretical comparisons made in the study. As one of the hallmarks of grounded theory, the main aim of theoretical comparison was to facilitate the definition and classification of PPP contracts in terms of some their respective theoretical properties. Regarding the role of theoretical concepts in such a classificatory endeavour, Blumer (1969) contends that concepts form a basis for "the categories for which data are sought and in which data are grouped; they also become the chief means for establishing relations between data; and they are the anchor point in interpretation" (Blumer 1969, p. 26) in (Corbin & Strauss, 2008, p. 50)). Specifically, the study involved references to the concepts of "payoff configuration" and "operating task allocation" in comparing and classifying apparently diverse PPPs.

Using these concepts, the author then compared and classified the entries in the PPP database into two main categories, one category being those that are vulnerable to the risks of holdup and underinvestment, and the other category being those that are not. The comparison facilitated the study's ability to group and differentiate one PPP from another. These generally formed the basis for the features that were used to suggest a PPP's vulnerability and contract-type. These concepts also enabled the author to discover some new information about how the issues of "payoff configuration" and "operating task allocation" cut across different PPP projects and implementation models.

Finally, the author also used the implications in these technical literatures to frame the discussion on the significances of the study's findings and contributions in relation to the implementation of a PPP. The importance of the relationship between these theories and the explanation for contract termination advance in this study also helped to motivate to necessitate the role and use of these theories. Specifically, it is argued that:

> "When an explanation is well integrated into a larger theoretical framework, the theoretical connections can expand the range of answers to different what-if-questions in two ways. First, because of the inferential connections to an already existing body of knowledge, dependencies between factors in the background theory and different aspects of the explanandum phenomenon may open up unforeseen dimensions in which contrastive what-if-questions concerning the explanandum can be answered. Second, the explanation itself may bridge previous gaps within the existing theory and thus enable answers to new what-if-questions not directly concerning the original explanandum" (Ylikoski & Kuorikoski, 2010, p. 213).

In sum, therefore, insights from the extant theories served the purpose of ascertaining how reliable and consistent the measures associated with the study's point of view is in comparison with an ad hoc explanation for contract termination in a PPP.

## 3.6 The Research Design

A research design is a framework that guides the generation of evidences that are suited to the research question in which the researcher is interested. Given the nature of research focus and objectives, the author adopted the cross-sectional design. By definition, "a cross-sectional design entails the collection of data on more than one case (usually quite a lot more than one) and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables which are then examined to detect patterns of association" (Corbin & Strauss, 2008, p.53).

Generally, the cross sectional design facilitates the collection of data "on individual characteristics, including exposure to risk factors, alongside information about outcome. In this way, cross-sectional studies prove a snap-shot of the outcome and the characteristics associated with it, at a specific point in time" (Levin, 2006, 24). The author's use of this framework is based on the study's interest in the variations and the differential rates of vulnerability to termination; as well the fact that variations in the rates of contract termination are best established when many cases are examined. The use of this design facilitated the examination of many PPP cases.

Furthermore, in using the cross sectional design, the author minimized a potential drawback in some exploratory studies (the problem of representativeness). Specifically, the use of a cross-sectional design provided a platform for studying almost the entire population. This thus helped the author to overcome the problem of sampling bias and representativeness. It also facilitated the incorporation and assessment of multiple variables in the study.

The cross-sectional design further facilitated the ability to collect and organize the data on the variables of interest. In this manner, the author then examined the relationship between PPP attributes and outcomes. These features of a cross-sectional design also brought the analysis within the sphere of quantitative research strategies.

Another key feature of the cross-sectional design is that it embodies the logic of comparison. Incorporating a framework that can facilitate comparison became necessary, given the study's aim to identify the potential sources of differential vulnerability among PPP contracts, and the need to evaluate the merit of the study's findings against rival explanations in the literature. This generally facilitated the elimination of weaker explanations (or variables) and the identification of alternatives that makes the most empirical sense.

In sum, unlike experimental designs, it is important to note that cross-sectional research design are sometime criticised for lacking the ability to infer causality (rather than association) among the variables in the cross-sectional table (Bryman & Bell, 2011, p. 56). As an example, Levin (2006) notes that they are limited by the fact that they sometimes fail to give any indication to the sequence of events – whether exposure occurred before the event of interest or simultaneously. In this study, given the fact that it is not possible for the study to manipulate the aspects of a PPP contract examined in this study in the form of experiments, the study used the preceding nature of the explanatory attributes to make inferences on causality. Specifically, the inference is based on the fact that explanatory conditions or variables all precede the outcome.

## 3.7 Data Description

The data used in this study were taken mainly from the database developed by the World Bank's Public Private Partnership Group and the Public-Private Infrastructure Advisory Facility (PPIAF) on Private Participation in Infrastructure (PPI). This database classifies PPP projects in terms of the sectors (energy, transport, telecom,

water) involved, their implementation models, and the nationality of the investors. It also provides detailed information on the number of projects under each sector and implementation model. This database also classifies PPP projects in terms of their being operational, terminated or completed. In addition to using the project information in this database, the study adopted its operational definitions in relation to a PPP's implementation model. In turn, the elements in the operational definitions guided the identification of the common theoretical properties that the author used to reclassify each project and their implementation models in terms of their contract-type and vulnerability to the holdup problem.

Since quantitative data may be insufficient for capturing some contextual information on the specificities of a PPP contract, the study also used some qualitative data from news reporting and publicly available documents relating the implementation and termination of some contracts. In general, the use of publicly available qualitative data (including, newspaper reports and government documents) to analyse the certain events surrounding a project is quite common in business and organizational research. Particularly, the use of these documents is based on the study's interest in discovering the dominant concepts that dominate how a wide range of participants and observers view a contract's implementation and the problem of contract termination. This facilitated the study's ability to capture some of the complexities that characterise the implementation of PPP contracts that are lacking in the statistical dataset. Hence, where possible, the study also made use of various reports deriving from an inquiry over the implementation of a certain PPP contract that contain some hints on the factors deemed by an official inquiry to have been instrumental in the handling of a project's implementation. Since the people who wrote the reports might have different opinions on what is important and what is not, the study also made use of multiple documents to enhance authenticity and minimize the possibility of arriving at a conclusion with a biased report.

## 3.8 The Procedures of the Analysis

The use of both quantitative and qualitative information in this study formed the bases for the use of two distinct methods of analysis.

### 3.8.1 The Quantitative Analysis

The quantitative data analysis carried out in this study involved the use rough sets-theoretic methods. Generally, rough set theory "is a mathematical approach to intelligent data analysis and data mining" (Pawlak, 2002a: 1). The theory embodies a set of methods that are suited for drawing conclusions from data. The use of this approach in this study is due to rough sets' suitability for the classificatory analysis of data tables. It is also very suitable for analysing an information system that comprises of data about objects of interest characterized in terms of some attributes. These inform its importance and increased use in "artificial intelligence and machine learning, knowledge acquisition, decision analysis, knowledge discovery from databases, expert systems, inductive reasoning and pattern recognition" (Pawlak, 2002a: 2). Another advantage of this approach in this study hinges on its ability to facilitate the development and straightforward interpretation of "algorithms for finding hidden patterns in data" (Pawlak, 2002a: 2).

In using this method of analysis, the author generated a set of decision rules from the PPP data. Apart from constituting a sound theoretical basis for our data analysis, the rough sets model facilitated the identification of partial or total dependencies (i.e. cause and effect relations) in the database. It also facilitated the identification and elimination of redundant information (Komorowski et al., p. 38). This overall analysis involved the following sequence of steps and sub-steps.

### 3.8.2 The Construction of a PPP Information System

*An information system* is defined as "a data table, whose columns are labelled as attributes, rows are labelled by the objects of interest and entries in the table are attribute values" (Pawlak, 2002a: 3). Formally, the PPP information system $\mathbb{S}$ is defined as a triple, $\mathbb{S} = \langle U, A, V \rangle$, where $U$ is a non-empty finite set of PPP contracts and $A$ is a non-empty finite set of attributes that describe each element (i.e., PPP contract) in $U$. Hence, if $x_i$ denotes a given PPP contract, then $U = \{x_1, x_2 \dots x_n\}$, where $n = |U|$. The four attributes used in this study include: the contractual type, the project's sector, the nationality of the private investors and a contract's status (i.e., $A = \{a_1, a_2, a_3, a_4\}$). Finally, each attribute $a_j \in A$ is associated with a set $V_j$. The set $V_j$ contains the possible values associated with attribute $a_j$. Table 2 summarizes the information regarding the attributes and their corresponding value sets.

**Table 2: A Summary of the Attribute used in the Study**

| Description | Attribute | The value set |
|---|---|---|
| Contractual type | $a_1$ | $V_1 = \{\text{Type-m, Type-}\beta\}$ |
| Project's sector | $a_2$ | $V_2 = \{\text{Energy, Telecom, Transport, Water}\}$ |
| Investor's nationality | $a_3$ | $V_3 = \{\text{Domestic, Foreign, Mixed}\}$ |
| Contract's Status | $a_4$ | $V_4 = \{\text{Terminated, Operational}\}$ |

Observably, Table 2 shows the four attributes and the values associated with each attribute. The table also shows that the value set of the outcome attribute is binary. As a result, the author omitted the PPP contracts that are still in their planning and construction stages in the analysis. In other words, the study only focused on the PPP contracts in Sub-Saharan Africa (SSA) that are either operational (or successfully concluded) or terminated. Table 2 also shows that there are two main types of attributes. As a result, the author further partitioned the elements of $A$ into two disjoint subsets, one consisting of the conditional attributes or simply the conditions (i.e., $C = \{a_1, a_2, a_3\}$) and the other one consisting of the outcome attribute (i.e., $D = \{a_4\}$). Based on this distinction, one can alternatively refer to $\mathbb{S}$ as a decision system and a quadruple, $\mathbb{S} = \langle U, C, D, V \rangle$. As with the definition of the information system, $V$ contains the possible values associated with each of the attributes in $C$ and in $D$.

### 3.8.3 The Construction of Elementary Sets

The next step in the rough set classification and analysis involved the construction of *elementary* sets. Based on the information system, the author used the notion of indiscernibility to partition the universe of the contracts into new disjoint subsets. Formally, let $B$ denote a nonempty subset of the set $A$ of all attributes. The indiscernibility relation $IND(B)$ is a relation on $U$ defined for $x_i, x_k \in U$ by $(x_i, x_k) \in IND(B)$ if and only if for both $x_i$ and $x_k$, the values for all the attributes from $B$ are identical. In other words, the two cases $x_i$ and $x_k$ are said to be identical in terms of $B \subset A$ if the value of attribute $a_j \in B$ for case $x_i$ is equivalent to the value of attribute $a_j \in B$ for case $x_k$ (i.e., $x_i IND(B) x_k$ iff $v_{ij} = v_{kj}$ for all $a_j \in B$). Hence, the

indiscernibility relation $IND(B)$ is also known as an equivalence relation over $U$. Each class of identical cases in terms of the attribute(s) in $B$ is called an elementary set of $B$.

The construction of the elementary sets is based on the principle that "objects characterized by the same information are indiscernible (similar) in view of the available information about them" (Skowron et al., 2015, p. 333). Accordingly, the author grouped all contracts that are indiscernible (similar) in terms of the corresponding values of their attributes to form elementary sets. In other words, an elementary set can be defined as a set of contracts that possess identical attributes.

Furthermore, the construction of the elementary sets employed three basic notions of binary relations. The notions are summarised as follows.

a. Reflexivity: each case $x_i \in U$ is in relation to itself, $x_i R x_i$.
b. Symmetricity: given two cases $x_i$ and $x_k$ in $U$, if $x_i R x_k$, then $x_k R x_i$.
c. Transitivity: for any three cases $x_i, x_k$ and $x_l$ in $U$, if $x_i R x_k$ and $x_ R x_k$, then $x_i R x_l$.

Based on the objective in this study, the author constructed the set $B$, using at least one condition attribute and the outcome attributes (i.e., $B = \{a_i, a_4\}, i = 1,2,3$). Hence, the construction of the initial elementary sets in this study focused primarily on a conditional attribute and the outcome attribute at a time. Specifically, the main goal was to explain (or narrow down) what causes a contract's termination (i.e., the outcome) in terms of the values of each of the three conditions in $C$. As a result, the study determined the existence of an indiscernibility relation between any two elements in $U$ in terms of one conditional attribute and the outcome attribute. In so doing, the author grouped all cases that are *indiscernible* in terms of the elements in $B$ together to form a partition in $U$. The next stage in the construction of the elementary sets involved the two conditional attribute and the outcome attribute.

### 3.8.4 Decision Rule Synthesis (Induction)

"A decision algorithm is a set of mutually exclusive and exhaustive decision rules associated with a given decision table" (Pawlak, 2002a: 7). It is defined as a formal language that describes approximations in logical terms. The use of logical decision

rules is apt when the objective is to identify patterns and practical implications in an information system.

Each rule synthesized from the decision table is expressed in the form of "$if \ldots then$ ..." logical implications. Hence, each rule comprises of two parts; namely, a premise and the conclusion. The "premise" part of the rule is also known as the condition, predecessor or the antecedent. It contains a pair, namely, a conditional attribute and one of its associated values. The conditional attributes belong to the set $C$. The "conclusion" part of the rule is also known as the successor or the consequent. This part of the rule is also defined in terms of a pair that consists of the outcome attribute and one of its associated values. The outcome attribute belongs to the set $D$. Notably, the outcome attribute used in this study takes only two values. In rough set theory, the attribute-value pairs are called descriptors (or selectors). In making the rule induction, the study tried to establish a logical link between the value of an attribute in $C$ and a value of the attribute in $D$.

Based on the fact that "a main challenge in inducing decision rules from decision tables lies in determining which attributes should be included in the conditional part of a decision rule" (Komorowski et al; 28), the study delimited the number of descriptors in the synthesized decision rules. This led to the construction of short decision rules. This also corresponded with the author's goal of approximating the values of the outcome attribute in terms of each of the nine values of the conditional attributes.

Both the premise and the consequent parts of each rule contain some properties (i.e., the specified attribute and value) that can induce a partition in $U$. On the one hand, the criterion specified in consequent part focuses primarily on the entire contracts whose status is terminated. This is due to the study's interest in the class of terminated contracts. On the other hand, the premise parts of the rules are un-identical, depending on the attribute and the value that is to be examined.

### 3.8.5 Regarding the Competing Explanations

Noticeably, the two contract-types (i.e. Type-m and Type-β) emerged from the classification of PPP implementation model presented in Figure 4 (in Chapter 2). Rules regarding the influence of the sectors are built on the value set of $a_2$ (the four primary sectors covered in the PPP dataset). This classification is based on the type of service

the project provides to the public. The initiations of the rules are based on some assumption in the literature on the possible implications of sector characteristics and some of their attendant political-economy issues. As an example, Harris and Kumar (2009) observe that despite the considerable variations in the rates of project termination, "projects in the water and sewerage sector are most prone to cancellation" (Harris and Kumar, 2009: 2), giving the problem of pricing and the low level of cost recovery in comparison with other sectors that are highly commercialized. It is also argued that, "energy projects were the least likely to be cancelled" (Harris and Kumar, 2009: 2). These observations motivated the study's interest in re-examining the variations in the rates of termination among the four primary sectors in Sub-Saharan Africa.

In addition, there are several references in the existing literature that indicate some variations in sectoral characteristics and vulnerability. Particularly, Markard (2011) argues that, "in some respects, infrastructure sectors are quite different from other sectors and that these particularities matter, especially if there is an interest to initiate and govern transformation processes toward a specific end" (Markard, 2011: 107). In general, the conjectures in these studies on "whether sectors might react differently to such external pressures" and the questions on whether the infrastructure sectors possess certain disruptive particularities that play a role in their differential vulnerability motivated the emergence and inclusion of decision rules specifically evaluate the explanatory power of a project's sector.

Regarding the derivation and inclusion of nationality considerations, the study made reference to the obsolescing bargaining literature (Jenkins, 1986; Ramamurati, 2001, 2003). The premises of these rules are based on the implications in the obsolescing bargain literature. These literature focuses on the role of states in international political economy and the expropriation of foreign direct investments. First, it is important to the note that, by definition, sponsors are the investors or private entities that have equity participation in a PPP project. Accordingly, the issue of a sponsor's nationality comes from the fact that nationality is an important component in the premise of the obsolescing bargain. A main position in this regard is that time deteriorates and alters the balance in the bargaining relations between host government and foreign investors. The crux of this position is based on the assumption that host governments that initially lack the technology and the financial resources to execute a project may have an incentive to renege of the generous concessions they considered

necessary and justifiable for attracting the foreign investor once the investments are made. As Ramamurati (2003) frames it, "deals which appear attractive to government actors ex ante become predictably less attractive ex post. While stated originally in the context of mining investments, the same arguments apply to infrastructure investments" (Ramamurati, 2003: 262). In such a case, the lucrative bargain that the investor struck with the host upon entering the country inevitably obsolesces over time (Jenkins, 1986: 141).

The sections that follow specify the process through which the study evaluated the predictive performance and explanatory relevance of each attribute in respect of contract termination.

### 3.8.6 Evaluating the Decision Algorithms

To facilitate the evaluation of each rule, the author lets $\phi_l$ and $\theta_l$ denote the premise and the consequent parts of rule $r_l$, respectively. In such a case, a decision rule can be re-stated in the following form: if $\phi_l$ then $\theta_l$. In addition, the author lets $\Phi_l$ denote the set that contains of all the cases in $U$ that satisfy $\phi_l$ -the property (or condition) expressed in the premise of rule $r_l$. The author also lets $\Theta_l$ denote the set that contains all the cases in $U$ that satisfy $\Theta_l$- the property expressed in the conclusion part of rule $r_l$. Furthermore, the author lest $|\Phi_l|$ denote the cardinality of $\Phi_l$. Likewise, $|\Theta_l|$ denotes the cardinality of $\Phi_l$ (i.e., the number of terminated contracts). Finally, the author lets $\Phi_l \wedge \Theta_l$ denote the set of contracts that meet the two properties specified in $\phi_l$ and $\theta_l$ (the premise and the consequent parts of a rule). In such a case, $|\Phi_l \wedge \Theta_l|$ would denote the cardinality of $\Phi_l \wedge \Theta_l$. Using these denotations, the study then proceeded to evaluate the certainty, coverage and the support associated with each rule.

In general, the goal of the evaluation is to identify the rule that best approximates the set of terminated contacts. The study also involved the computation of the extent to which each of the decision rules reveals some associated probability of contract termination. The study also computed the numerical accuracy of each rule. These numerical values are "typically defined in terms of a measure of the degree to which the logic condition implied" in a rule is true (Yao, 2008: 258). For each decision rule the following measures were computed.

### i. A Rule's Support

The number $supp(r_l) = |\Phi_l \wedge \Theta_l|$ denotes the number of support of rule $r_l$ in the PPP information system. It represents the number of contracts that meet the properties specified in a rule's predecessor and successor, or the number of contracts in *U* that satisfy the premise and the conclusion of $r_l$ (Bazan et al. 2004, p. 114; Komorowski et al., p. 28).

### ii. The Certainty Factor

The *certainty factor* is coefficient associated with every decision rule $r_l$. The computation of a rule's *certainty factor* involved the division of the number of cases satisfying the premise $\phi_l$ and the conclusion $\omega_l$ by the number of case(s) that satisfy the premise $\phi_l$.

$$cer(r_l) = prob(\Omega_l|\Theta_l) = \frac{|\Phi_l \wedge \Theta_l|}{|\Phi_l|}.$$

In rough sets theory and data mining, the certainty factor is widely used as the *confidence coefficient* (Pawlak, 2002a, 2002b; Nasiri & Mashinchi, 2009). It can be interpreted as the frequency of cases having the property specified in $\omega_l$ in the set of cases in *U* having the property specified in $\phi_l$. Obviously, the certainty factor equals 1 if all the entire cases that satisfy a rule's premise also satisfy the property specified in a rule's conclusion. In such a case, $r_l$ is called a certain decision rule if $cer(r_l) = 1$. On the other hand, certainty factor equals 0, if the entire cases that satisfy a rule's premise fail to satisfy the property specified in a rule's conclusion. A rule is called uncertain if $cer(r_l) \in (0,1)$. As "the measure of the truth of the decision rule" (Bazan et al. 2004, p. 114), the main interest in rule induction is usually to search for rules with high confidence coefficients. Also, the certainty factor can be interpreted as a measure that shows "how strongly the decision rule can be trusted in view of the data" or the available evidence (Pawlak, 2002a, p. 6).

### iii. The Coverage Factor

The coverage factor is also a coefficient belonging to [0,1]. It is a measure that captures the frequency of terminated contracts in the set of contracts that possess the property (or condition) specified in a rule's premise, $\phi_l$. The computation of a rule's *coverage*

*factor*, involved the division of the number of cases satisfying the rule's premise $\phi_l$ and the conclusion $\omega_l$ by the number of case(s) that that belong to the set induced by the rule's conclusion $\omega_l$.

$$cov(\mathrm{r}_l) = prob(\ \Phi_l|\Theta_l) = \frac{|\Phi_l \wedge \Theta_l|}{|\Theta_l|}.$$

Simply, the coverage factor shows the extent to which the cases in a rule's conclusion appear among the cases that possesses the conditions specified in a rule's premise.

In general, in the rough sets literature (Pawlak, 2002a: 6), the certainty and the coverage factors are both referred to as the conditional probabilities that expresses the exactness of our knowledge about the reality being considered. The fact that the factors are computed from data, rather being assumed arbitrarily also enhances the objectivity of these measures.

### 3.8.7 The Formal Analysis of Explanatory Power

In general, explanatory 'power is a notion that is "employed in contexts in which two or more explanations are compared with respect to their explanatory qualities" (Ylikoski & Kuorikoski, 2010: 202). It can be an attribute of a theory or an individual explanation. Questions related to how good an explanation is in comparison with rival or competing explanations is an importing issue in the philosophy of science literature (Schupbach & Sprenger, 2011).

This section describes the process used to measure the explanatory power associated with the attribute(s) in each of decision rule in this study. The process and the associated measurement are based on the recent developments in the philosophy of science literature (Hempel, 1965; and Glymour, 1980; Ylikoski, 2007; Ylikoski and Kuorikoski, 2010; Schupbach & Sprenger, 2011) in respect of explanatory power analysis. Notably, one of the novelties that characterises this study lies in its ability to integrate the criteria developed in the philosophy of science literature in respect of explanatory power assessment with the measures (i.e., support, coverage and certainty) associated with rough sets-theoretic algorithms. In so doing, one of the main goals is to identify how informative a given attribute or explanatory variable is in comparison with the obvious knowledge on the rate of contract termination. The paragraph that follows

establishes the structural link between the basics of explanatory power analysis and rough sets decision rules. The subsequent paragraphs then elucidate on set of axioms adapted to guide the measurement of explanatory powers in this study.

In the preceding sections, a decision rule or algorithm $r_l$ is defined as a formal language that comprised of two parts - a premise (or condition) and the consequent. Furthermore, to facilitate the evaluation of each rule, $\phi_l$ and $\theta$ are used to denote the premise and the consequent parts of rule $r_l$, respectively. Thus, each decision rule can be re-stated as follows: if $\phi_l$ then $\theta$ (where $\theta$ denotes "status = termination").

As with the decision rules, the logic of explanatory power analysis comprises of two main components – the *explicans* and the *explicandum*. On the one hand, the explicans is defined as the explanation or explication given for a fact or an observation. On the other hand, the explicandum is defined as the event or fact to be explained. On the basis of these two concepts, the aim of a formal analysis of "the strength of an explanation" is to specify the degree to which a particular *explanans* explains the *explanandum*. Accordingly, one can think of a rule's consequent $\theta$ as an explicandum - the event or fact to be explained, and a rule's premise $\phi_l$ as the *explicans* - the explanation or explication given for $\theta$ or the event of contract termination. Based on these definitions, the author then use the framework of explanatory power analysis to specify the extent to which the conditions in a rule's premise constitutes or provide a strong or weak explanation for contract termination. The measures that ensued from the analysis then formed the basis for comparative explanatory judgements – the basis for ascertaining whether the condition or attribute in rule $r_j$ provide a better explanation of contract termination than does the conditions or attributes in rule $r_k$.

### 3.8.8 Measuring and Attributing Explanatory Power

As with the conventional definition of explanation in the philosophy of science literature (Hempel, 1965; and Glymour, 1980), an attribute or sets of attributes is said to be explanatory of an explanandum if it necessarily "increases the degree to which we expect that explanandum" (Schupbach & Sprenger, 2011, p.5). In other words, the explanatory power that the study sought to identify and measure has to do with the degree to which the set of variables or conditions specified in a rule's premise – (i.e., the *explicans*) increase the degree to which one expects the explanandum – the event of contract termination. In this study, the measurement of the explanatory powers is

based on an adaptation of the following five axioms developed in Schupbach & Sprenger (2011). The first axiom specifies the probabilistic nature and limits of the explanatory power analysis.

***Axiom 1***. ***Formal Structure:*** *An explanatory power $\mathcal{E}_l$ is a measurable function that maps the two propositions $\phi_l$ and $\theta$ to a real number in $[-1, 1]$. The function $\mathcal{E}_l(\phi_l, \theta)$ is defined as a function of $Pr(\theta)$, $Pr(\phi_l|\theta)$, and the $Pr(\phi_l|\neg\theta)$.*

Besides specifying the probabilistic nature and the limits of the explanatory power analysis, the properties implied in axiom 1 introduce some of the logical implications in explanatory power analysis. Furthermore, the notation $\neg\theta$ denotes 'not-termination' - the exclusive alternative value of a contract's status, while $Pr(\theta)$ refers to the background knowledge about the probability of contract termination. Regarding the inclusion of $\neg\theta$ in this study, Yilsoski (2007) notes, the incorporation of contrastive explanandum makes explanatory power analysis more explicit and forces one to articulate the main object of the explanation and its possible values. It is also argued that the power of an explanation is an objective matter that depends on the "range of inferences to counterfactual situations the explanatory information makes possible and by the ease with which these inferences can be made with respect to some body of background knowledge" (Ylikoski & Kuorikoski, 2010: 208).

The property implied in the second axiom centers on the notion of *Positive Relevance*. As Ylikoski and Kuorikoski (2010: 205) posits, "a good explanation is one that is informative relative to the current body of background knowledge" about the fact to the explained, otherwise the explanation will simply be stating the obvious. The background knowledge in the context of this study refers to the unconditional probability of contract termination, $Pr(\theta)$. Based on the *Positive Relevance* axiom, in probabilistic terms, the explanatory variable $\phi_l$ provides a strong explanation of outcome $\theta$, to the extent that it increases the degree to which one expects outcome $\theta$ (i.e., the explanandum). Accordingly, if the condition $\phi_l$ in $r_l$ increases the degree to which one expect contract termination, $\theta$ then, $\phi_l$ is considered positively relevant to the explanation of $\theta$.

***Axiom 2. Positive Relevance****: Ceteris paribus, the greater the degree of statistical relevance between* $\theta$ *and* $\phi_l$*, the higher* $\mathcal{E}_l(\phi_l, \theta)$.

The third axiom concerns the *Irrelevance of Priors*. The property in this axiom requires the explanatory powers associated with an explanans (or explanatory attribute) to be independent of the prior probability of the explanans. The logic behind this axiom is based on the fact that the extent to which an explanatory attribute increases the degree to which one expects some explanandum should "not depend on considerations of how likely that" explanatory attribute is in and of itself.

***Axiom 3. Irrelevance of Priors:*** *The value of* $\mathcal{E}_l(\phi_l, \theta)$ *does not depend upon the value of* $Pr(\phi_l)$.

In essence, axiom 3 serves the purpose of preventing the allocation of higher explanatory powers to highly frequent explanatory attributes or the allocation of explanatory power simply on the basis of an explanatory attribute's comparative frequency. As an example, suppose that the attributes $\phi_j$ and $\phi_k$ are equally powerful determinants of $\theta$, and that the attributes $\phi_j$ and $\phi_k$ make the occurrence of event $\theta$ more or less expected (to the same degree). In the light of these considerations and the implications in axiom 3, the facts that attribute $\phi_j$ happens to be numerically more frequent than attribute $\phi_k$ should not diminish the explanatory power of $\phi_k$ over $\theta$ in comparison with that of $\phi_j$.

The fourth axiom further specifies the scope of the logical implications that are considered in the measurement of explanatory power. As with the earlier remark on how the measurement of explanatory power depends on the range of inferences to counterfactual situations that a rule facilitates, this condition specifies the truth-functional compounds of a decision rule.

***Axiom 4. Normality and Form:*** $\mathcal{E}_l$ *is the ratio of the functions of* $Pr(\theta \wedge \phi_l)$, $Pr(\neg\theta \wedge \phi_l)$, $Pr(\theta \wedge \neg\phi_l)$, *and* $Pr(\neg\theta \wedge \neg\phi_l)$.

Basically, axiom 4 is based on the fact that the $Pr(\theta \wedge \phi_l)$, $Pr(\neg\theta \wedge \phi_l)$, $Pr(\theta \wedge \neg\phi_l)$, and $Pr(\neg\theta \wedge \neg\phi_l)$ fully determine the probability distribution over the truth-

functional compounds of decision rule $r_l$ that comprises of $\theta$ and $\phi_l$. The representation and measurement of $\mathcal{E}_l$ in terms of the truth-functional compounds of rule $r_l$ also facilitates the determination of a unique and normalized measure of explanatory power.

Based on the foregoing, the condition $\phi_l$ in $r_l$ ought to be maximally explanatory regarding contract termination, $\theta$, when it renders contract termination maximally expected, and this occurs whenever $\phi_l$ guarantees the truth of $\theta$ (i.e., when $cer(r_l) = Pr(\theta|\phi_l) = 1$). Similarly, the condition $\phi_l$ in $r_l$ is minimally explanatory of $\theta$ if θ is maximally unexpected in the light of $\phi_l$, and this occurs whenever $\phi_l$ implies ¬θ (i.e., when $cer(r_l) = Pr(\theta\,|\phi_l) = 0$). Notably, larger values of $\mathcal{E}_l$ indicate stronger positive explanatory power of $\phi_l$ with respect to $\theta$. In such a case, $\mathcal{E}_l(\theta, \phi_l) = 1$ (being the maximal value) indicates the point at which the explanans $\phi_l$ fully explains its explanandum $\theta$, and $\mathcal{E}_l(\theta, \phi_l) = -1$ indicates strong negative explanatory power (when $\phi_l$ provides a full explanation for $\neg\theta$). Lastly, $\mathcal{E}_l(\theta, \phi_l) = 0$ represents the neutral point at which $\phi_l$ lacks any explanatory power relative to $\theta$. A complete lack of explanatory power is happens when the condition $\phi_l$ fails to increase or decrease the degree to which one expects $\theta$. In such cases, the conditions in the explanans $\phi_l$ and the explanandum $\theta$ are considered explanatorily irrelevant.

The fifth axiom that guided the identification of the explanatory power requires that the more the attribute $\phi_l$ explains $\theta$, the less it explains its negation $\neg\theta$.

***Axiom 5. Symmetry:*** $\mathcal{E}_l(\theta, \phi_l) = -\mathcal{E}_l(\neg\theta, \phi_l)$.

The logic of the requirement in axiom 5 is based on the expectation that the more expected the truth of contract termination $\theta$ is in light of condition $\phi_l$, the less expected is $\theta$'s falsity. This means that $\mathcal{E}_l(\theta, \phi_l)$ takes its maximal value precisely when $\mathcal{E}_l(\neg\theta, \phi_l)$ takes its minimal value and vice versa.

The properties implied in the above five axioms facilitated the determination of the grounded and unique measure of explanatory power proposed in Schupbach & Sprenger (2011) as stated in below:

$$\mathcal{E}_l(\theta, \phi_l) = \frac{Pr(\phi_l|\theta) - Pr(\phi_l|\neg\theta)}{Pr(\phi_l|\theta) + Pr(\phi_l|\neg\theta)}$$

The following additional comments refer to the adaptation of this measure and its relationship with rough sets measures. Observably, the basic elements of this measure are already in discussed in the section on rough sets theory. Specifically, $Pr(\phi_l|\theta) = cov(r_l)$ denotes the coverage of $r_l$, the measure that captures the frequency of terminated contracts in the set of the contracts that possess the property or attributes specified in $\phi_l$. The measure $Pr(\phi_l|\neg\theta)$ thus captures the frequency of "non-terminated" contracts in the set of the contracts that possess the property or attributes specified in $\phi_l$. To compute this measure, one simply divides number of cases in a rule's premise $\phi_l$ that fails to meet the property specified in the rule's conclusion $\theta$ by the number of cases that fail to satisfy the decision rule's conclusion.

$$Pr(\phi_l|\neg\theta) = cov(r_l') = \frac{|\neg\Theta \wedge \Phi_l|}{|\neg\Theta|}.$$

Putting these together, one can re-sate the measure of explanatory power as follows:

$$\mathcal{E}_l(\theta, \phi_l) = \frac{Pr(\phi_l|\theta) - Pr(\phi_l|\neg\theta)}{Pr(\phi_l|\theta) + Pr(\phi_l|\neg\theta)} = \frac{cov(r_l) - cov(\neg r_l)}{cov(r_l) + cov(\neg r_l)}$$

Significantly, this establishes a novel connection between two seemingly different developments in rough set theory and the logic of explanatory power analysis. In general, besides facilitating the resolution of explanation-related controversies, it is argued that $\mathcal{E}_l$ is "an intuitively appealing formal account of explanatory power" that "makes questions pertaining to the normativity of explanatory considerations much more tractable" (Schupbach & Sprenger, 2011, p. 13).

### 3.8.9 The Regression Analysis

In addition to the rough sets analysis, this study also used a multiple regression analysis to investigate the statistical relationship between contract outcome (the dependent variable) and the three explanatory attributes (i.e., contract-type, sector and the sponsor's nationality). Outcome is a binomial variable that determines whether a contract is terminated or still operational. The investigation also aimed at ascertaining the causal effect of each of the three variables on contract termination, and the statistical

significance of the estimated relationship, using the PPP dataset. It is assumed that contract termination is affected by these three attributes. Formally, the model for the multiple linear regression used to capture the hypothesized relationship between the three attributes and contract outcome, given $n$ number of contracts or observations is defined as follows:

$$Outcome_i = c + \lambda_1 Contract_i + \lambda_2 Sector_i + \lambda_3 Sponsor_i + \varepsilon.$$

Based on this specification, the study assumed that the value of each attribute affects a contract's outcome, linearly.

Where:

The subscript $i = 1, 2, \ldots n$ indexes a particular case or observation.

$c =$ the constant term.

$\varepsilon =$ the error term.

$\lambda_j =$ the regression coefficient of the associated attribute.

As summarised in Table 2, $Outcome_i$ denotes the status of project $i$ in terms of being either terminated or not terminated. Not terminated includes projects that are either operational of successfully concluded upon the expiration of the contract period. Those projects that are still under construction during the study's time frame are excluded. Terminated projects include those projects in which either the public or private partner exits from before fulfilling the contract's terms. Also, $Contract_i$ denotes project $i$'s belongingness to the two contract types that emerged from the classifications presented in Table 2 and Figure 4. Binomially, a contract is considered to be either Type-m or Type-β. As also summarised in Table 2, $Sector_i$ is classified in terms of the main infrastructure services (energy, telecom, transport and water) that the project $i$ provides to the public, while $Sponsor_i$ is defined in terms of the nationality of the partners that are involved in the implementation of project $i$.

Essentially, the use of the regression analysis served the purposes of validating and triangulating the study's findings and conclusions.

### 3.8.10 The Qualitative Analysis

The qualitative analysis involved the use of the case study method. Generally, a case study is defined as "an empirical enquiry that uses multiple sources of evidence to

investigate a contemporary phenomenon within its real life context" (Yin 2009: 18). The two cases examine by the author are the Tanzanian Railway Limited (TRL) and the Nigerian Telecommunication Limited (NITEL). The author's use of the case study method is based on the need for a closer look on the factors associated with contract termination in real-life. Despite some reservation on the generalizability of a case study's findings, the proximity of the case study to the reality of contract termination facilitated the identification of some salient issues that lay credence to the empirical analysis. It also facilitated the author's ability to integrate multiple source of evidence in the study. The case study also relied on the grounded theory's technique of direct observation and comparison. In general, the case study focused on identifying the common concepts through which various participants perceive and interpret the incidence of contract termination, and the factors that are used by the participants to explain a contract's termination. The comparison also enhanced the understanding of the commonalities that under the explanation of contract termination in the two projects (TRL and NITEL).

## 3.9 Remarks

Developing a framework general enough to account for all the incidences of contract termination will require the collection of a vast amount of both qualitative and quantitative facts on many different issues involved in the implementation a PPP. From this perspective, to an extent, due to confidentiality and practicality constraints, the study could not succeed in accounting for all the cases of contact termination. Also, the secondary data used in this study's empirical analysis were previously collected and complied by the World Bank/PPIAF. While the use of this data enhances the study's objectivity and practicality, the fact that they data were previously collected without this study's objective in mind may have led to the omission of some relevant facts. Hence, the study could not overcome some of the drawbacks that could result from the use of secondary data.

# 4 An Empirical Analysis of Contract-type and Contract Termination

## 4.1 Overview

This chapter presents the main findings of the study's analysis. It centres on the measures (support, coverage, certainty and explanatory power) associated with the decision rules synthesized in the study. The results are organised in a manner that facilitates a comparative analysis of the relevance of each condition or set of conditions in a rule's premise in respect of contract termination. The first part of the chapter focuses on the measures associated with each of the 9 conditions or contractual attributes that formed the basis for the antecedents used in the study and the extent to which each attribute or condition constitutes a strong or weak explanation for contract termination. The second part of the chapter focuses on the measures associated with a conjunction of two or more conditions or attributes. One of the main highlights in the second part revolves around the notion of context-sensitivity – how the explanatory relevance of a certain attribute increases or decreases when it is tacked to another attribute. This then formed the basis for some of the final remarks on the susceptibility of an attribute's relevance to changes in the values of the other attributes.

Notably, the results presented in this chapter are based on a total of 444 PPP contracts signed in SSA between 1990 and 2012. Of these 444 contracts, 53 are terminated while 391 are operational. These numbers indicate that the average rate or probability of termination is approximately 0.119. This number (i.e. the average rate of termination) served as a reference point that determines a premise' positive or negative relevance to the explanation of contract termination.

## 4.2 Measures Associated with each Competing Explanation

Table 3 shows the measures associates with each of the conditional attributes. In this table, the information under $\theta$ represents the outcome attribute or consequent to be explained, while the information under $\phi$ represents the conditions (the hypothetical explanations given for contract termination, $\theta$.

**Table 3: Measures Associated with Each Attribute**

| | **Antecedent** | → | **Consequent** | | $\boldsymbol{Supp(r_l)}$ | $\boldsymbol{Cov(r_l)}$ | $\boldsymbol{Cov(\neg r_l)}$ | $\boldsymbol{Cert(r_1)}$ | $\boldsymbol{\mathcal{E}_l(r_l)}$ | $\boldsymbol{\mathcal{E}_l(\neg r_l)}$ |
|---|---|---|---|---|---|---|---|---|---|---|
| | ϕ | → | θ | \|Φ\| | \|Φ ∧ Θ\| | Pr(ϕ\|θ) | Pr(ϕ\|¬θ) | Pr(θ\|ϕ) | $\mathcal{E}_1(\theta, \phi)$ | $\mathcal{E}_1(\neg\theta, \phi)$ |
| $r_1$ | (Contract, Type-β) | → | (Outcome, Terminated) | 88 | 23 | 0.434 | 0.166 | 0.261 | 0.446 | -0.446 |
| $r_2$ | (Contract, Type-m) | → | (Outcome, Terminated) | 356 | 30 | 0.566 | 0.834 | 0.084 | -0.191 | 0.191 |
| $r_3$ | (Sector, Energy) | → | (Outcome, Terminated) | 120 | 17 | 0.321 | 0.263 | 0.142 | 0.098 | -0.098 |
| $r_4$ | (Sector, Telecom) | → | (Outcome, Terminated) | 202 | 24 | 0.453 | 0.455 | 0.119 | -0.003 | 0.003 |
| $r_5$ | (Sector, Transport) | → | (Outcome, Terminated) | 97 | 9 | 0.170 | 0.225 | 0.093 | -0.140 | 0.140 |
| $r_6$ | (Sector, Water) | → | (Outcome, Terminated) | 25 | 3 | 0.057 | 0.056 | 0.120 | 0.003 | -0.003 |
| $r_7$ | (Sponsor, Foreign) | → | (Outcome, Terminated) | 392 | 39 | 0.736 | 0.647 | 0.134 | 0.064 | -0.064 |
| $r_8$ | (Sponsor, Mixed) | → | (Outcome, Terminated) | 51 | 8 | 0.151 | 0.110 | 0.157 | 0.157 | -0.157 |
| $r_9$ | (Sponsor, Domestic) | → | (Outcome, Terminated) | 72 | 4 | 0.075 | 0.174 | 0.069 | -0.395 | 0.395 |

Observably, the values of the conditional attributes induced a partition of the universe into nine subsets. The elements in each subset are indiscernible from each other in terms of the attribute-value in the rule's premise. The column $|\Phi|$ denotes the cardinality of each subset– the number of elements that possess the property specified in the rule's premise. The column $|\Phi \wedge \Theta|$ denotes the number of the contracts terminated in each subset. In other words, it shows the number of contracts that satisfy the conditions specified in a rule's premise and consequent. While the coverage $cov(r_l)$ captures the frequency of terminated contracts in the set of contracts that possess the property (or condition) specified in a rule's premise, $cov(r_l')$ captures the frequency of "not-terminated" or operational contracts in the set of contracts that possess the property (or condition) specified in a rule's premise. The $cert(r_l)$ column shows the certainty or confidence coefficient, the frequency of terminated contracts in the subset of cases having the property specified in the rule's premise. The last two columns show the explanatory power associated with the truth-functional compounds of each decision rule. A closer look at Table 3 indicates that there are some obvious differences in the numbers and measures associated with each rule and subset. The main features and patterns in the table are further explored from various perspectives as follows.

In terms of the sector attribute, the information in Table 3 indicates that 17 out of the 120 contracts in the energy sector are terminated. This number, 17, represents

about 14.2% of the entire PPP contract signed in the energy sector. The table also indicates that 9 out of the 97 contracts signed in the transport sector are terminated. In comparison with the other 3 sectors, the table indicates that the contracts in the transport sector have a lowest rate of termination. In general, the respective certainty coefficients imply that: if a contract's sector is energy, then probability that the contract is terminated equals 0.142. Furthermore, if a contract's sector is telecom, then probability that the contract is terminated equals 0.119, and if a contract's sector is transport, then probability that the contract is terminated equals 0.093. In addition to these indications, Figure 5 shows the respective explanatory powers of the sector attributes.

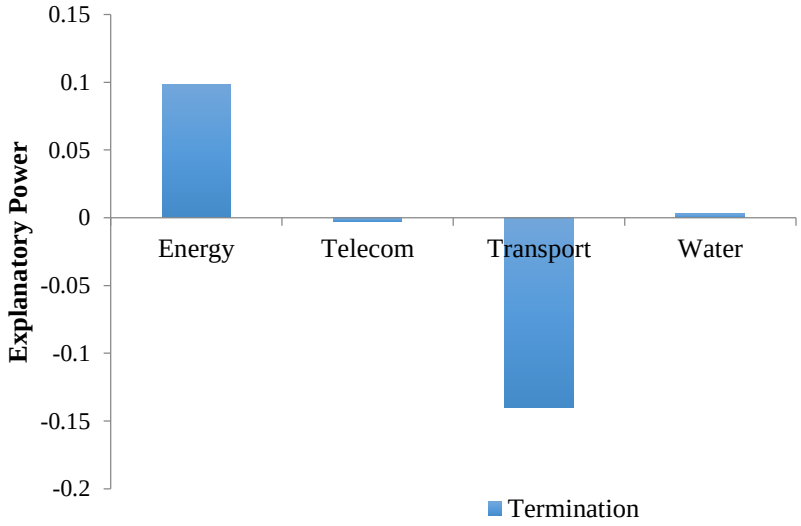


**Figure 5: The Explanatory Power of the Sector Attributes**

Figure 5 shows the relative relevance of each attribute in respect of contract termination and not-termination. It indicates that the energy sector has the highest explanatory power for contract termination, in comparison with the other sectors. The figure also captures ordinal relationship between explanatory powers and the confidence coefficients associated with each attribute. As an example, the fact that the energy sector has the highest rate of termination, in comparison with the other 3 sectors, and the fact that its rate of termination is slightly above-average helped account for its greater power and relevance. On the other hand, the transport sector's below average certainty of termination makes it negatively relevant to the explanation of contract termination. The height of each bar in the graph literally reflects each sector's degree of statistical relevance to contract termination or not-termination. In line with the

symmetry axiom, the more a sector explains contract termination, the less it explains its negation or not termination.

In terms of the effect of the sponsor's nationality attribute, the information in Table 3 also indicates some clear differences. Notably, the contracts whose sponsors are foreign account for about 65% of the entire contracts. The rates of termination also vary considerably, from a low or approximately 5% to a high of about 16%. As the table indicates, the most likely to be terminated contracts are those whose sponsors are mixed (i.e., a partnership between foreign and domestic sponsors), while the least likely to be terminated are those whose sponsors are domestic. The gap between these rates provides some evidence of varying vulnerability. The possible implication of these slight differences will surely form a basis for some of the issues examined in the discussion sections. Figure 6 shows the respective explanatory powers of the sector attributes.

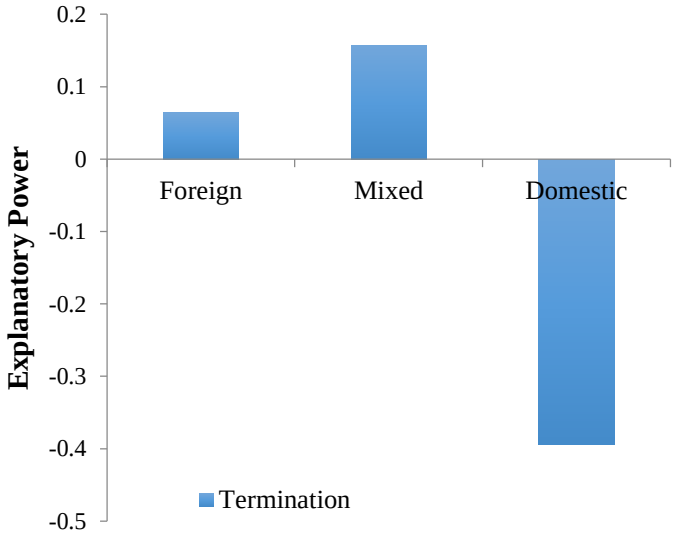


**Figure 6: The Explanatory Power of the Sponsor's Nationality**

The information in Figure 6 shows that the "mixed nationality" property has the highest explanation for contract termination, and the least explanatory power for not-termination, in comparison with the other values of the nationality attribute. On the other hand, the "domestic nationality" property possesses the lowest explanatory power for contract termination, and the highest explanatory power for not-termination, in comparison with the other values of the nationality attribute. The negative relevance of the "domestic nationality" to contract termination proceeds from the fact that, unlike

the contracts in the "foreign nationality" and the "mixed nationality" subsets, its rate of termination is slightly below the overall rate of contract termination. In other words, the "domestic nationality" attribute decreases the degree to which we expect contract termination given the fact that the probability of contract termination, $\Pr(\theta)$, is greater than $\Pr(\theta|\text{domestic nationality})$. Specifically, the certainty coefficients indicate that, if a contract's sponsor is domestic, then the probability that the contract is terminated equals 0.069. On other hand, unlike the overall rate of termination, 0.119, if a contract's sponsor is mixed, then probability that the contract is terminated equals 0.157.

Regarding the role of contract types, the information in table 3 shows that 23 out of the 88 type-$\beta$ contracts sector are terminated. This number, 23, represents about 26% of the entire type-$\beta$ contract. The table also indicates that 30 out of the 356 type-$m$ contracts are terminated. As a result, the certainty coefficients associated with the termination of type-$m$ and type-$\beta$ contracts 0.084 and 0.261, respectively. In rough sets parlance, this implies that if a contract's type is type-β, then the probability that the contract is terminated equals 0.261, and that if a contract's type is type-m, then the probability that the contract is terminated equals 0.084. Observably, the certainty factor associated with type-$m$ is relatively small in comparison with its larger support. An important fact to note in this regard is that the high number of support and coverage somewhat reflects the larger number of contracts that match the criterion specified the predecessor of the rules – the cardinality of the subset of type-$m$ contracts. As with the telecom and foreign sponsored contract, the irrelevance of such numerical advantages satisfy the *irrelevance of prior axiom* – the requirement that explanatory powers should not depend on the relative likeliness of the cause or condition. Figure 7 compares the explanatory powers associated with contract types, alongside the sector and nationality attributes.

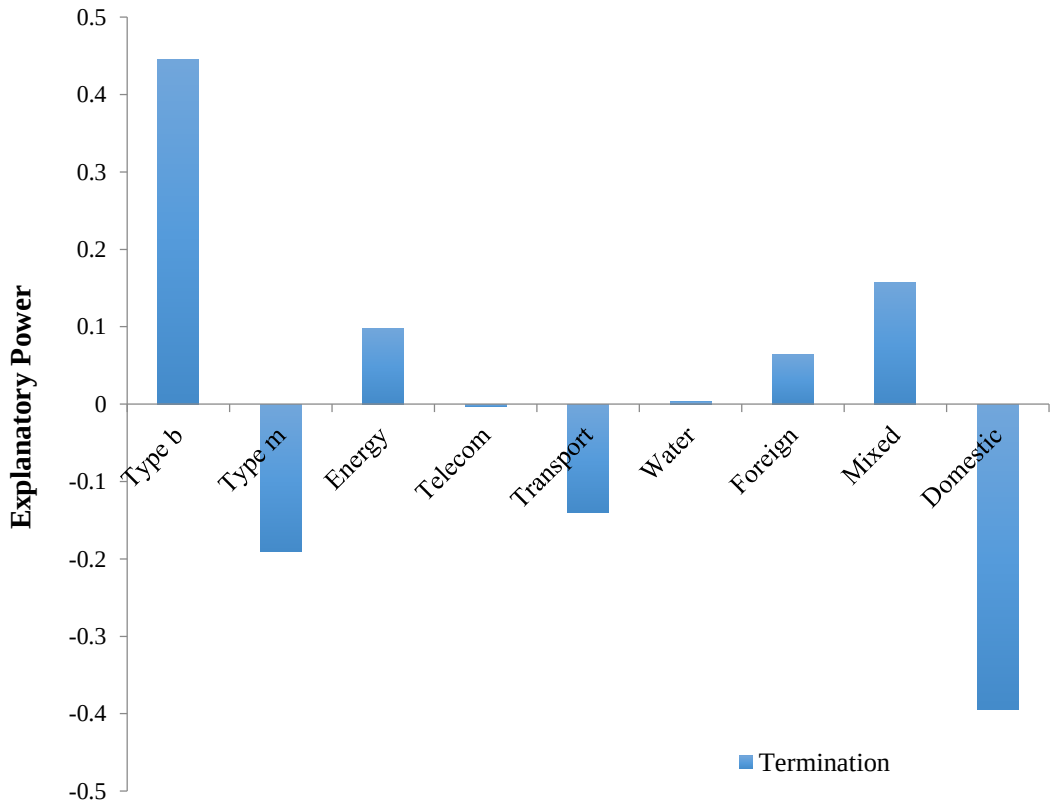


**Figure 7: The Explanatory Power of the entire Attributes**

In summary, Figure 7 clearly shows the attributes that are positively relevant to the explanation of contract termination, and the attributes that are negatively relevant. One of the main findings from these results is that type-$m$ contracts are less likely to be terminated in comparison with type-$\beta$ contracts. This implies that, in comparison with the other 8 conditional attributes, type-$\beta$ increases the degree to which one expects the incidence of contract termination the most. The termination of type-$\beta$ (as in, $r_1$) also happens to be the most certain algorithm. Another finding concerns the indication that energy contracts are most likely to be terminated in comparison with the other three sectors, and the indication that contracts whose sponsors are mixed are more likely to be terminated in comparison with contracts whose sponsors are either domestic or foreign. Generally, type-$\beta$ provides the best explanation for contract termination while domestic sponsorship provides the least explanation for contract termination. This implies that, while being type-$\beta$ increases the degree to which one expects contract termination, domestic sponsorship decreases the degree to which one expects the event of contract termination. Clearly, the information in Figure 7 provide some evidence of differential relevance and vulnerability in respect of contract termination. Noticeably,

as a result of the roughness of the database or the PPP information system, none of the rules have an explanatory power or certainty coefficient that equals 1. However, a few of the rules have considerably higher measures. The sensitivities of the relevance of each attributed when tacked to another attribute are further explored in the second part of this chapter.

The concluding remark in this section concerns the type of relationship between the certainty coefficients and the explanatory power. Literally, any conditional attribute that does not add to this background knowledge is considered to be negatively relevant, while any conditional attribute that adds to this background knowledge is considered to be positively relevant. The respective degrees of relevance correspond to the height of each bar in the graph.

The relationship shown in Figures 8 and 9 (in the section that follows) are quite significant from a theoretical perspective. Apart from providing a novel and logical foundation for the interpretation of rough sets' confidence coefficients, the logic of explanatory power effectively resolves the ambiguity associated with the interpretation of coverage in rough sets theory. The interpretative ambiguity arises from fact that a rule's coverage (the measure that captures the frequency of terminated contracts in the set of contracts that possess the property specified in a rule's premise) somewhat depends on the cardinality or the relative probability of its conditional attribute. Based on the definition of coverage in rough sets theory, it becomes difficult to isolate the relevance of an attribute from its numerical advantage. Figure 8 depicts the associated interpretative ambiguity.

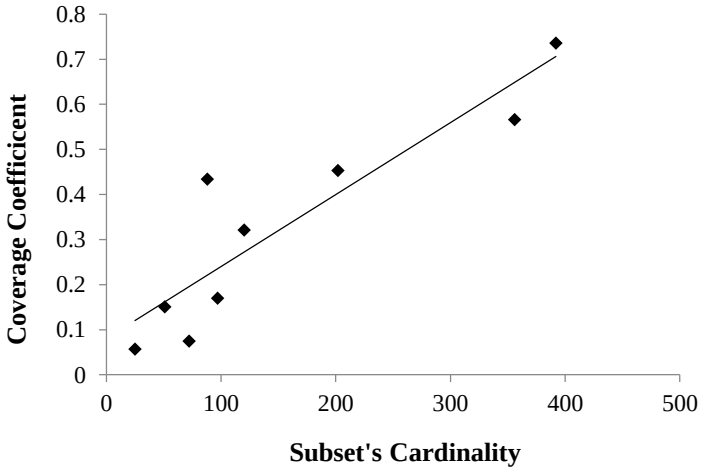


**Figure 8: The Relationship between Coverage Coefficient and Cardinality**

As indicated in Figure 8, higher cardinalities clearly lead to higher coverage coefficients. This accounted for the reasons why telecom contracts, foreign sponsored contracts and type-m contracts possess higher coverage coefficients, despite having little or no positive relevance to the explanation of contract termination. Theoretically, this positive relationship violates the logic behind the *Irrelevance of Priors* axiom. Given this violation, the use of explanatory power intuitively provides a grounded and normalized way of using a rule's coverage to provide an informative measure that correlates with the certainty coefficient. Essentially, one of the main sources of the interpretative ambiguity associated with the value of the coverage coefficient in rough sets theory proceeds from the non-incorporation of the entire truth-falsity implications of the conditional probability that the definition of coverage denotes. By considering these truth-falsity implication however, the logic of explanatory power effectively alleviates the issue associated with the undue influence of relative cardinalities in the allocation and interpretation of one of the most important measures of conditional probability in rough sets theory. Figure 9 depicts the finding's consistency with the *Irrelevance of Prior* axiom.

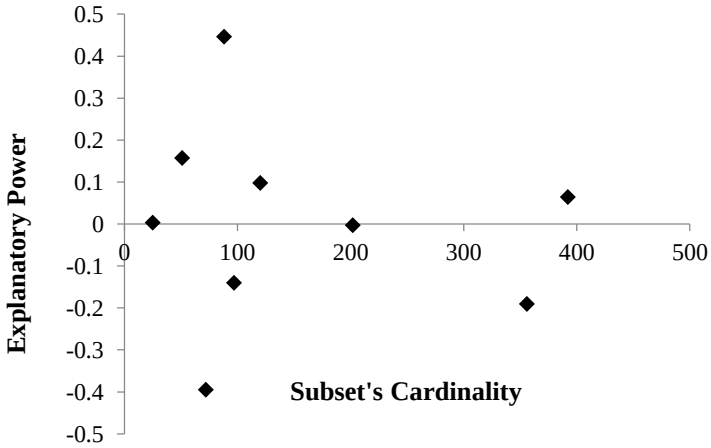


**Figure 9: Relationship between Cardinality and Explanatory Power**

In comparison with Figure 8, Figure 9 shows that the facts that the subsets induced by the attribute in a rule's premise happens to be numerically more frequent does not increase or diminish its explanatory power. A theoretical implication of this in the scheme of rough sets literature is that, the incorporation of the range of inferences to

counterfactual situations that a rule facilitates does matter. The results in Figure 9 also serves the purpose of facilitating a discussion on how two conditions that are significantly unequal in their respective frequencies could have the same amount of explanatory power over an outcome (such as contract termination).

## 4.3 The Sensitivity of each Attribute's Explanatory Relevance

Based on the notion of context-sensitivity, this part of the chapter evaluates how the measures associated with each attribute vary when it is tacked to another attribute. Generally, an evaluation of the context-sensitivity of an attribute's explanatory relevance is necessary for identifying the susceptibility of an explanatory relevance to other "local causal interference" (Ylikoski & Kuorikoski, 2010, p. 208). In presenting the results of the analysis therefore, greater emphasis is placed on the potential use of the wider implications of the findings in decision-making and the development of recommendations.

Figure 10 shows the sensitivity of the explanatory power of the two contract-types to changes in background factors. The length and the direction of each bar in the graph reflect the explanatory power associated with the attribute (or conjunction of attributes) in respect of contract termination. Figure 10 clearly facilitates the comparison of the relative impacts of various factors or circumstances to the explanatory power of contract-types in respect of contract termination. The first observation in the Figure 10 centers on the fact that the positive and negative relevance of type-β and type-m contracts in respect of contract termination continue to hold under a larger set of interventions or contexts. In general, the use of type-m contracts tends to minimize the certainty of contract termination across a range of circumstance, while the use of type-β contracts tends to enhance the certainty of termination.

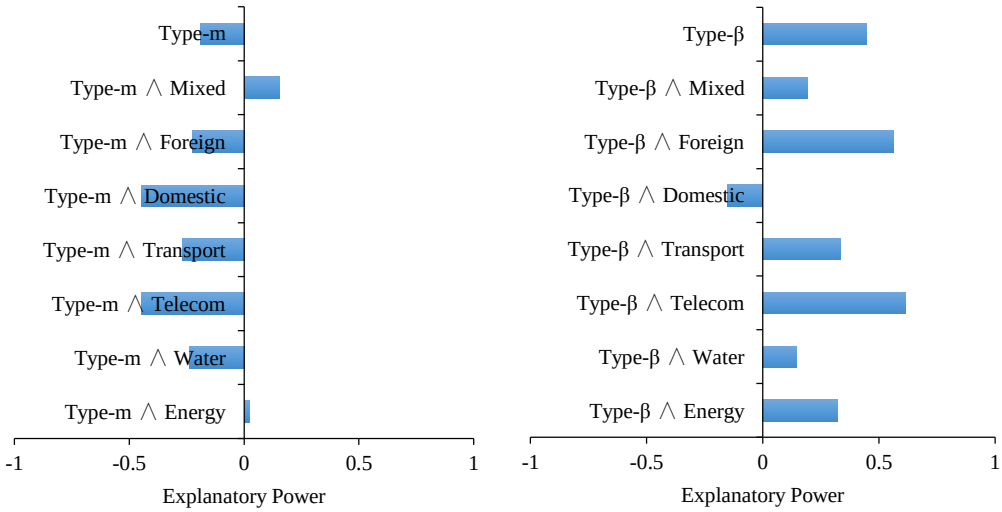


**Figure 10: The Sensitivity of Contract-Type's Explanatory Power**

In respect of minimizing the certainty of contract termination, the information in figure 10 suggests that it is best to use type-β contracts when the nationality of the investor is domestic. Besides the implication of the explanatory power, the certainty coefficient associated with the subset or partition that the conjunction "type-β ∧ domestic" induces imply that: if a PPP contract is type-β and the sponsor is domestic, then the probability that the contract is terminated equals 0.09. This probability also happens to be less than the overall probability of contract termination (i.e. 0.119). On the other hand, if a PPP contract is type-β and the sponsor is foreign, then the probability that the contract is terminated equals 0.33. Likewise, if a PPP contract is type-β and the sponsor is mixed, then the probability that the contract is terminated equals 0.17. Comparatively, it is therefore reasonable to avoid the use of type-β contracts when the project sponsors are foreign or of mixed nationality.

Another interesting observation in Figure 10 concerns the positive relevance of the "type-m ∧ mixed" attributes to contract termination in comparison with the other circumstances. This observation also appears to have some connection with the holdup and underinvestment problem. The hypothetical explanation for the positive relevance connection is based on the sub-agreement that a mixed-nationality partnership may require. This often results in more than one contract – a shareholding (or type-β) contract between the group of private investors, in addition to the overall public-private contract. Irrespective of the type of contract that governs public-private partnership takes, underinvestment may result if the sub-contract governing the group of private

investors is designed in a manner that corresponds to the type-β contract. The nested optimization problem that the form of sub-contracting induces can therefore be regarded as a good example of a circumstance that can undo or undermine the optimality of the type-m contract. Hence, while type-m contracts generally minimize the certainty of contract termination, based on the positive relevance of the "mixed ∧ type-m" contracts in respect of contract termination, it is recommended to avoid the use of type-m contracts in circumstances that involve a sub-contracting.

Figure 11 shows the sensitivity of the explanatory power of the respective sectors to changes in background factors. The result is also organized to facilitate the comparison of the relative impacts of various factors or circumstances to the explanatory power of the sector-attributes in respect of contract termination. Observably, the positive relevance of the four sectors in respect of contract termination appear to be highly dependent or sensitive to background factors. As an example, while the conditions - "energy ∧ type-β" increase the degree to which one expects contract termination, the "energy ∧ domestic" attributes completely eliminates the expectation of contract termination. A similar observation applies to the distance between the explanatory power of "water ∧ mixed" and that of "water ∧ domestic".

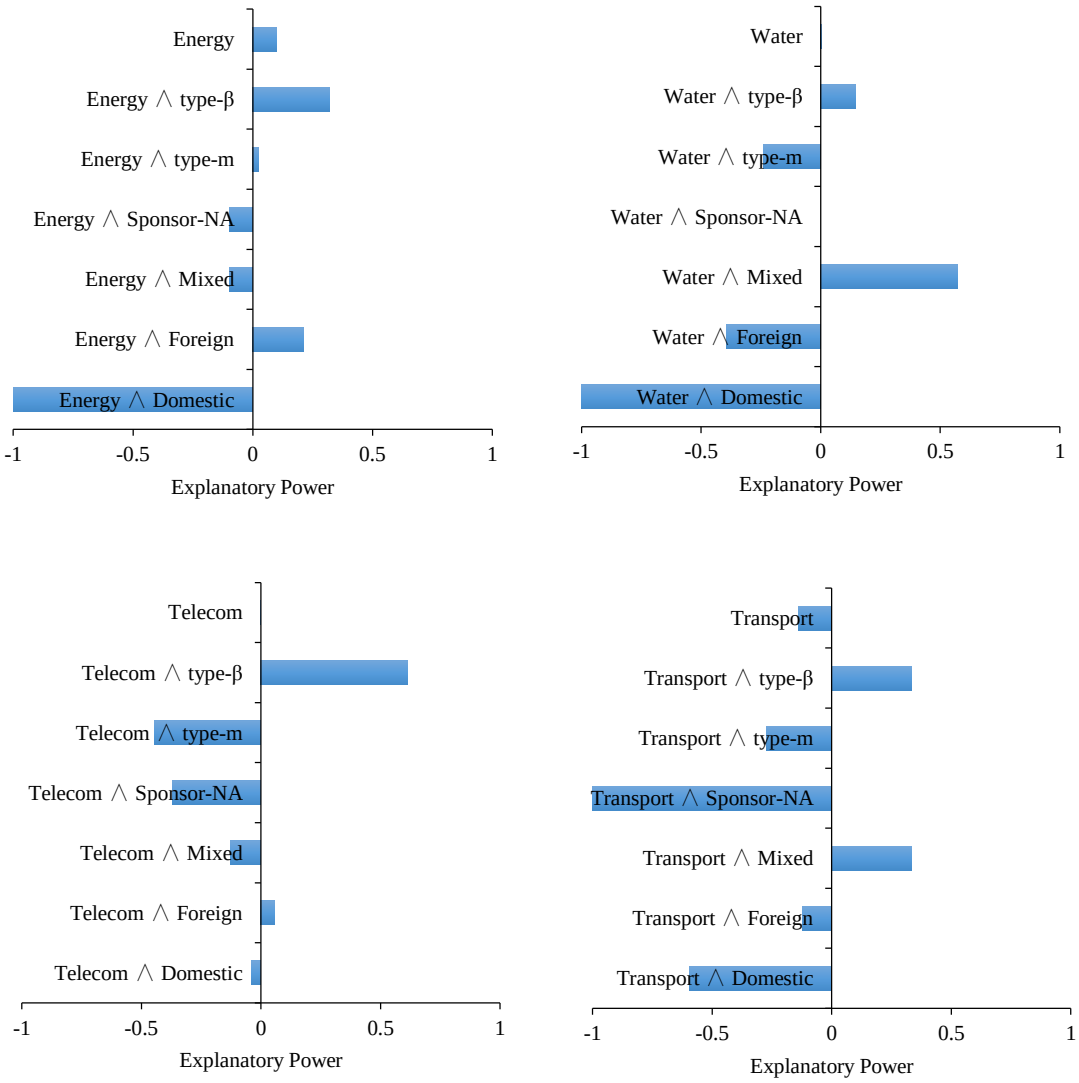


**Figure 11: The Sensitivity of the Sector Attributes**

Notably, in relation to the corresponding certainty coefficients, if a PPP is an energy project, and the sponsor is domestic, then the probability that the contract is terminated is zero. This explains why the explanatory power associated with "energy ∧ domestic" in respect of contract termination equals -1, the minimum value of explanatory power. A similar explanation applies to the measures associated with "water ∧ domestic". Interestingly, unlike the respective partitions that "energy ∧ domestic" and "water ∧ domestic" induce, no contract in the PPP information system met the criteria implied in "transport ∧ NA". In other words, the cardinality of the set of transport projects which sponsors are NA equals zero.

Furthermore, one can also see that despite not being strongly relevant in the explanation of contract termination, there seems to be some circumstance under which the telecom and water sectors increase or decrease the degree to which one expects the incidence of contract termination. Generally, however, there does not appear to be an easily generalizable logic for the changes in the sensitivity of these sector attributes across the range of circumstances. In any case, the result indicates that, if the objective is to minimize the certainty of contract termination, it seems reasonable to avoid the use of type-β contracts in the entire sectors. The result also facilitates the visualization of the consequences of mixed-sponsorship in transport and water sectors.

Figure 12 shows the sensitivity of the explanatory power of the sponsors' nationality in respect of contract termination in a range of circumstances. Noticeably, unlike "mixed" sponsored projects, domestic sponsored projects tend to do well in many contexts. In particular, the negative relevance of domestic sponsorship in respect of contract termination continues to hold, irrespective of the changes in the tacked attribute. The nagative relevance of domestic sonsorship to contract termination appears to be less sensitive to background factors.

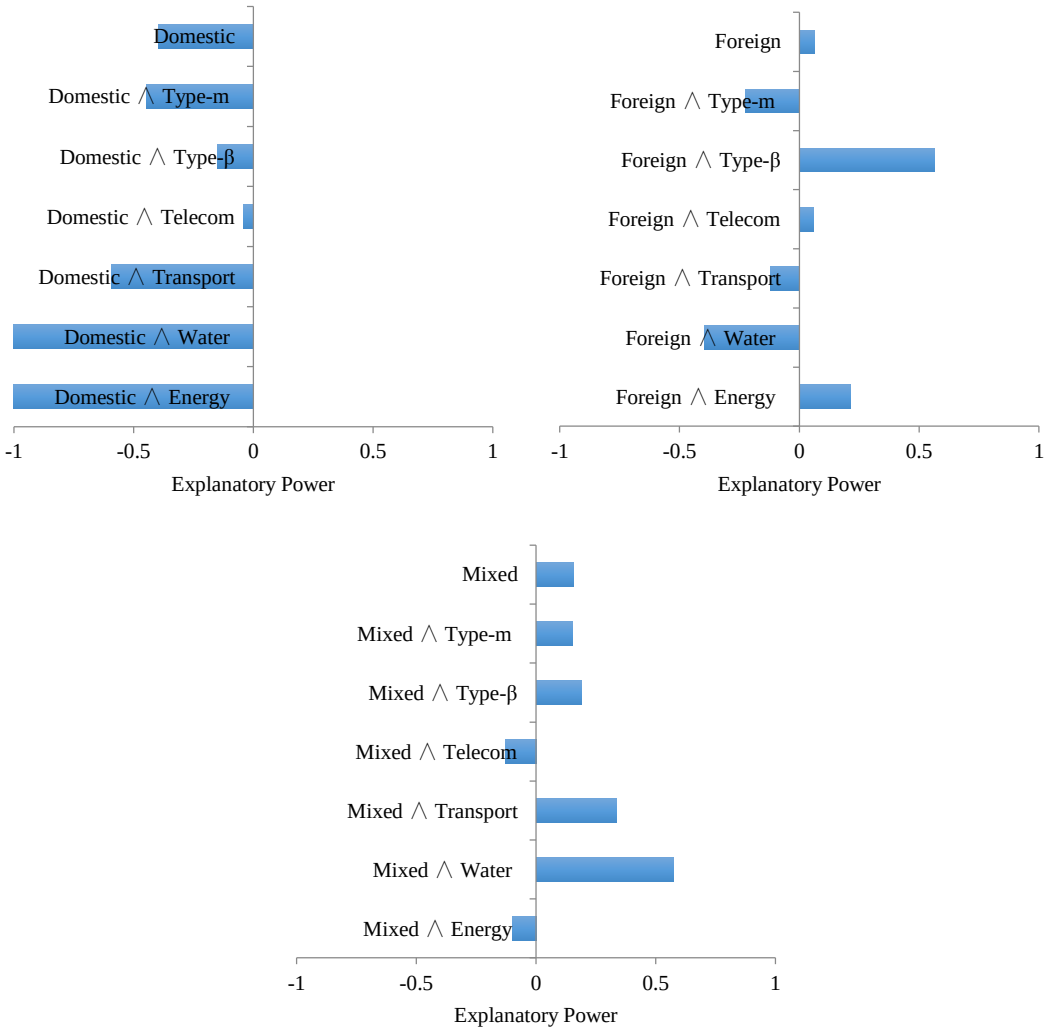


**Figure 12: The Sensitivity of the Sponsor's Nationality Attributes**

It is important to note that, the probability that a domestic sposored contract is terminated cahnges from 0 to 0.11 if the sector changes from energy (or water) to telecom. Despite the uninformativeness of a probability of 0.11 in the context of the background information on the overall probability of contract termination, it clealy singles out a context that worth paying closer attention to, particularly in risk analysis and further studies. In addition, Figure 12 shows the circumstance to which the riskiness of foreign sponsorship is most sensitive to. Significantly, the probability that a foreign sponsored projects is terminated changes from a low of 0.08 to a high of 0.33 if the contract-type changes from type-m to type-β. The probability that a foreign sponsored projects is terminated also changes from 0.06 to 0.17 if the sector changes from water to energy. In comparison with the other two sectors, the explanatory power associated

with foreign sponsorhip in respect of contract termination tends to be highly dependent on the circumstances. Albeit, the explanation changes the most in respect of contrac-type.

In relation to the sensitivity of the explanatory power of mixed-sponsorship in repest of contract termination to contextual changes, it is easy to see that the assocaited measures tend to be more stable in comparison with those of foreign sponsorship. In general, while it is possibe to attibute the largely positive explanatory relevance of mixed-sponsorship in respect of contract termination to the previous comment on the holdup problem that could arise from sub-contracting, the remark in relation to the difficulty of explaining how the specifities of a project's sector predisposes it to the risk of contract termination if the sponsor's nationality changes still applies. As an example, despite its relative insensitivity, the corresponding certanty coefficients indicate that, the probability that a mixed-sponsored project is terminated changes from 0.1 to 0.33 if the sector changes from telecom to water. Besides facilitating the identification of the possible effects of mixed-sponsorship in various sectors, the result generally indicates the existence of some special kind of causal mechanism that is beyond the scope of this research.

In addition to the qauntitative measures associated with how counterfactually relevant the respective values of these attributes (contract-type, the project's sector and the sponsor's natinality) are to the explanation of contract termination, the final part of the findings highlights some qualitative principles or criteria also bear on how good an explanation is. The two main principles often "used as an argument in favour of the theoretical perspective from which the preferrred explanation is derived" (Ylikoski & Kuorikoski, 2010, p. 207) are relative sensitivity and the degree of integeration. While most of the foregoing summeries focus on the sensitivity of the respective values of the attributes, the summary that follows focuses largely quality or virtue of the perspective from which the explanatory relvance of the values of the three attributes (i.e., contract-type, the project's sector and the sponsor's natinality) is derived.

Notably, there is no concensus in the literature (Ylikoski & Kuorikoski, 2010; Pannell, 1997) in relation to the calculation of an index or coefficiet that gives a general information on relative sensitivity. As an example, while Kleijnen (1995) suggets the use of simple slope or elasticity analysis, Hamby (1994) recommends the use of a relative deviation index. Another suggestion revolves around the use of range (the distance between maximum and minimum values). With particular reference to

explanatory power analysis, Ylikoski & Kuorikoski (2010) notes that "there are no general principles for comparing the sensitivity of explanations" (Ylikoski & Kuorikoski, 2010, p. 209). In this study, however, the evaluation of the relative sensitivities of the relevance of each attribute to changes in circumstances involves the calculation of varaince. Besides being computationally simple and suitable for a discrete and non-differentiable relationship, the use of variance effectively alleviates the interpretative disadvantages associated with the use of range as an index of sensitivity. Figure 13 shows the results of the variance analysis.

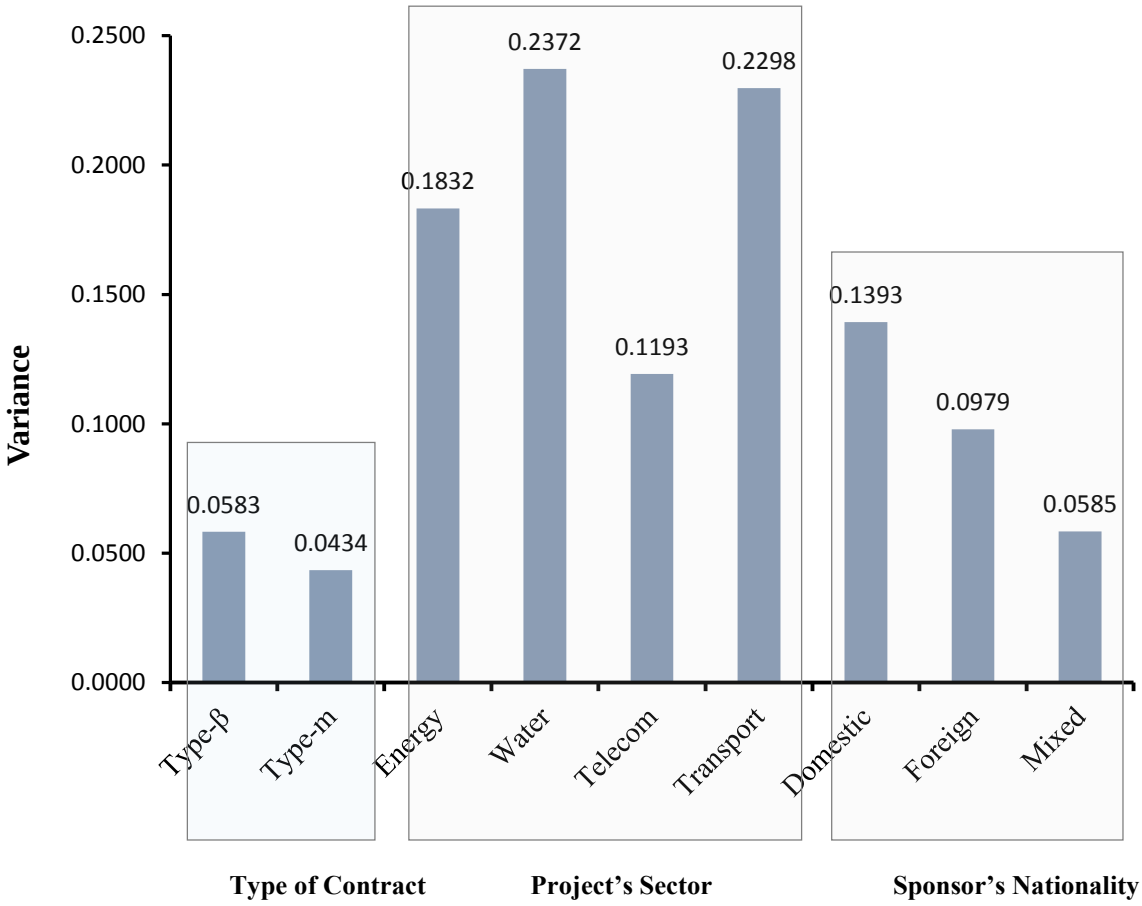


**Figure 13: The Variance of a PPP Attributes' Explanatory Powers**

As with the conventional interpretation of variance, smaller values indacate that the explanatory powers associated with the attribute across a range of circumstances tend to be quite close to the expexted values of the attributes's explanatory power, while the

higher values indicate greater dispersion from the expected values. Simply, smaller and higher values correspond to lower and higher sensitivity, respectively. Additionally, "an increase in sensitivity makes the explanatory relationship more fragile, whereas a decrease in sensitivity makes it more robust" (Ylikoski & Kuorikoski, 2010, p. 208). The result in figure 13 thus indicates that the explanatory power associated with contract-type tend to be less contingent on other factor, in comparison with the sector and nationality attributes. This therefore makes the explanations derived from contract-type more reliable and less fragile.

Comparatively, the lower variance also means that the explanations derived from contract-type would be correct in a larger number of circumstances. On the other hand, the sector attributes tend to be hyper-sensitive. This indicates the existence of a less reliable and less geralizable causal relationship between contract termination and the sector attribute. Besides theoretically weakening the explanations derived from the perspective of the project's sector, this fragility also means that the explanations derived from the sector attribute would be incorrect in a large number of circumstances.

## 4.4 The Statistical Significance of each Explanatory Attribute

The information in Table 4 summarizes the results of the multiple regression model used to investigate the statistical relationship between contract outcome (the dependent variable) and the three explanatory attributes (i.e., contract-type, sector and the sponsor's nationality). The analysis also aimed at ascertaining the causal effect of each of the three variables on contract termination, and the statistical significance of the estimated relationship, using the PPP dataset.

**Table 4: The Results of the Regression Analysis**

| Outcome | Coefficient | Std. Err. | t | P>\|t\| | 95% Conf. | Interval |
|---|---|---|---|---|---|---|
| Contract-Type | 0.1943 | 0.0380 | 5.11 | 0.000 | 0.1195 | 0.2691 |
| Project's Sector | -0.0266 | 0.0181 | -1.47 | 0.143 | -0.0621 | 0.0090 |
| Sponsor's Nationality | 0.0161 | 0.0206 | 0.78 | 0.433 | -0.0243 | 0.0565 |
| Constant | 0.1031 | 0.0618 | 1.67 | 0.096 | -0.0184 | 0.2246 |

| | | |
|---|---|---|
| Prob > F | = | 0.0000 |
| R-squared | = | 0.0609 |
| Adj R-squared | = | 0.0544 |
| Root MSE | = | 0.3178 |

The first point to note in Table 4 is the values of the regression coefficient that describe the effect of each explanatory attribute on the outcome of a PPP project. This shows that the predicted effect of contract-type on outcome is 19%, holding all the other explanatory variables constant. Observably, the signs of the coefficient shows that the effect of the sector and nationality attributes are negative and positive, respectively. Albeit, in view of the size of the corresponding P-values (0.143 and 0.433, respectively), it is easy to see that the effect of the sector and nationality attributes are not statistically significant at 95% confidence interval. On the other hand, the P-value associated with contract-type is very significant. In addition, in view of the F-test (Prob>F = 0.0000), one can reject the null hypothesis with extreme confidence.

## 4.5 A Summary of the Results

A main conclusion from the foregoing findings is that, contract-type is the significant factor in the explanation contract termination in public-private partnerships. Besides having higher certainty factors, the available evidence indicates that explanations derived from the two contract-type are less sensitive to contextual factors, in comparison with the explanations derived from a project's sector and the sponsors' nationality. Given the lower sensitivity, the explanations for contract termination derived from the contract-type would be correct in a larger set of circumstances. The findings thus confirm the consistency with the theories regarding the complexities involved in contract termination in a PPP.

# 5 An Illustration of how Contract-type Affects a PPP

## 5.1 Overview

To understand the endogenous determinants of contract termination that emanate from contract-type, this study examines some theories that offer some explanation on the mechanisms through which the partners' actions could affect a partnership's failure or success. Since underinvestment leads to poor performance and often amounts to contractual default, as a general objective, this theoretical framework aims to show that it is possible to mitigate the underinvestment problem, and equally achieve the first-best outcome, using an apparently simple contractual framework, namely the specific performance mechanism. A larger implication of the framework is the contention that, the mitigation of the underinvestment problem would generally lead more success or less termination in a PPP.

Notably, the mitigation of the underinvestment problem have been subjects of interest and controversy in the study of holdup. The debates and interests mostly center on the possibility of using a simple contract to induce efficient relationship specific investments in a contractual relationship. This study uses a Public-Private Partnership (PPP) to facilitate the modeling process and the contextualization of the paper's practical and theoretical implications. In addition to the use of a PPP contract, the significance of this illustration lies in its ability to address the gaps and questions in relation to the possibility of implementing of a socially efficient investment in a PPP, and the strict optimality of the ensuing outcome.

The rest of the chapter is organized as follows. Section two summarizes theoretical perspectives used in the study. Sections three and four introduce the holdup problem and the existing studies. The fifth section presents the model, the accompanying assumptions, and the underinvestment problem. The sixth section focuses on the use of the specific performance mechanism in holdup mitigation. It also includes a proof of the fact that the investment that results from the specific performance mechanism corresponds to the first-best social outcome; and that this outcome is strictly greater than the social surplus that results from underinvestment. Section seven discusses the general implications of this result in the context of a PPP design, and in industrial organization and contract theoretic literature.

## 5.2 Theoretical Perspectives

This section summarizes the key theories that formed the basis for the illustration, the research questions, and the working hypothesis. Clearly, the contributions of these theories in the study are interwoven in such a way that, they are best taken together rather than in isolation. Figure 14 depicts the inter-relationship that exists between these theories.

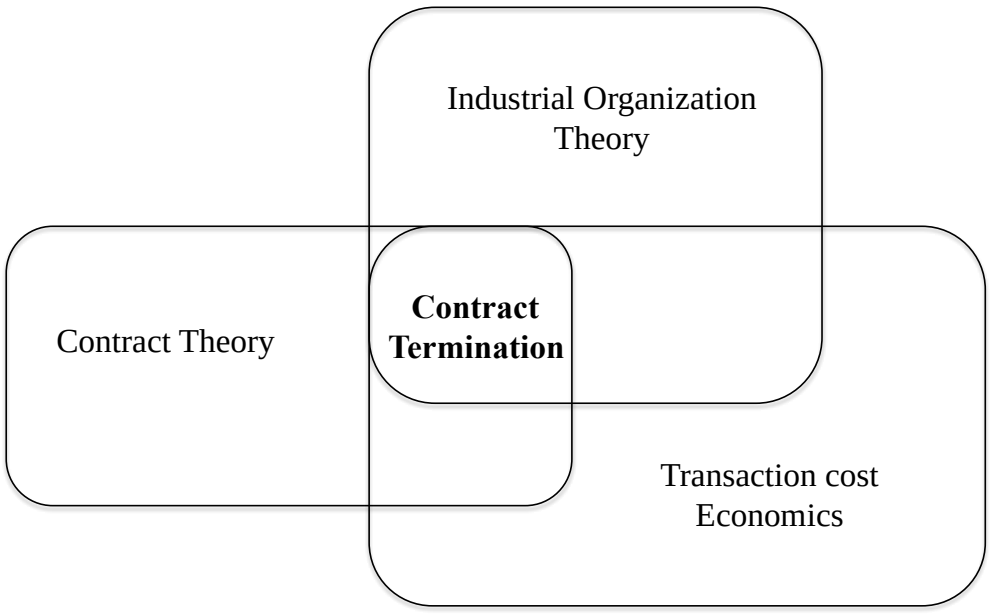


**Figure 14: The Study's Theoretical Perspectives**

The key insights from each of the theories are summarized as follows.

**a. Contract theory**

Contract theory is generally referred to as a field of study that encompasses the "theory of incentives, information and institutions" (Bolton and Dewatripont, 2005: 2). As with mechanisms and institutions, contracts are defined as the laid down rules that guide an economic transaction. Specifically, contracts are used to describe the actions that parties to a transaction can undertake, as well as the outcomes that will accompany a given action or inaction. Thus, it is an important instrument in reward and penalty stipulation. In this study, the main contributions from this theory revolve around those set of assumptions that underlie the study's hypothesis on the cause of contract termination, particularly the practical implications of underinvestment and the hold-up problem.

**b. Transaction cost economics**

The study also used the literature on transaction cost economics to gain some insights into the governance of contractual relations and the problems that can emerge in the process. Insights gained from this perspective centred on the ramifications of the roles of observability, non-verifiability, asset specificity and the holdup problem. Since the main purpose of a PPP contract is to facilitate an exchange between the host government and the private investor, using the transaction cost perspective, this perspective facilitated the definition of contract termination in a PPP as a form of transactional failure. That in turn created the need for the examination of such failures in terms of the nature of a PPP transaction and the combination of a set of human attributes and incentives. This influences one of the main contentions in the study, that in as much as a PPP is transaction is concerned with actions and interactions, it is rational to expect the pervasive effects of endogenous human factors.

**c. Industrial Organization Theory**

Although the Industrial Organization Theory focuses largely on market structure, market behaviour, internal organization, and the central concepts of microeconomics, this study used its "structure-conduct-performance" (Tirole, 1998: 1) paradigm to gain some insights on the nature of the partner's behaviour in a PPP. Based on this paradigm, it became possible to conceptualize the specificities in a PPP contract (such as payoff configuration, and the operating task allocation) that determines the "conduct" (which consists of the partners' actions and investments). In turn, the "conduct" yields performance (in terms of efficiency, profitability, and the surplus). A main impact of this paradigm on how the study examined the problem of contract termination centres on the attempt to establish a link between payoff structures and certain conducts (or actions that affect the realization of the commercial purpose of the PPP). Specifically, given the centrality of performance and outcome optimality in typical clauses on contract termination and 'cure notices', the practical implications of the insights gained from the "structure-conduct-performance" facilitate the establishment of a logical connection between holdup and underinvestment and a PPP's viability.

## 5.3 The Holdup and the Underinvestment Problems

Holdup is a problem that is deep-rooted in many economic transactions that involve relationship-specific, sunk investments. Generally, the problem of holdup is common in teams, partnerships, and various forms of cooperative arrangements. The crux of the holdup problem centers on the assumption that, ex-post a problem arises if one of the parties to the contract fails to capture the full benefits associated with his or her initial investments. As a result, the hold-up problem has become synonymous with terms like extortion, profiteering, and expropriation (Graham and Peirce, 1989). Given the possibility of such opportunistic behaviour, hold-up modeling often revolves around the ensuing underinvestment problem. Since less relationship-specific or sunk investments reduce the scope of one's vulnerability, underinvestment can be referred to as a strategy that aims at minimizing one's exposure to the hazards and losses that result from being held-up ex-post. Hence, solving the under-investment problem has become an integral part of hold-up mitigation. This has in turn raised some questions on what contract can achieve in the context of an economic transaction that is vulnerable to holdup and underinvestment.

There are various practical and theoretical reasons that make the study of the connection between holdup, underinvestment and contract termination quite apt and motivating. To start with, the notions of shared responsibility and bilateral or cooperative investment are quite central in the definitions of a PPP. These notions are the main bases behind the reference to a PPP as a mechanism that harnesses the advantages of collaboration in project procurement and implementation. They also underscore the fact that the success of a PPP will depend on the parties' ability to fulfill their respective performance obligations and responsibilities. Hence, in order to achieve the stated objectives in a PPP contract, the scope of reciprocity often include counterpart funding and risk sharing. In line with these features, one can define a PPP as a cooperative venture that is based on the advantages that come with the combination of public and private resources and expertise. This also hinges the success of a PPP on the parties' ability to address the risk of holdup and opportunistic behaviour.

In addition, the procurement and operations of public involves a social-welfare perspective that helps to contextualize the negative effects of underinvestment, the social loss, and the practical implications of any mechanism making up for

underinvestment in a public-private infrastructure project. From a theoretical perspective, a PPP also presents a motivating example of those exceptional cases where some of the well-established solutions to the holdup problem (such as vertical integration) are not generally applicable. This exceptionality effectively reduces the options in relation to holdup and underinvestment mitigation in a PPP to contractual solutions.

In sum, the possibility of holdup is a practical problem that characterizes long-term bilateral and contractual relations. As a matter of fact, since the severity of the holdup problem depends on the specific nature of the sunken investments, one can argue that a PPP possesses one of the necessary conditions for the holdup problem. The main insight in this regard is that, investments in specialized assets are more susceptible to the hazards of holdup. Interestingly, asset-specificity is a common feature of infrastructure projects (e.g. power plant, bridges and railway), given that most of the initial expenses incurred in a PPP may be of little or no alternative use outside the transaction or partnership.

## 5.4 Related Studies

As with classical implementation problems, the possibility of using a simple contract to induce efficient investment has been a subject of great curiosity and debate. In practice, using a contract to discourage underinvestment will entail designing a contract that can induces both partners to invest optimally, even when the investments are unverifiable. Reasonably, some of the factors that have helped to inspire the diversity of questions and views in relation to a contract's ability often revolve around the constraints that investment verifiability and contractual incompleteness impose. Hence, a larger share of the focus in the literature has been on such remedies like vertical and lateral integration, as well as ownership rights allocation (Grossman and Hart, 1986; Bolton and Whinston, 1993; De Meza and Lockwood, 1998; Bolton and Dewatripont, 2005; Klein et al., 1978; Tirole, 1999). These constraints are quite prominent in Williamson's (1985) and Hart and Moore's (1988) arguments in favor of vertical integration. Generally, in comparison with conventional remedies (such as vertical and lateral integration), one can say that the reexamination of possible contractual frameworks themselves in holdup mitigation is the most recent.

Despite the understandable reservations in relation to a contractual remedy, recent developments in contract theory indicate that it is possible to use a simple contract to induce efficient investment. Albeit, there are some obvious differences on how the contractual solution works. As an example, with particular reference to the verifiability constraint, Bolton (1990), Cheng (2000), and Neeman and Pavlov (2013) focus on the feasibility of implementing the first best, using a renegotiation-proof contract. From Bolton's perspective, the main focus of the renegotiation proofness principle centers on how to deal with the inefficiency that may arise if the parties in a contracting relation bargain under asymmetric information (given that non-verifiability may foster the strategic revelation of private information). Hence, Bolton (1990) advocates for the use of a contract or mechanism that involve an appeal to the revelation principle.

As with Bolton (1990), Cheng (2000) also examines the constraints that non-verifiability and private information introduces in an inter-temporal contractual setting, and how the parties can use the promise of future payoffs to enhance truth telling. From a slightly different perspective, Neeman and Pavlov (2013) look at the possibility of influencing the details of a renegotiation process, with particular reference to how the parties communicate; and how the parties partition the surplus. As a result, Neeman and Pavlov's (2013) view on how a contractual solution should work has centered on how to make the equilibrium actions in an initial contract invulnerable ex-post. From this perspective, the contractual solution is defined as the process of designing a mechanism that induces an enduring equilibrium outcome. However, as Cheng (2000) points out, meeting this invulnerability requirement may be difficult, given the fact that in a dynamic setting, the continuation of a hitherto optimal contract may become sub-optimal after a certain history. As a result, dealing with long-term contracts has been identified as a new obstacle or limitation, in addition to the verifiability and the incompleteness constraints.

Despite these constraints, Chung (1991), Noldeke and Schmidt (1995) and Elden and Reichelstein (1996) argue that it is possible to contractually induce efficient investment and outcome, using a simple contract - the specific performance mechanism. This thesis is based on this latter position. Specifically, the study shows that it is possible to mitigate the underinvestment problem, and equally achieve the first-best social surplus. The need for a formal proof is motivated by the lack thereof (Che and Hausch, 1999). Understandably, the doubts in relation to this difference (in terms of a

strict inequality) are based on the supposition that the extra gains associated with efficient investment may turn out to be smaller than the difference between a suboptimal investment and an efficient investment. These doubts are further complicated by the conventional assumptions on the functional forms of the various components in the payoff function. By using these same conventional assumptions, and the classic setup of the holdup problem, the significance of this thesis lies in its ability to address the gaps and questions in relation to the implementability of efficient investment in a contractual relation, and the social optimality of the ensuing outcome.

## 5.5 The Holdup Model

To capture the holdup problem and the ensuing underinvestment in the context of a bilateral contract, the illustration starts with the following basic assumptions. First, the study defines a PPP as a long-term cooperative investment between an investor (or a group of private investors) $I$ and a government[2] $G$ that involves the procurement of an infrastructure service. The notation $b$ is used to denote the social benefit of the service delivered by the investor, while $c$ denotes the operating cost of delivering the service. In reality, $c$ captures the operating and maintenance expenses associated with the delivery of the service. Accordingly, the social surplus and the payoff that the partners obtain from the partnership would depend on the difference between the gross benefit $b$ and the cost of service delivery $c$.

Since the ex-post values of the service' costs and benefits are uncertain at the time of contracting, it is further assumed that the levels of the partners' initial sunk investment can influence the values that the net surplus can take ex-post. In other words, it is assumed that the operating costs and benefits of the procured infrastructure probabilistically depend on the partners' initial investments. Specifically, it is assumed that the government makes an initial investment to increase the social benefit of the PPP service, while the investor makes an initial investment to minimize the cost of delivering the service. In reality, the government's initial investments can refer to the provision of ancillary facilities, equipment, or any other form of expense that will enhance the public's benefit from the service delivered by the investor. The uncertainty of the operating costs and benefits leads to the following specific assumptions:

[2] The government in this case stands as a representative of the public.

$b \in \{\underline{b}, \overline{b}\}$, $with\ \underline{b} < \overline{b}$ and the $prob\ (\overline{b}) = p$

$c \in \{\underline{c}, \overline{c}\}$, $with\ \underline{c} < \overline{c}$ and the $prob\ (\underline{c}) = q$

The analysis of the study considers the case where probability $p$ depends on the government's initial investment, $k_G$, while probability $q$ depends on the investor's initial investment, $k_I$, where $k_j \geq 0$, for $j \in \{G, I\}$. Thus, $p = p(k_G)$, and $q = q(k_I)$ denote the assumption that the two probabilities $p$ and $q$ are functions of the partners' respective investments. An important remark in this regard is that, investment $k_j$ is sunk and specific to the objectives of the partnership. Simply, one can think of $p$ and $q$ as the product of the partners' initial investments. As with conventional assumptions on production functions, it is therefore reasonable to expect diminishing marginal productivity. Hence, it is assumed that as a partner uses greater amounts of investment to increase the probability of success (in terms of higher benefits or lower costs), the employment of additional units of investment will eventually become less productive. In such a case, it will then become more expensive to increase the probability of success when a higher level of probability is already being achieved.

Formally, the author assumes that the functions $p(k_G)$ and $q(k_I)$ are twice differentiable and concave in $k_j$, such that the first derivative $p'(k_G) > 0$, and the second derivative $p"(k_G) < 0$. Likewise, $q'(k_I) > 0$, and $q"(k_I) < 0$. It is also assumed that it is impossible to obtain a positive probability without the employment of investment $k_j$. In such a case, if $k_G = 0$, then $p(0)$, and if $k_I = 0$ then $q(0) = 0$. Furthermore, based on the properties of $p(k_G)$ and $q(k_I)$, using the inverse function, it is easy to characterize the relationship between a given probability and its corresponding cost function. The marginal cost of achieving a given level of probability will increase as the level of the probability rises.

A common interpretation of the relationship between the probabilities and the ex-post costs and benefits is that, the probability of a higher whole-life benefit is increasing in the level of initial investments. Likewise, it is assumed that the initial investments are made in lieu of increasing the probability of lower operational costs ex-post. As an example, it makes sense to expect that, a higher investment in project design, material quality, and construction will influence the probability of lower operational and maintenance costs ex-post. In line with the definition of sunk costs as one-time, upfront, irretrievable expenses, other examples of initial investments in a PPP

context will include costs related to the installation of high quality physical assets and other ancillary facilities that will enhance in the delivery of the contracted services. Generally, sunk costs include any resource expended to start the infrastructure service delivery, as well as the expenses that are incurred in the hope that the partnership will take place. Apparently, any party that makes a specific investment is somewhat locked-into the transaction, if the alternative value of his initial investments is much smaller outside the partnership.

Furthermore, the author assumes that $\overline{b} \geq \overline{c} > \underline{b} \geq \underline{c} \geq 0$ . The main implication of these assumptions is that, the outcome of the partnership is optimal if and only if $(\overline{b}, \underline{c})$ is realized. Moreover, the author introduced the possibility of $(\overline{b}, \overline{c})$ and $(\underline{b}, \underline{c})$ to capture the strategic interdependence that exists in the partnership. A common implication in these two scenarios is the possibility of free-riding. In $(\overline{b}, \overline{c})$, the investor free rides on the government's initial investment; and in $(\underline{b}, \underline{c})$ the government free rides on the investor's investment. Both scenarios are Pareto inefficient and sub-optimal. Finally, the realization of $(\overline{c}, \underline{b})$ can be referred to as the worst-case scenario. This scenario will ensue if neither of the partners makes an initial investment. Irrespective of the value of $\underline{b}$, there will be no positive gain from the partnership as long as $\overline{c} > \underline{b}$. In such a case, both partners will lose the positive payoff they could have received if both had made the initial investment.

As should be expected, it will be beneficial for both partners to ensure the realization of low costs and high benefits, $(\overline{b}, \underline{c})$. Implicitly, given the influence of the probabilities ($p$ and $q$), ensuring the realization of higher benefits and lower operational costs will entail increasing their associated probabilities $p$ and $q$, vis-à-vis their corresponding resource costs. Generally, the expected value of $b$ with respect the probability $p$ becomes $p(k_G)\overline{b} + \big(1 - p(k_G)\big)\underline{b}$. Likewise, the expected value of $c$ becomes $q(k_I)\underline{c} + \big(1 - q(k_I)\big)\overline{c}$. Accordingly, the ensuing social surplus $\pi_s$ becomes:

$$\pi_s = p(k_G)\overline{b} + \big(1 - p(k_G)\big)\underline{b} - \big(q(k_I)\underline{c} + \big(1 - q(k_I)\big)\overline{c}\big) - k_G - k_I.$$

A logical assumption in literature (Salanie, 1998:182) is that, realizing the efficient social surplus will entail "making the maximal optimal investment so as to ensure that the most favourable case" $(\overline{b}, \underline{c})$ materializes. Let $(k_G^*, k_I^*)$ denote the pair of initial

investments that maximizes the social surplus - the difference between the expected net benefit and the costs of the initial investments.

The most important remark regarding this configuration is that, it pays to maximize the social benefit, since an increase in the value of the benefit will translate to more net surplus. By the same logic, it also beneficial to minimize the operational and maintenance costs as much as possible. Literally, a larger difference between cost and benefit will translate to a better outcome in the partnership. The crux of the holdup problem lies in the hypothesis that, partner *j* may have an incentive to under-invest if the respective payoffs or the division of the joint surplus is not structured in a manner that discourages the other partner from underinvesting. At best, the parties may choose the minimum level of initial investment that they can afford to make without being caught.

Formally, it is assumed that the initial investments will result from the first order condition of their respective maximization problems. On the one hand, the partners can do better by if they optimize in view of the social surplus. In such a case, the government will solve the following maximization problem:

$$\max_{k_G}\{p(\,k_G)\overline{b} + \big(1 - p(\,k_G)\big)\underline{b} - \,k_G\}.$$

Equally, the investors' optimization problem becomes:

$$\max_{k_I}\{-q(\,k_I)\underline{c} - \big(1 - q(\,k_I)\big)\overline{c} - \,k_I\}.$$

Accordingly, the respective optimal investments will result when:

$$p'(k_G^\star)\big(\overline{b} - \underline{b}\big) = q'(k_I^\star)\big(\overline{c} - \underline{c}\big) = 1$$

**The Type-β Contract**

On the other hand, if one lets $\beta_I \in (0,1)$ denote the fraction of the profit that goes to the investors, while the government receives the remaining $\beta_G = 1 - \beta_I$ fraction; the investors' payoff becomes:

$$E\big(\pi_{I,\beta}\big) = \beta_I\big[p(k_G)\overline{b} + \big(1 - p(k_G)\big)\underline{b} - q(k_I)\underline{c} - \big(1 - q(k_I)\big)\overline{c}\big] - \,k_I.$$

In such a case, the government's payoff becomes:

$$E\big(\pi_{G,\beta}\big) = (1 - \beta_I)\big[p(k_G)\overline{b} + \big(1 - p(k_G)\big)\underline{b} - q(k_I)\underline{c} - \big(1 - q(k_I)\big)\overline{c}\big] - \,k_G.$$

Given these payoffs, the nature of their optimizations problem changes. In particular, the investors solve:

$$\max_{k_I}\{\beta_I[p(k_G)\overline{b} + (1 - p(k_G))\underline{b} - q(k_I)\underline{c} - (1 - q(k_I))\overline{c}] - k_I\}.$$

Similarly, the government's optimization problem becomes:

$$\max_{k_G}\{(1 - \beta_I)[p(k_G)\overline{b} + (1 - p(k_G))\underline{b} - q(k_I)\underline{c} - (1 - q(k_I))\overline{c}] - k_G\}.$$

Consequently, the respective optimal investments will result when:

$$q'(\hat{k_I})(\overline{c} - \underline{c}) = \frac{1}{\beta_I} \quad \text{for the investor, and}$$

$$p'(\hat{k_G})(\overline{b} - \underline{b}) = \frac{1}{(1 - \beta_I)} \quad \text{for the government.}$$

It is therefore straightforward to see that $\hat{k_I} < k_I^{\star}$ and $\hat{k_G} < k_G^{\star}$. The truth of these strict inequalities is due to the increasing and concavity properties of $p(k_G)$ and $q(k_I)$.

In essence, it is not coincidental that the main difference between $k_j^{\star}$ and $\hat{k_j}$ originates from the role of $\beta_I$. One major observation is the fact that, $\hat{k_I}$ is increasing in $\beta_I$, such that, an increase in $\beta_I$ will result to an increase in the investor's initial investment. On the other hand, $\hat{k_G}$ is decreasing in $\beta_I$. Literally, an increase in the fraction of the profit that goes to the investor will result in a decrease in the government's initial investment. This result implies that the size of the investor's initial investment is contingent on his share of the profit. It also captures the inevitable trade-offs that characterize the problem of payoff allocation. It is simply difficult to know where to draw the lines of division in a manner that does not distort or compromise any of the parties' incentives.

Another strategic implication of this relationship between $k_I$ and $\beta_I$is that, if the initial investment $k_I$ is made ex-ante in view of an initially agreed $\beta_I$, ex-post (when initial investment $k_I$ is already sunk), the investors lose the ability to re-optimize vis-à-vis any future changes or reductions in $\beta_I$ (i.e. their share of the profit). This captures one of the main predicaments that partners face when they are being held-up in an economic relationship. At the extreme, the investors do not invest at all if $\beta_I = 0$.

Generally, they reduce the level of their initial investment as their share of the profit reduces.

As Tirole (1998) notes, the problem is, of course, that the partners investing do not capture all the benefits generated by their investment and contribution (Tirole, 1998: 25). This explains why the under-investment hypothesis has become a central concept in the definition of hold-up. Corroborating this hypothesis, Ellingsen and Johannesson (2004) note that, the "fundamental premise of the whole literature on hold-up problem is that: investors cannot guarantee themselves a sufficient share of the return" (Ellingsen and Johannesson, 2004: 2). Underinvestment in this regard can be seen as a necessary safeguard strategy that arises out of an investors' concern that they may be expropriated of the surpluses that result from their initial investments. As a result, the strategic benefit of underinvestment lies in the fact that it can reduce the investors' ex-post exposure to the hazards of holdup.

## 5.6 Solving the Holdup Problem: the Specific Performance Mechanism

The main focus of this section will be on the use of specific-performance mechanism to solve the underinvestment problem (Chung, 1991; Bolton & Dewatripont, 2005). In the context of a PPP, this will entail a clear definition of the level of service that the investor is expected to deliver to the public, and a specification of the monetary transfer $\tilde{m} \in \mathbb{R}_+$ from the public to the investor in exchange for the service. It is assumed that $\tilde{m}$ is decided ex-ante on a take-it-or-leave-it basis, in view of the investors' participation constraint. The logic of this assumption is straightforward. If the government proposes an unsatisfactory or unrealistic compensation, then, no investors will not be willing to bid for a place in the partnership. In reality, maximizing the public's payoff while meeting the investors' participation constraints is often a precondition to a viable PPP. Accordingly, if the investors accept the offered price and specifications, the partnership takes place on these terms. In which case, the investors deliver the specified services at the pre-specified price $\tilde{m}$. The contract can thus be defined as follows; if the investors deliver the specified service, they get $\tilde{m}$ in return. Rationally, it is assumed that the investors will sign the contract if the expected payoff is at least greater than their outside option.

A main argument in favour of this mechanism is that it implements the first best level of investment. In particular, the incentive to obtain high net payoff ex-post induces

efficient investment ex-ante. Thus, if the partners contract on $\widetilde{m}$ prior to the investment decisions, unless renegotiated, the investors' expected payoff becomes:

$$E(\pi_{I,m}) = \widetilde{m} - q(k_I)\underline{c} - (1 - q(k_I))\overline{c} - k_I.$$

Anticipating the specified payment, and the expected value of the operating costs, the investors' initial investment will result from the following optimization problem.

$$\max_{k_I} E(\pi_{I,m}) = \max_{k_I} \{\widetilde{m} - q(k_I)\underline{c} - (1 - q(k_I))\overline{c} - k_I\}$$

This gives rise to the following first order condition:

$$q'(\tilde{k}_I)(\overline{c} - \underline{c}) = 1.$$

It is therefore straightforward to see that $\tilde{k}_I$ is equivalent to the social-surplus maximizing investment $k_I^*$. The investors invest as though they are maximizing the social surplus. The basic intuition behind this maximization problem can be re-stated as follows. The investors take into account the expected value of their operational costs. The incentive to invest optimally is thus based on the dependence of their net payoff on their initial investment. Literally, since the probability of $\underline{c}$ is $q$, and that of $\overline{c}$ is $1 - q$, the investor's optimal choice will entail choosing the level of $k_I$ that maximizes the probability of lower operational costs $\underline{c}$, in view of obtaining the highest net payoff.

Another highlight of this mechanism is that, it makes the public the residual claimant of the infrastructure facility, as with most build-operate-transfer (BOT) contracts. Hence, the expected payoff of the government becomes:

$$E(\tilde{\pi}_G) = p(k_G)\overline{b} + (1 - p(k_G))\underline{b} - \widetilde{m} - k_G.$$

The government's optimization problem reduces to the following:

$$\max_{k_G} \{p(k_G)\overline{b} + (1 - p(k_G))\underline{b} - \widetilde{m} - k_G\}.$$

The government's optimal investment will therefore result when:

$$p'(\tilde{k}_G)(\overline{b} - \underline{b}) = 1.$$

As with the investor, it is therefore straightforward to see that $\tilde{k}_G$ is equivalent to the social-surplus maximizing investment $k_G^*$. In addition to the payoff configuration, the government's incentive to invest optimally lies in their position as the residual claimant. This latter observation somewhat corroborates the contention in literature (Bolton and Dewatripont, 2005; Tirole, 1999) that, the allocation of residual ownership rights has a motivational effect on initial investment. Part of the underlying incentive proceeds from the assumption that: holding the residual rights can protect one from the risk of expropriation. Simply, it can be said that holding a residual right somewhat solves the rights holder's holdup problem. Surely, the possibility of inducing the first-best investment validates the use of the specific performance mechanism to mitigate ex-post holdup.

## 5.7 The Optimality of the Specific Performance Mechanism

In addition to the result on how the partners chooses their initial investment in relation to the structure of their respective payoff in the partnership, it is equally imperative to formally appreciate the social repercussions of underinvestment. In order to show that social surplus is strictly sub-optimal with underinvestment, let us define the social surplus as follows:

$$\pi_s(k_G, k_I) = p(k_G)\left(\overline{b} - \underline{b}\right) + \underline{b} - \left(q(k_I)\left(\underline{c} - \overline{c}\right) + \overline{c}\right) - k_G - k_I.$$

Hence, letting $\pi_s(k_G^\star, k_I^\star)$ denote the social surplus that results from the socially optimal pair of investments, while $\pi_s\left(\hat{k_G}, \hat{k_\mathrm{I}}\right)$ denotes the outcome that results from underinvestment, it is easy to confirm the fact that the former is strictly greater than the latter, using the initial assumptions in relation to $p$ and $q$. Notably, the social surplus is maximized when:

$$\frac{\delta \pi_s}{\delta k_G} = p'(k_G)\left(\overline{b} - \underline{b}\right) = 1, \qquad \frac{\delta \pi_s}{\delta k_I} = q'(k_I)\left(\overline{c} - \underline{c}\right) = 1.$$

Recall that:

$$p'(k_G^\star)\left(\overline{b} - \underline{b}\right) = q'(k_G^\star)(\overline{c} - c) = 1$$

Given the properties of $p$ and $q$, these derivatives, imply the following:

$$\frac{\delta \pi_s}{\delta k_G} = \square'(k_G)\left(\overline{b} - \underline{b}\right) - 1 \begin{cases} = 0 & \text{if } k_G = k_G^\star \\ < 0 & \text{if } k_G > k_G^\star \\ > 0 & \text{if } k_G < k_G^\star \end{cases}$$

Likewise:

$$\frac{\delta \pi_s}{\delta k_I} = q'(k_I)\left(\overline{c} - \underline{c}\right) - 1 \begin{cases} = 0 & \text{if } k_I = k_I^\star \\ < 0 & \text{if } k_I > k_I^\star \\ > 0 & \text{if } k_I < k_I^\star \end{cases}$$

These conditions mean that $\pi_s$ is largest at $(k_G^\star, k_I^\star)$. Hence, for any points other than $(k_G^\star, k_I^\star)$, the value of $\pi_s$ will be strictly less. It is easy to verify that the first-order conditions with respect to $k_G^\wedge$ and $k_I^\wedge$ are strictly greater than zero. Therefore, $\pi_s$ cannot be optimal at $\left(k_G^\wedge, k_I^\wedge\right)$. A practical implication in this regard is that, the effect of underinvestment does matter, especially from the point of view of the social need that informed the formation of the partnership or contractual relationship. With $k_j^\star = \tilde{k}_j$, it is thus straightforward to see that the social surplus that results from the specific performance mechanism corresponds to the socially optimal outcome.

## 5.8 Remarks and Implications for Public-Private Partnerships

Based on the foregoing analysis, it is possible to distinguish two contract-types. In the first type of contract, the partners use $\beta_j \in (0,1)$ to denote the fraction of the surplus that goes to partner *j*. In this study, this type of contract is referred as type-β. The second type of contract involves the use of the specific performance mechanism, which is referred to as the type-m contract in this study. Comparatively, the type-m contract induces socially optimal investments, unlike the type-β contract. Hence, the type-β contract is arguably not a good means for attracting optimal private sector investment in a PPP. In respect of the issues outlined in the introductory section, especially the problems of funding shortfalls and underinvestment in infrastructure development, it is easy to appreciate the importance of the specific performance mechanism. First, it provides good incentives for efficient private investment in infrastructure development. It also yields a socially optimal outcome. Thus, the mechanism is arguably a good means through which governments can attract or mobilize efficient private sector investment in public services delivery.

Furthermore, the underinvestment problem also has some intuitive, organizational theoretic interpretation. First, $\beta_j$ is defined as the fraction of the social

profit that goes to partner $j$ in the partnership. Precisely, $\beta_I$ denotes the fraction of the profit that is allocated to the investor, while $\beta_G = 1 - \beta_I$ denotes the fraction of the social profit that is allocated to the government. Based on this definition, one can see the comparative-statics effects of $\beta_j$: how a partner $j$'s initial investment varies in response to the share of the social profit that the partner hopes to appropriate. Accordingly, it is shown that a reduction in a partner's share of the social profit results in underinvestment. In an extreme case, if $\beta_j = 0$, then partner $j$ would have no incentive to invest in the partnership. Through the first-order condition, one can also implicitly regard the equilibrium investment $\hat{k_j}$ as a function of $\beta_j$. Since $\hat{k_j}$ is increasing in $\beta_j$ (based on our assumption on the concavity of $p(k_G)$ and $q(k_I)$), it is therefore logical to say that the less a partners' share of the profit, the less they are willing to invest in the partnership, and vice versa. The strategic intuition behind this relationship between payoff allocation and the initial investment is based on the problem that the partner face when they are not in a position to obtain all the benefits associated with their personal investments and contributions. This is one of the factors driving the ensuing underinvestment.

In addition to the comparative-statics question on how a change in $\beta_j$ affects the equilibrium investment level, it turns out that the change in $\hat{k_j}$ with respect to $\beta_j$ has another practical interpretation. Based on the literature on industrial theory and organization (Grossman and Hart, 1986; Hart and Moore, 1985; and Tirole 1998), $\beta_j$ can equally be defined as a proxy for partner $j$'s authority or rights of control in the partnership. As an example, as with our initial definition of $\beta_j$, Tirole (1998) notes that, the allocation of authority has a direct consequence on the distribution of the gains in a partnership. Specifically, "authority puts the party that has it in a better bargaining situation" in relation to the division of the social profit (Tirole, 1998: 30). Furthermore, it can be argued that, if all the authority is given to one of the parties; "the preferred decision of the party who has authority may be very costly to the other party" (Tirole, 1998: 30). In such a situation, the party with all the authority can expropriate the entire social profit. This possibility will in turn affect the size of the other partner's initial investment. Consequently, while the party with absolute authority invests optimally, the party with no authority will under-invest (since it is easy to expropriate the investments of the party who has no authority). As with our remark on the comparative-static effect of $\beta_j$, the party with no authority will have no incentive to make an initial

investment. To a large extent, the view of this study in relation to $\beta_j$ reflects the fact that, the partners' respective share of the social surplus and their degree of authority over the main dimensions of the social profit are somewhat difficult to separate in practice.

On the other hand, the specific performance mechanism separates the social payoff function into two distinct functions, one involving only the investor's inputs, and the other involving only the public's input. This gives each partner complete authority or rights of control over only one dimension of the social profit, $b$ or $c$. Specifically, it gives the private investors an exclusive or complete authority over the PPP project's operating cost. Practically, this means that, the project's operating costs, and the associated operating risks will fall under the sole control of the private investors. This makes the operating cost dimension of the social surplus contractually independent from government's authority and control. This framework thus allows the investors to reap the benefits of their initial investment in relation to $c$; this in turn solves their moral hazard problem. Likewise, the mechanism exclusively designates all the authority in relation to the social benefit of the project to the government; in theory, this also discourages the government from underinvesting in the partnership.

In relation to incomplete contract theory and institutional design, Bolton and Dewatripont (2005: 491) note that, in an attempt to simplify the formal analysis, most of the recent literature focus entirely on the sub-optimality of the initial investment, thereby paying less attention to subsequent inefficiencies. In view of such trends, the focus of this study on both the initial inefficiency (in terms of underinvestment) and latter inefficiency (in terms of the ensuing social outcome) is quite novel. Since such latter inefficiencies are of practical importance in an economic transaction, the result of this study provides a basis for appreciating the implications of underinvestment. In the context of a PPP, it can undermine the partnership's overall viability or feasibility. In particular, this line of thought makes sense if one thinks of underinvestment as a reasonable antecedent to project abandonment or failure.

One of the main theoretical implications of the illustration in this study centers on the triviality of the non-verifiability constraint. In general, this constraint is informed by the fact that it may be difficult for the partners to infer the true value of each other's investment level. To make a correct inference, each partner should be able to tell not only the actual investment made by other partner, but also what the optimal investment

should have been. Despite this non-verifiability constraint, the result of this study shows that, by using the specific performance mechanism, it is possible to provide each partner with sufficient incentive to invest optimally.

Finally, the holdup problem has motivated various studies (Grossman and Hart, 1986; and Chiu, 1998) on the effects of ownership structure and the form of integration in an economic relationship. These studies are usually motivated by the conventional justifications for vertical and lateral integration: the argument that internal transactions are less vulnerable to the hazards of transaction costs. As Grossman and Hart (1986) note, in terms of costs and benefits, all forms of integration inevitably lead to some form of trade-off or distortion in the parties' incentives. Specifically, partners invests less when they owns less assets and vice versa. Chiu (1998) further notes that the effects of integration on investment incentives may be more complicated than Grossman and Hart (1986) suggests. In practice, while most the recommendations in these studies apply easily to employment relations and contracts between separately owned firms, they may not easily apply to a PPP context, due to the differing nature of government and private interests and modes of operation. The fact that a PPP provides a good example of a contractual situation where the more established recommendations (especially vertical integration) do not readily apply thus underscores the need for more research on the contractual solution to the problem of holdup and underinvestment, as well as this study's significance.

# 6 A Contextual Analysis of Contract Termination

## 6.1 Overview

As with the definition of a case study, that chapter summarizes the findings of "an empirical enquiry that uses multiple sources of evidence to investigate a contemporary phenomenon" (Yin 2009: 18) - the problem of contract termination in a PPP within its real life context. The two cases are: the Tanzanian Railways Limited (TRL), and the Nigerian Telecom Limited (NITEL). Despite the peculiarities that typify the two cases (in terms of sector and country), they both embody some features that make them deserving of a theory-based analysis. The development of the two cases is based on multiple sources of evidence (such as project completion reports, the concession agreement, and other relevant documents). In addition to the review of documents, the preparation of the cases involved a field visit and discussions with consultants and stakeholders with relevant information on the cases. The chapter concludes with a discussion on the relationship between the findings and the existing literature.

## 6.2 The Link between the Case Studies and the Empirical Analysis

The findings of the two case studies serve the purpose of complementing the results of the empirical analysis. In relation to the research questions and objectives, the empirical analysis provides quantitative measured that helps explain the role of contract-type in contract termination. Albeit with an approach that assess numerical frequency and explanatory power, the empirical analysis has identified contract-type as a significant factor in contract termination in PPPs. Specifically, in comparison with the other attributes (the sector and the sponsor's nationality) used in the study, the empirical analysis has discovered that the explanatory power of contract-types in respect of contract termination continues to hold under a larger set of circumstances.

Likewise, albeit with a focus on qualitative information, the case studies complement and contextualize the numeric evidence of the empirical analysis by facilitating a deeper and broader understanding of contract termination in real-life. The case studies also provide a platform that facilitates the incorporation of multiple perspectives, the voices of the participants, in-depth interviews and direct observations

in the study. Using these approaches, the case studies have identified the some salient issues that strategically depend on the implications of the contract-type on the nature of the partners' incentives and contributions in a PPP. In so doing, the case studies identified the type of difficulties and frustrations that are associated with certain contract-types in a PPP.

Based on the foregoing, a main relationship in the conclusions of the two case studies and the empirical analysis lies in the identification of if the existence and successful implementation of a PPP somewhat depends on the contractual issues that impact on the shape of the partners' incentives. In relation to alternative explanations, their respective findings attest to the positive relevance of contract-type in contract termination, and the pervasive effect of the strategic factors that lies beyond the project's sector, the sponsor's nationality, and the broader socio-economic environment.

In relation to the formal analysis, the case studies have helped corroborate the presence and applicability of the implications derived from the holdup and underinvestment model among the factors that lead contract termination. In so doing, the cases facilitate the clarification and scrutinization of the problem of contract termination and the role of the proposed causes. Besides corroborating the applicability of the logical implication of the holdup model, the case studies have also served the purpose of identifying those factors that re not derivable from the study's current model and formal analysis.

Moreover, the use of the empirical analysis helped address some reservations in the literature (Flyvbjerg, 2006) on the merits, reliability and validity of a case study in a scientific enquiry. As an example, it is argued that a single-case study cannot provide sufficient basis for generalization since one cannot generalize on the basis of an individual case. It is further argued that a case study gives too much room for the researcher's subjective interpretations. In view of these reservations, this study has relied on more than one case, in addition to an empirical analysis and multiple sources of evidence. The consistency of the findings of the two approaches had collectively helped in broadening the understanding of the research problem and the significant role that issues associated with contract-type play in a PPP.

### 6.3 Case 1: The Tanzanian Railway Project

The concessioning of TRL was one of the main components of the Central Transport Corridor Project (CTCP) initiated by the Government of Tanzania (GOT) and the

World Bank in the early 2000s. The importance of the project is based on the recognition of the inefficiency of the railway sector as one of the bottlenecks in the export and distribution of agricultural and mining products in the country. In this regard, the government expected improvements in the railway transport infrastructure "to reduce the transport costs of those exports, provide the poor with better access to economic and social services and enhance the integration of the national economy" (World Bank, 2010, p. 1). As shown in Figure 15, besides serving as a strategic link to a large part of the Tanzania's economic activities, the project also has some significant regional development impact, given the rail's connections to some neighbouring east African countries.

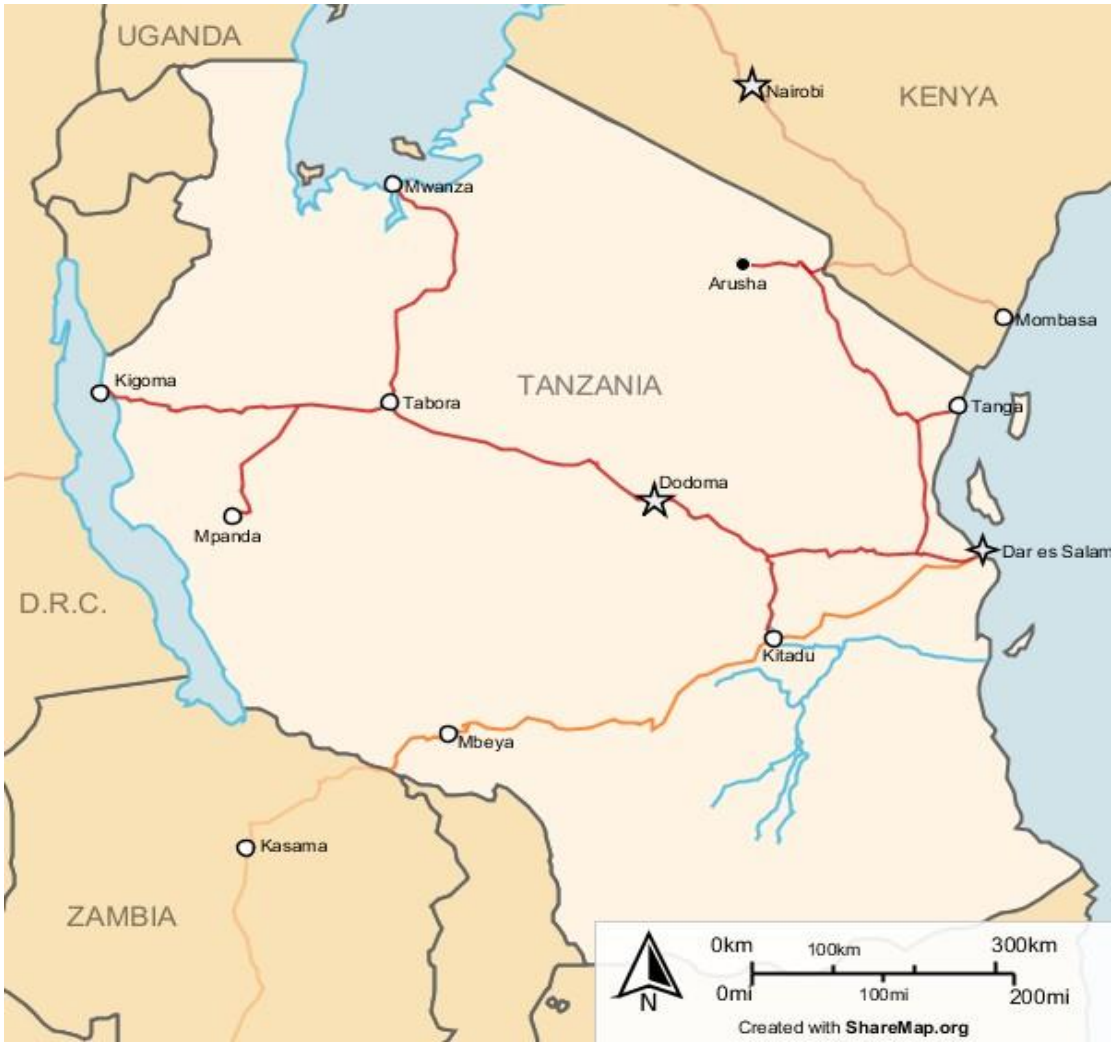


**Figure 15: Map Showing TRL's Network**

(Source: https://commons.wikimedia.org/wiki/File%3ARailways_in_Tanzania.svg).

The information in Figure 15 captures the strategic importance of TRL to countries like the Democratic Republic of Congo (DRC), Kenya, Uganda and Zambia. Additionally, some of the countries that are expected to benefit from an expansion in TRL's network include Burundi and Rwanda. The government expected improvements in TRL to reduce the transport costs of their exports, provide the neighbouring landlocked countries with better access to railways services and enhance the integration of the national and regional economy (World Bank, 2010).

As with the conventional rationale for the establishment of a PPP, attracting private investment was one of the main factors that necessitated the need for the concession contract. Basically, the government aimed at using a PPP to finance those aspects of the railway infrastructure that they could not make a sufficient budgetary allocation for. Some of the specific expectations from the partnership included: an increase in the total freight traffic tonnage carried on TRL network, an increase in the level of railways transit traffic, the expansion of rail services to new areas, and a decrease in the percentage of the total track that are un-usable or under speed restriction. These expectations also served as the main basis for the evaluation of the partnership's performance and outcome.

In 2007, the Rail India Technical and Economic Services Ltd (RITES) won the contract to operate TRL for 25 years. Despite the eventual commencement of the concession, there were clear signs of steep decline in TRL's financial and operational performance. As a result, the outcome of the railway component of the CTCP was rated as highly unsatisfactory. The government and the private partners thus decided to terminate the contract and transfer the private partners' equity back to the government. Following the termination, RITES Board members tendered their resignation on July 22, 2011 and TRL operations were handed over to an interim management team on July 26, 2011 (RAHCO, 2011).

### 6.3.1 Defining the TRL's Contract-type

The TRL concession involved the use of a contract-type that allocated 51 and 49 percent of TRL's equity to the private investors and the government of Tanzania, respectively. Based on this configuration, the TRL's concession contract can formally be referred to as a type-β contract, where $\beta_I$ (RITES' entitlement) and $\beta_G$ (the government's entitlement) correspond to 0.51 and 0.49, respectively. The results of the formal analysis indicates that, such types of contract are typically vulnerable to three major

forms of inefficiency - the underinvestment problem, the realization of a socially sub-optimal outcome, and the problem of controlling interests. The succeeding sections examines the consistency of these three inefficiencies with the issues that led to the termination of the concession contract.

### 6.3.2 Factors that led to the Termination of TRL's Concession Contract

In order to test the relevance of the contract-type model, this section critically examines the consistency of the practical implication deduced from the formal analysis in relation to the inefficiency of type-β contracts with the observations – the actual reasons that led to the termination of the contract. In so doing, the analysis would ascertain how contradictory the observations (reality) are in relation to the issues deduced in relation to the role of contract-type. Implicitly, it is assumed that the implications deduced from the formal analysis are discardable. On the one hand, if the inefficiencies associated with the type-β contract are not consistent or not among the issues that led to the termination of the contract, the role of contract-type can be discarded. On the other hand, the presence of the type-β inefficiencies would serve the purpose of corroborating the role of contract-type model. Basically, the analysis scrutinizes how useful and fit the contract-type hypothesis is to the explanation of the observed reality in TRL concession.

A schematic diagram of the main factors that led to the termination of the contract is shown in Figure 16. The link between the issues contained in the diagram will guide the rest of the analysis is shown as follows.

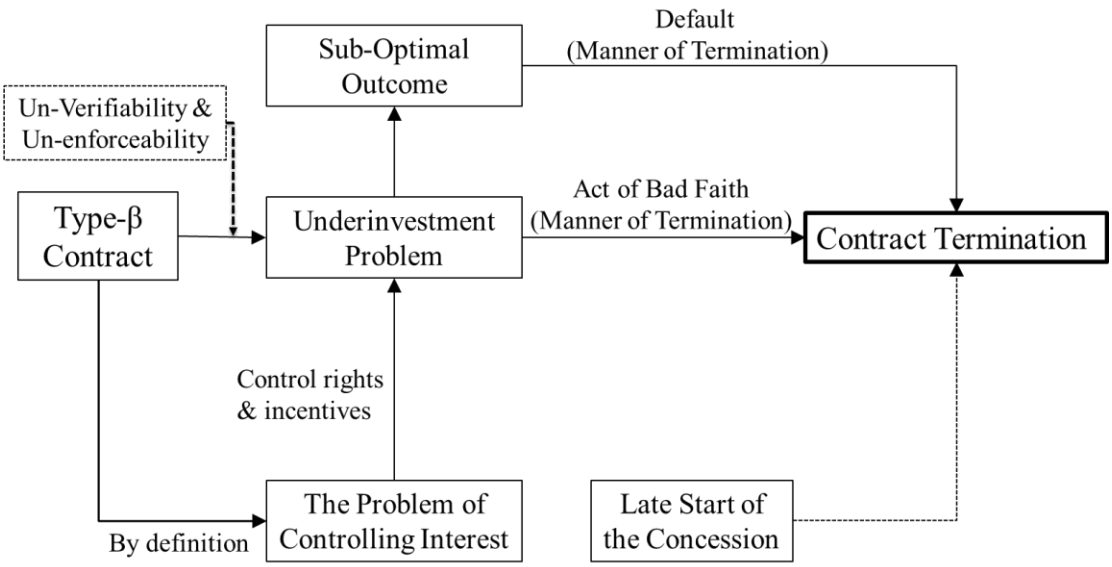


**Figure 16: The determinants of TRL's contract Termination**

As the information in Figure 16 shows, there are a number of factors that led to the termination of the concession contract. Despite the apparent relationship among the factors that led to the contract's termination, it is possible to group the main issues into four main themes, namely: the late commencement of the concession, the underinvestment problem, the realization of a sub-optimal outcome, and the problem of controlling interests. Before elucidating on the ramifications and observations made in relation to the role of each of these four factors, it is easy to see that the last three issues are consistent with the inefficiencies deduced from the analyses of the holdup model. In such a case, it would be unreasonable to discard the explanations derived from the effect of contract-type. Particularly, the consistency of the reality with the logical consequences of the type-β contract somewhat corroborate the power of the formal model in the explanation of the problem in question. These observations would arguably undermine any objection to the relevance of the contract-type. Albeit, it is equally important to take note of the role of a factor (i.e., the late commencement of the concession) that is not derivable from the study's model.

The sub-sections that follow elucidate on the roles of these four issues, their relationship with the study's model, and their general implications for the theory and practice of concession contracts.

### 6.3.3 The Problem of Controlling Interest in TRL

By definition, type-β contracts have a property that enhances the controlling interest problem. The origin of this problem is attributed to the effect of a partner's percentage of allocation $\beta_j$ on their ability to enact managerial and operational changes. Hence, it is always an issue that type-β contracts or shareholding arrangements (as used in the case of TRL) often contend with. Some of the attendant issues are associated with the practical interpretation of $\beta_j$ in the theory of industrial organizations in relation to the partners' allocation of voting rights, entitlements and their general ability to influence the decisions made in the partnership.

The first point to note in relation to the consistency of the controlling interest property with the observation made in relation to TRL rests on the actual definition of controlling interest in the TRL's shareholding agreement. As stipulated in the TRL's Shareholding Agreement, controlling interest encompasses issues related to the following:



Based on these contractual stipulations, it is therefore straightforward to appreciate and explain some of the observed problems. Notably, there were some references to the frustrating effect of a partner's partial rights on their ability to enact managerial and operational changes and decisions in the course of the partnership. As an example, despite the fact that the private investors (RITES) were contracted to take part in the PPP at their own costs and risks (as stipulated in Section 2-5 of the concession contract), the effect of the government's partial control rights also came into play in TRL's operation and management. Specifically, the contract stipulates that:

Arguably, this allocation of risk may have been intended to provide the private investors with some incentives to make their initial investments in a manner that would minimize their subsequent operating costs and risk. In reality, however, this incentive appear to have been undone by the partners' inability to enforce their preferred decisions. As the property of $\beta_j$ imply, the government as a shareholder directly bore some of TRL's risks as well, irrespective of the contractual stipulations in terms of risk allocation. This effectively made the investors' decisions and ability to enact changes in relation to operational risk minimization subject to the government's partial control. Likewise, the government ability to implement their preferred decisions also became partially dependent on the investor's approval.

Generally, references to how the partners' respective ability or inability to enact their individually preferred changes broadened the scope of conflict in the partnership over the daily operation of TRL. The fact that both partners had some genuine but incompatible priorities was also instrumental. Besides leading to serious problems of organisation, some respondents confirmed that the partial control rights denied the investor and the government the freedom to operate according to their individual principles. Precisely, as noted in one report on the project's implementation, "the arrangement instead of resolving the matter created serious problems of coordination" (World Bank, 2010, p. 10).

According to the respondents, the issues associated with partial control rights culminated in the existence of a parallel management in the partnership and gave rise to the complete paralysis of actions that undermined the successful implementation of the partnership. As a result, despite some initial arguments on how the TRL concession

provides a good example of public-private partnership, many respondents and stakeholders saw it "as a bad idea as it represents a conflict of interest with the government being on both sides of the deal: as shareholder of TRL and owner of the railway as RAHCO" (World Bank, 2010, p. 10). In sum, it was learnt that conflicting interests and the coordination problems that arose therefrom effectively frustrated the partnership and undermined the achievement of a more desirable outcome. A critical examination of the foregoing observations and experience in TRL shows that the issue of controlling interest is in a form that can be explained by the inefficiencies derived in respect of type-β contract. This consistency arguably invalidates the irrelevance of contract-type in the explanation of the concession's termination.

### 6.3.4 The Underinvestment Problem in TRL

The TRC concession involved the rehabilitation and improvement of about 2,700 km of the Tanzanian railway infrastructure. The success of the partnership (in terms of reducing operating costs and improve service standards) required investments in the TRL's infrastructure, the replacement of old tracks, and the procurement of new passenger wagons, new freight wagons and locomotives. Some of the government's investment commitments were directed at mitigating the environmental and social liabilities that would undermine the social benefits of the project. Both RITES and the government of Tanzania were expected to bring in millions of dollars in equity. Specifically, "the total project cost for the first five years is estimated at $111 million, of which $34 million would be contributed by the sponsors in the form of direct equity worth $16 million and internal cash generation worth $18 million (International Finance Cooperation, 2007). The balance of $77 million were expected to "be funded in the form of a $33 million World Bank IDA Credit and $44 million IFC A-loan" (International Finance Cooperation, 2007) to the government of Tanzania. In general, the analysis of the concession's economic rate of return (ERR) and net present Value (NPV) during the project's appraisal were based on some key assumptions on the expectations on the optimal investments that the partners would make over some time interval.

The applicability of the inefficiency deduced in respect of type-β contract (as used in TRL) is corroborated by many references to how the concession suffered from the "underfunding of track and asset rehabilitation" (World Bank, 2010, p. 8). The poor state of the TRL's assets and reports from respondents indicate that the expected

investments in the rehabilitation of TRL's tracks and assets were not made. On the one hand, there were reports that "the government did not actively work with concessionaire to revive the deteriorated railway system, including not taking timely action to fulfil the precondition to activate IFC's loan for improving TRL performance" (World Bank 2010, p. 23). Likewise, there were contentions that, the private investors could not receive the credit of injecting sufficient fund in TRL, given the abysmal state of the assets.

The link between the contract-type and the underinvestment problem resulted from some concerns in relation to the verifiability and enforceability of each partner's investment and contribution. On the one hand, non-verifiability seem to have provided a cover for an underinvesting partner to mimic the behaviour of an optimally investing partner. This situation gave rise to counter accusations between the partners. Similarly, due to the non-verifiability problem, it also became difficult to enforce an optimal investment. The fact that the contract was not self-enforcing did not help. As an example, given TRL's contract-type, any of the partners that underinvested in the railways assets would still be able to benefit from the contributions of the other partner. As such, the experience of TRL seem to be consistent with the hypothesized effects of the possibility of free-riding in the provision of a collective good. The observed underinvestment is also consistent with the definition of the holdup problem - the contention that both partners underinvested because they were not in a position to appropriate the full benefits associated with their individual investments. Furthermore, the link between underinvestment and contract termination is based on the contractual designation of underinvestment as an act of bad faith and a fraudulent deception that reasonably infringes upon the other partner's expected benefits.

Furthermore, the fact that the private investor received $1 USD upon the termination of the contract also appeared to have contributed to the underinvestment problem. Based on the reasons put forward by participants, the choice of the $1 compensation somewhat arose from the verifiability problem. Besides, the fact that the contract was not self-enforcing also received some mention. As such, the partners' underinvestment (as a form of precaution of safe play) arguably served the strategic purpose minimizing the scope of their losses and sunk investments upon the termination the contract. As one respondent noted, it therefore became relatively easy for the investors to pick up their briefcase and leave.

Based on the presence of the underinvestment problem in TRL, and the references made in relation to the fact that the arrangement was not self-enforcing, there seems to be no good reason to discard or deny the effect of contract-type. By definition, a contract or an agreement is considered to possess the self-enforcement property if it is configured in manner that makes making optimal investments in the best self-interest of the partners. In such a case, the partners do not need external means of enforcement to make optimal investment. In conclusion, the implications of the holdup model fairly rationalises and explains the observations and the participant's references to the occurrence of the underinvestment problem in TRL. Contract-type thus provides a reasonable basis for a causal explanation of the underinvestment problem.

### 6.3.5 The Realization of a Sub-optimal Outcome

It is important to note that in relation to the TRL concession contract, the partners had an earlier agreement on the events or occurrences that constitute a basis for the termination of the contract. The terms of termination is generally defined to take into account any event or outcome that demonstrably indicates that the partners have failed to act in their collective best interest of achieving the stated objectives. The partners' initial agreement on non-performance, the link between the realization of a sub-optimal outcome and the contract's termination is thus easy to establish. This will be further elaborated on shortly.

As implied in the formal analysis, the social payoff associated with underinvestment is strictly less than optimal. The realization of a sub-optimal outcome is therefore consistent with the holdup and underinvestment hypothesis. In Essence, it is reasonable to assume that the underinvestment problem did contribute to the realization of a sub-optimal outcome (which in TRL resulted increased operating costs and lesser income). These will be substantiated shortly. Generally, the partners' references and author's observations in relation to the poor performance of the concession is consistent with the prediction of the formal analysis on how unfavourable the use of a type-β contract is to the realization of a socially optimal outcome.

As reports on the project indicate, the outcome of the concession was rated as highly unsatisfactory. As an example, the Tanzanian Surface and Marine Transport Authority (SUMATRA) noted that "the anticipated objective of improving TRL performance after concessioning was not achieved" (SUMATRA, 2011, p. 3). Specifically, another report reads that:

> "The total freight traffic and transit traffic carried by TRL network in 2009 was only 0.408mt and 0.14mt as opposed to the target of 2mt and 0.67mt, respectively. The traffic on TRL declined to less than one-third of the level at project appraisal, despite gross domestic product growing steadily at about seven percent per annum during the five-year project implementation period. The continuing decline of railways also meant more traffic on road and much faster deterioration of the roads leading to the need for more frequent rehabilitation and increased cost of maintenance. That in turn increased the overall cost of transport for the economy" (World Bank, 2010, p. 16).

Regarding the role that the realization of a sub-optimal outcome played in the termination of the concession contract, from a legal perspective, the main point to note is that, a sub-optimal outcome is central in the partners' earlier agreement on the *manner of termination*. The partners agreed that, the contract may be terminated at any time prior to the concession term by either party on the basis of default. Specifically,

constitute a default as defined in the contract include any failure by either or both partners to perform any of their respective obligations under the contract. The information revealed in the observed outcome also led some respondents to conclude: "the expected investment was not made". The observed outcome served as a window into the sub-optimality of at least one of the partners' contributions. The observability of the concession's poor outcome thus served the purpose of confirming that at least one the partners had acted in bad faith. This then led to the activation of the non-performance or default clause in the concession's terms of termination.

In sum therefore, one can argue that, based on the partners' view on the sub-optimality of the concession's outcome, and the correspondence of such an outcome to the legal definition of default, it is easy to refute any objection as to irrelevance of the observed outcome on the contract's termination. In such case, the assumption that the realization of a sub-optimal outcome will be among the reasons for contract termination cannot be discarded. According to the some respondents, it generally undermined the initial confidence they had in relation to the ability of the PPP to improve TRL's performance and operation.

### 6.3.6 The Late Commencement of TRL Concession

In addition to the aforementioned factors, the fact that "the concession became operational more than two years behind schedule" (World Bank, 2010, p. v) receive a fair share of the blame for the partnership's failure. First, one of the bidders filed a suite in a court to challenge the handling of the procurement process. Despite the fact that the suite was later thrown out, it held up the commencement of the concession for close to a year. Furthermore, some controversies surrounded the GAPCO – the local partner that RITES selected. As a potential lender to the project, the International Finance Cooperation (IFC) strongly objected to GAPCO's involvement in the partnership. This was as result of the fact that GAPCO was "in arrears with regard to IFC payment in another deal" (World Bank, 2010, p. 10). IFC's objection in the regard resulted in a contentious and timewasting exchange of views between the various stakeholders, and the eventual dismissal of GAPCO. This then led to the emergence of the Government of Tanzania as the local partner and a minority shareholder.

Some of the serious problems attributed to the late start of the concession include: lack of investment during the waiting period and further depletion of the inventory of TRL's physical assets. These led to an increase in the number of the track sections that were in need of critical repair. It also increased the backlog of maintenance and rehabilitation works that that the partners had to deal with at the commencement of the partnership. Additional, the late start of the partnership compromised the partners' initial cost projections, the quality of TRL's assets, and exacerbated the issues covered in the project design. This adversely affected the partnership and undermined the continued efficiency of operations. In view of these issues, it is argued that a "timely induction of fund for rehabilitation of critical sections of track and rolling stock could have avoided the steep decline in performance" (World Bank, 2010, p. 8).

This role of this factor is clearly difficult to explain with the study's model. Some stakeholders argued that it would have been better to accompany the partnership with some sort of contingency plan that can offset the adverse effects of the delay. It was also learnt that the delay exposed the partners to unanticipated backlog of rehabilitation works, thereby increasing the burden of the initial investments. Despite the absence of the delayed concession in the study's model, it is important to point out that it does not in any way undermine the serious problem created by the factors that are consistent with the model. Actually, one can argue that the delayed concession may have created a good opportunity for the partnership to make a visible difference – the transformation of TRL. From this perspective, the fact that the partners failed in significantly improving the state of the track and rolling stocks upon the commencement of the partnership can serve as basis for the justification of the relevance of the model's implications.

### 6.4 Case 2: The Nigerian Telecommunications Limited (NITEL)

The Nigerian Telecommunications Limited (NITEL) is a state-owned telecom company. It once had a monopoly in relation to telecom service provision in Nigeria. Despite NITEL's erstwhile monopoly status, its current market share is almost zero. Its reign as the sole provider of telecom services in Nigeria came to an end in 2000, when the National Council on Privatization inaugurated and mandated the Telecom Sector Reform Implementation Committee (TSRIC) to coordinate and monitor reform, revitalization and privatization of the telecomm sector. One of TSRIC's main recommendations centred on attracting private investment in the sector. These

recommendations led to the first attempt to open NITEL up for private investment, as well as the emergence of new private telecom service providers.

Remarkably, however, all the attempts to partially divest NITEL's control to interested private investors were largely unsuccessful. First, the contract between the federal government and the Investors International London Limited (ILLL) in 2001 was terminated when ILLL failed to come up with their entire financial obligations. Thereafter, the government requested the reserve bidder, TELNET, to take the place of ILLL. TELNET however failed to accept the offer. Next, in March 2003, the government entered into a three-year management contract with another investor - Pentascope International (ILO, 2003). Nevertheless, the contract with Pentascope was terminated after 18 months, due to apparent declines in NITEL's income and value during the partnership. Another attempt to form a PPP in 2005 led to the emergence of a new contractor – ORASCOM as the highest bidder. The procurement process was however terminated due to the government's dissatisfaction with the company's bid price (Transparency for Nigeria, 2011).

Using a negotiated bid process, the government entered into a new agreement with the Trans-National Corporation of Nigeria (TRANSCORP) Plc. This new agreement was soon terminated when TRANSCORP failed to fulfil their entire financial obligations. Hence, in 2008, the government directed the Bureau of Public Enterprise to recommence the process of contracting with another partner. This led to the emergence of the New Age consortium as the preferred bidder. However, the investors failed to pay the consortium's bid price, despite several extensions in the deadline. The Bureau of Public Enterprise then revoked the agreement with New Age consortium. Interestingly, when the government later approached the reserve bidder (OMEN consortium) to take the place of the highest bidder, OMEN consortium also failed to come up with their bid price. The series of terminations gave rise to the government's decision in 2012 to liquidate NITEL, using the services of a professional liquidator (TeleGeoraphy, 2011; Okonjo-Iweala, 2012; Adugbo, 2014).

### 6.4.1 Defining NITEL's Contract-type

The privatization of NITEL involved the use of contract-types that divest part of the government's entitlements to private investors. Based on the existence of multiple partnerships, the allocation of $\beta_j$ took different values in the range of 0 and 1 at various

point in time. As an example, IILL had a stake of 0.51 in NITEL. In such a case, the contract can formally be referred to as a type-β contract, where $\beta_I$ (IILL's entitlement) and $\beta_G$ (the government's entitlement) correspond to 0.51 and 0.49, respectively. In another example, the NITEL-TransCorp contract started with the allocation of 0.25 and 0.75 stakes to the public and private partners, respectively. This allocation was later restructured, leading to the allocation of 0.49 and 0.51 stakes to the government and TransCorp, respectively (Badaru, 2008).

## 6.5 The Determinants of NITEL's Contract Termination

One of the main issues identified in the formal analysis is that, NITEL's contract-types typically undermine the incentive for optimal investments and exacerbate the problem of controlling interest. Based on the formal analysis, it is thus assumed that the things that determined the termination of the contracts will work like the schematic diagram in Figure 17. The extent to which these issues actually contributed to the termination of NITEL's contracts are further examined.

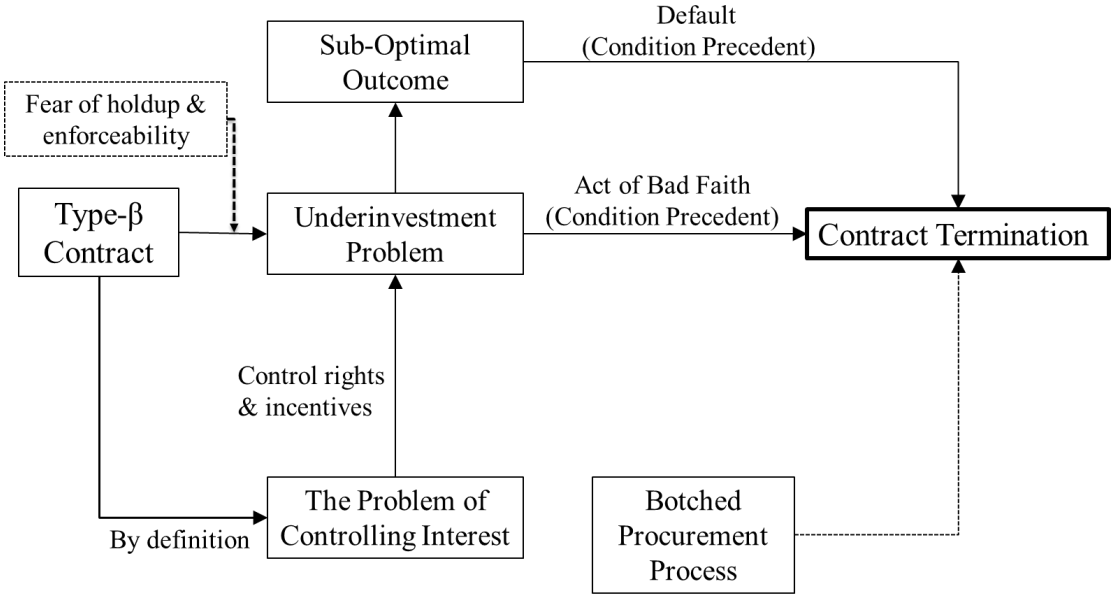


**Figure 17: Factors that led to the Termination of NITEL's Contracts**

Suppose things work like the diagram in Figure 17, some of the questions to be addressed in the subsequent sections centre on whether such inefficiencies did actually play a significant role in detracting the successful implementation of the partnerships

and how each factor did lead to termination of NITEL's contracts. The link between these issues contained in Figure 17 will guide the rest of the analysis in the sections that follow. Generally, the analysis in the sections that follow will elucidate on the relevance of the contract-type model, and the consistency of its practical implication in the explanations provided by various stakeholder in relation to the termination of the contracts. In so doing, the analysis would ascertain how contradictory the observations and reasons put forward by the stakeholders are in relation to the issues deduced in relation to the role of contract-type. Implicitly, one can assumed that, if the inefficiencies associated with the type-β contract are not consistent with the observations and issues that led to the termination of the contract, the role of contract-type can be discarded.

### 6.5.1 Contract-type and the Underinvestment Problem in NITEL

The government's decision to divest part of their entitlements in NITEL to private investors was based on the poor state of NITEL's infrastructure. The multiple partnerships generally aimed at attracting new investments in the rehabilitation, expansion and improvement of NITEL's telecom services. IILL and TELNET, as an example, undertook to invest US$1.317 billion and US$1.310 billion (USD) in NITEL, respectively (Badaru, 2001; Doran, 2002; TeleGeoraphy, 2003). The preferred partner in 2008 (the New Age Consortium) and the reserve bidder (OMEN Consortium) also pledged to inject US$2.5 billion and US$900 million in NITEL, respectively (Adugbo, 2014). Despite the partners' pledges to invest in NITEL's best interest, NITEL's assets suffered from underinvestment. They partners largely failed to live up with their investment commitments. As an example, the contract between the federal government and ILLL in 2001 was terminated when IILL failed to come up with the required level of investment within the agreed time frame, despite several extension in the deadline (Badaru, 2001; Doran, 2002; TeleGeoraphy, 2003). In addition, following IILL's failure to fulfil their investment commitment, and the eventual the termination of the contract between IILL and the government, the government invited the reserve bidder, TELNET, to take the place of IILL. However, TELNET withdrew their initially expressed interest and declined the offer of an opportunity to invest in NITEL (Doran, 2002).

Likewise, the government revoked the contract with TransCorp when TransCorp failed to fulfil its investment commitment, despite several extensions in the

stipulated investment time frame. Specifically, the National Council on Privatization contends cited TransCorp's failure to inject an agreed amount of money (N8.9 billion) within 100 days of the inception of the partnership to address some immediate problems facing NITEL (Okonjo-Iweala, 2012) contravened to the stipulation of the Share Sales Purchase Agreement it entered into with TransCorp. As with the previous investors, the New Generation Consortium, and OMEN Consortium also reneged on their investment commitments (Adugbo, 2014). In an announcement on the termination and withdrawal of TransCorp's 51% equity in NITEL, the then Director of the Bureau of Public Enterprise (BPE) said the "decision was based on the fact that TransCorp did not fulfil certain aspects of the agreement as predicted on the conditions that gave birth to the privatization of NITEL as a going concern" (IT NEWS Africa, 2009). These series of unfulfilled investment commitments hindered the procurement and installation of urgently needed equipment that would improve NITEL's efficiency and profitability. This also led to a steep decline in NITEL's subscriber base, and the disappearance of NITEL's market share (despite NITEL's erstwhile position as the sole provider of telecom service in Nigeria).

The information in Figure 17 puts the explanation of the link between contract-type and the underinvestment problem in a forms in which it can be critically discussed. In essence, the logic of the connection between NITEL's contract-type and the underinvestment problem hinged on the fear of holdup and concerns about the contract's long-term enforceability. Partly, this fear and concern originated from historical evidences of previous terminations and the government's reluctance to divest itself NITEL's control and management. As an example, it is argued that:

> "Government's decision to reverse the sale of NITEL/MTel to Transcorp had caused ripples and anxiety in the private sector as well as in the international investors' forum. The signal that emerged from the decision was that the government, instead of allaying the fears of institutional investors that Nigeria can honour business agreements and enforce property rights, demonstrated that it has no respect for the sanctity of contracts" (The Nigerian News Service, 2009).

Furthermore, the incessant "bickering among the lawmakers and politicians" over NITEL exacerbated the scepticism about the government's long-term commitment.

More so, dysfunctions and inactions that resulted from the infighting and unresolved issues between the Bureau of Public Enterprise (BPE), the National Council on Privatization (NCP) and NITEL union enhanced the investors' fear of losing part of their sunk investment. The ability of these infighting to holdup the smooth implementation and enforcement of the contract further undermined the incentive for optimal investment. Above all, besides the fact that the contract-type precludes the partners' ability to appropriate the full benefits associated with their individual investments, the fact that the contract was not self-enforcing also played in. Simply put, it was practically difficult to ensure that each partner invests in a manner that favours the realization of the first-best outcome. Given the contract-type and the above mentioned concerns, underinvestment became somewhat favourable to each partner's self-interest.

Finally, as the partnership TransCorp's exemplifies, the fact that underinvestment contravenes the condition precedent (in terms of the actions that must be performed, the events that must occur and the conditions that must fulfilled) helped nail the termination of the contracts. According to then Chairman of the National Council on Privatization, "the NCP met to review the contract agreement between Transcorp and BPE, and found out that Transcorp did not fulfil certain aspects of the agreement reached in 2006 when NITEL was sold to Transcorp" (The Nigerian News Service, 2009). This according to the BPE amounts to breaches of contract. This explains the link between the underinvestment problem and the termination of the contracts. As with one of the implications of the formal analysis, the vulnerability of the NITEL's contract to the underinvestment problem somewhat demonstrates the empirical applicability of the holdup and underinvestment hypothesis.

### 6.5.2 The Sub-optimality of NITEL's Performance

As with the underinvestment problem, the realization of sub-optimal outcome contravened "the raison d'etre" of the partnership, as well as the condition precedents. Besides the reference to sub-optimal outcome to default (in terms of a failure to achieve the desired outcome), the partners were able to trace it to the underinvestment problem. This link, according the stakeholders necessitated the discontinuation of the partnership, and the repeated search for more reliable investors. Some of the evidences that are used to support this conclusion centre on the contention that underinvestment in new

equipment and service expansion led to a rapid decline in NITEL's market share and overall profitability.

The first point to note in relation to the role of the sub-optimality of the partners' performance in NITEL revolves around the steady disappearance of NITEL's markets share, despite NITEL's erstwhile position as the sole provider of telecom services in Nigeria before 2001. A report on the telecom operators in Nigeria published by the Nigerian Communications Commission (NCC) on each operator's number of subscribers shows that NITEL had a total of 58,750 subscribers as at December 2014. The insignificance of NITEL's number of subscribers becomes more apparent when one considers the fact that NITEL once had the entire markets. A recent report on the market share of mobile operators published in February 2015, is shown in Figure 18.

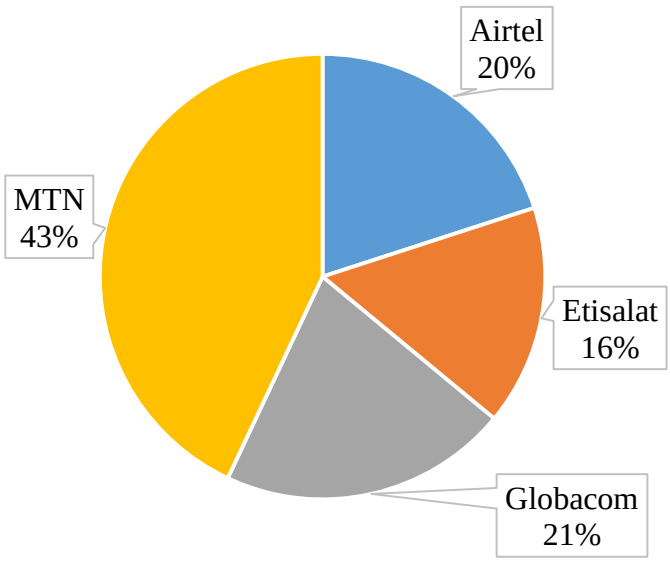


**Figure 18: The Market Share of Mobile Operators in Nigeria (February 2015)**

(Source: Nigerian Communications Commission, 2015)

The absence of NITEL in the Figure 18 is quite conspicuous, given its previous dominance. In relation to NITEL's share of 58,750 subscribers the previous year, a breakdown of the numbers behind the percentages in Figure 18 and NITEL's unenviable position and market performance is summarised in the Table 5 that follows.

**Table 5: The Market Share of Mobile Operators in Nigeria (February, 2015)**

| Operator | Airtel | Etisalat | Globacom | MTN | Total |
|---|---|---|---|---|---|
| No. of Subscribers | 28,380,848 | 22,015,685 | 28,877,537 | 61,001,529 | 140,275,599 |

(Nigerian Communications Commission, 2015)

Comparatively, the progress that the operators in Table 5 (such as MTN, Globacom, Etisalat and Etisalat) made (in terms of the modernization of their installed infrastructures, rapid service expansion, and overall profitability) helped highlight the sub-optimality of NITEL's performance. The failure of the government's multiple attempts to form a successful partnership then necessitated the government's decision to sale NITEL as a liquidated asset.

In general, references to the partnership's failure to achieve the initial objectives featured prominently in the various announcement in relation to the termination of the contracts. As an example, the partnership with Pentascope was terminated on the ground that NITEL's performance under the partnership was sub-optimal. Specifically, the eventual termination of the contract was seen as a positive development in view of the partners' inability to improve NITEL's performance.

Similarly, the realization of a sub-optimal outcome was also raised in relation to the termination of the partnership with TransCorp plc. A Senate Committee on Communications notes that TransCorp's "30-month unimpressive management" of NITEL (Aragba, et al., 2009) did enhance NITEL's continued deterioration. Furthermore, in a press conference organized in relation to the termination of the contract, the National Council on Privatization (NCP) notes that the termination of the contract became necessary when TransCorp "failed to meet the condition precedent" in the Shares Sales Purchase Agreement (SSPA). One report in this regards reads that: "TransCorp had shot itself in the foot by not meeting the terms of the Share Purchase Agreement (SPA) and therefore can no longer hold on to the ownership of NITEL" (The Nigerian News Service, 2009). Lack of investment, and the reduction of NITEL's market share from 15% to 0.03% under TransCorp's management also came up in relation to the termination. Following the disappointing outcomes, and the termination of the contract, a re-privatization process and new expressions of interests were issued in search for a new partner that can inject sufficient resources to ensure the realization of a better outcome (Kelly, 2008; BBC News, 2013).

Despite some contentions that whether or not the private partners did actually fail "to perform to the level called for under the contract is a matter of the fact that the Ministry of Communication may have to prove" (Gbenga, 2003) the sub-optimality of the realized surplus under the partnerships served the purpose of confirming that at least one of the partner was free-riding. Specifically, it argued that such behaviour gives the injured party the rights to terminate the partnership and sue the other party for damages. Despite the burden of proof associated with unverifiable investments, the observables associated with NITEL's performance formed the basis for partners' inference that at least one of the partners did act in bad faith. Precisely, the partners observed a downward trend in NITEL's profit, the rapid reductions in NITEL's market share, and the changes or lack thereof in network expansion. The partners were also able to observe the absence of new equipment or new installations, irrespective of the partners' claims in relation to the "sufficiency" of their respective contributions. These observations later became some of the reasons for the termination of the partnerships, and the conclusion that one of the partners must have failed to act in good faith during the partnership.

### 6.5.3 The Problem of Controlling Interests in NITEL

By definition, NITEL's contract-type possessed a property that exacerbates the controlling interest problem. Evidences on the manifestation of this property rests on fallouts of the internal politics that resulted from partners' limited ability to enact some of their preferred managerial and operational decision. As an example, besides the fact that TELNET would not have been in a position to appropriate the entire benefits associated with their investments in NITEL, one of the main issues raised in relation to their decision withdraw their initial commitment to acquire 51% of NITEL's equity and invest in NITEL centred on the intrigues of boardroom politics.

Generally, it is interesting to note that the two types of contracts used in NITEL's privatization were a management contract and a partial divestiture contract. Arguably, even if both partners were presumably interested in the realization of an outcome that is consistent with the social optima, a fundamental issue that they had to deal with revolved around the problem of controlling their individual interests. By definition, under the management contract, the "private entity takes over the management of a state-owned enterprise for a fixed period while ownership and investment decisions remain with the state" (World Bank/PPIAF, 2014). Likewise,

under the partial-divestiture contract, "a private entity buys an equity stake in a state-owned enterprise through an asset sale, public offering" (World Bank/PPIAF, 2014). Unlike a full divestiture, the government and the investor retain some percentage of operational and managerial control rights that correspond to their equity.

The definitions of the management and the partial-divestiture contracts capture an important property of type-β contracts, and the type of problems exemplified in NITEL's experience. As with the definition of the management contract, the private partner (Pentascope International as an example) took over the management of NITEL (a state-owned enterprise) while ownership, operating risk, and investment decisions remain with the Nigerian government. The crux of one of the problems that NITEL faced in this regard is that, the separation of managerial and operational decisions was contentious. As a result, the private investors' decisions and actions regarding NITEL's operations and management becomes subject to the government's partial control and investment decisions.

Furthermore, it was practically difficult for the partners to write a contract that completely specifies the dimensions and ramifications of their managerial and operational spheres of influence in both foreseen and unforeseen circumstances. The interlocking nature of the payoffs and the interdependent control rights also affected the decision-making process that was to be relied upon in relation to the NITEL's continued management and operation. Consequently, the arrangement broadened the scope of the conflict between the public and private partners. In addition, the decision of the Bureau of Public Enterprise (BPE) to establish an executive committee that will to monitor and supervise the daily operations of Pentascope in NITEL (Soriwei, 2013; Udo, 2013) failed to ease the problem. On the contrary, it was learnt that this decision ended up exacerbating the problem encountered in the partnership. The executive committee limited the implementation of some of Pentascope's preferred decisions. In addition to the vulnerability of the executive committee to political influence, the investors' and the government's individually rational preferences did not to always coincide. These further frustrated the partnership and helped to worsen the rifts and the complications that characterized the internal administrative process.

In general, despite the partners' interest in the realization of an outcome that is consistent with social target, one problem that they had to confront revolved around the issue of controlling their conflicting interests. Some of the contentious issues centred on political interference, the payment of the staff inherited by the investors, the

approval of major acquisitions, expenditures, and human recourse managements. The lack of consensus that ensued over some of the contentious issues led to a complete paralysis of action and heightened the fear of holdup. This undermining effect (the fear of losing part of their investment to both unresolved and unresolvable differences) explains the link between the problems of controlling interest and underinvestment in Figure 17. The observations made in this regard seem to be consistent with practical implications associated with the interpretation $\beta_j$ and the allocation of control rights in the theory of industrial organization. The manifestation of the attendant problems in NITEL thus provides some empirical evidence on the applicability of some of the inefficiencies associated with certain types of contract.

### 6.5.4 The Role of Botched Procurement Process

Despite the conspicuous absence of this factor in study's model, its contribution to some of the controversies that surrounded the termination of some of NITEL is undeniable. It also helped to showcase the infighting between an erstwhile Director of the Bureau of Public Enterprise, a former Chairman of the National Council on Privatization, and the Executive Committees set up to investigate the handling of NITEL's privatization. Some of the issues that marred the procurement process were allegations of intense lobbying, corruption and political meddling in the contract award process. As an example, regarding the termination of the contract with Pentascope International, the then director of the Bureau of Public Enterprise was accused of selecting an incompetent and financially incapable private investor. Also, there were allegations that some politicians rooted for a particular bidder and sought contract for their friends and. In another example, the fact that TransCorp did not have any previous experience in relation to telecom operation and the use of a direct negotiation process instead of competitive bidding in the award of TransCorp's contract also played into the allegation that some political figures had some personal stake in the deal. As the new Director that headed the Bureau of Public Enterprise (BPE) from 2003 testified at the Ad-hoc Senate Committee investigating the activities of the activities of the BPE, a World Bank report in this regard reads that:

> "The most important Public Enterprise, in terms of economic and social impact, have not yet been divested. Moreover, the bank expressed

> serious concern about inadequate transparency in some transactions (e.g. NITEL), and the failure to comply with FGN's privatization procedures in a consistent fashion." (Business News, 2011; iREPORT Nigeria, 2011)

It is therefore generally argued that shady deals and issues associated with the lack of transparency in the contract award process enhanced the controversies associated with the partnerships and adversely affected the sustainability of the PPP contracts. Generally, due to the hidden nature of the alleged acts, it was difficult for the researcher to get the evidence needed to establish the exact nature of the fraudulent procurement practices. Despite this limitation, it will be irresponsible to ignore the issues that the stakeholder raised in this regard. Botched procurement process created serious problems that compromised the integrity of the partnerships. The grievance of those who felt sidestepped in the procurement process helped fuel the contentions among the stakeholders involved in the implementation of the partnership.

## 6.6 Final Remarks

Based on the available evidence, it is easy to see that three of the main issues that led to the termination of both TRL and NITEL contracts are consistent with the inefficiencies deduced from the analyses of the holdup model. This means that, it would be unreasonable to discard the explanations derived from the strategic effect of contract-type. The consistency of the evidences with the logical consequences of the type-β contract somewhat corroborates the explanatory power of the formal model. Despite the existence of the some factors that the model could not account for, in view of the available evidence, it is difficult to completely dismiss the explanatory relevant of the models implications.

The role that the fear of holdup and concerns about enforceability played in both NITEL and TRL is consistent with the fundamental premise of the holdup problem. This also explains why the ensuing underinvestment is seen as a strategy that arises out of the partners' fear that they may be expropriated of some of the surpluses that result from their initial investment. Additionally, since optimal investment effectively locks a partner into the transaction, the lesser loss and ease of exit that associated with underinvestment was also observed. Basically, most of the investors that were accused

of underinvestment left without a fight - they simply walked out the partnership without contesting the termination in a court of law.

Besides the correspondence of underinvestment with an act of bad faith as seen in both NITEL and TRL, the link between underinvestment and the social surplus is also worth noting. This generally makes underinvestment a reasonable antecedent that can undermine the partnership's overall viability or profitability.

Two other interesting observations that are consistent with the issues associated the underinvestment problem in the problem in the literature centre on the concepts of non-verifiability and enforceability. Based on the cases, one can appreciate why non-verifiability and enforceability are perceived as serious problems in the literature (Holmstrom, 1979; Laffont & Tirole, 1988; Hart & Moore, 1999). As the observations made in case of TRL exemplified, the problems associated with non-verifiability is based on the partners' inability to make a correct inferences on the actual amount that each partner invested. This partly led to the $1 compensation that RITES received. Under full perfect verifiability, RITES would arguably have been in a position to ask for a higher compensation.

From another perspective, it is argued that un-verifiability can enhance the incentive for underinvestment if the contract-type is not structured in a manner that makes an optimal investment an equilibrium behaviour. Particularly, Green and Laffont (1994) argue that, non-verifiability constrains contract enforcement, and that "this fact may limit the ways in which the contract can function in the mutual interest of the players" (Green & Laffont, 1994, p. 82). Besides discouraging socially optimal investments, an observation made in this regard is that, it is difficult to enforce a contract based on unverifiable or unknown information. This constraint helped frustrate the TRL concession. By extension, the observations made in this regard somewhat attest to the contention that verifiability facilitates a contract's enforceability. Some of the issues that are associated with verifiability will disappear if the contract is designed in a manner that makes an optimal investment self-enforcing.

Furthermore, despite the problem of verifiability – the existence of an imperfect information on the partners' actual investments and contributions in the partnership, one could see how the observability of the ensuing outcome helps uncover the presence of underinvestment in the two case studies. In TRL, the observed outcome dismantled the partners' claims of investing optimally. The information revealed in the observed outcome (in terms of the state of TRL's track and rolling stock or NITEL's market share

and physical assets) played a significant role in the cases. The observations served as a window into the sub-optimality of at least one of the partners' contributions and the eventual activation of the terms of termination.

Finally, as with the type-β contract, the two cases involved the use of a mechanism that entails joint operation and surplus sharing. The arrangement gave each partner a partial authority or rights of control over the two dimensions of the social surplus. This subjected each partner's influence to the other partner's partial control and competing interests. The sensitivities implied in the interlocking nature of the partners' individual contributions and individual interest led to serious problems of coordination. In TRL, the unresolved differences led to the existence of parallel management, the government on the one side, and the private on the other side. In NITEL, this played out in the form of infighting and lack of consensus on some important issues.

# 7 Conclusion and Recommendations

This chapter presents the main conclusions of the study. It starts with a summary of the relationship between the findings in the case study and the empirical analysis. It then proceeds to recap the study's contributions to the theory and practice of public-private partnerships. The chapter ends with some recommendations for future research, vis-à-vis the limitations of the study and the new directions for future study that the findings gave rise to.

## 7.1 Summary of the Findings

The study's results has shown how the vulnerability of a PPP project to contract termination varies from one category to another. In terms of the project's sector, the study found the energy and transport sectors most vulnerable and least vulnerable, respectively. Despite the apparent differences in terms of vulnerability among the four values of the sector attribute, the study's regression analysis found the relationship between sector and contract termination to be statistically insignificant. In terms of the sponsor's nationality, the study also found some evidence of varying vulnerability. Specifically, the findings indicate that domestic-sponsored projects are less vulnerable to termination, in comparison with foreign and mixed sponsored PPP projects. As with the sector attributes, however, the study's regression analysis indicate that the relationship between the sponsor's nationality and the outcome of a PPP is statistically insignificant.

The study's findings in relation to the effect of contract-types also indicate the existence of some differences in the vulnerability of type-m and type-β contract. Precisely, the results derived from the empirical analysis found that, if a contract's type is type-β, then the probability that the contract is terminated equals 0.261, and that if a contract's type is type-m, then the probability that the contract is terminated equals 0.084. In comparison with the values of the sector and sponsor attributes, the study also found that, the type-β attribute increases the degree to which one should expect the incidence of contract termination the most. In particular, while type-β contracts provides the strongest positive explanation for contract termination, domestic sponsorship provides the strongest negative explanation for contract termination. This finding implies that, while being type-β increases the degree to which one should expect

the incidence of contract termination, domestic sponsorship decreases the degree to which one should expect the event of contract termination in a PPP.

The study's regression analysis also identified contract-type as a statistically significant factor in the explanation contract termination. Besides, the results of the study's sensitivity analysis indicate that explanations for contract termination derived from the two contract-type are less sensitive to contextual factors, in comparison with the explanations derived from a project's sector and the sponsors' nationality. In this regard, unlike the other competing attributes, the study found that the relevance of contract-type in the explanations of contract termination less ad hoc and more correct in a larger set of circumstances.

Through the case studies, the study has found some connection between the specificities of a PPP's contract-type and some of the factors that constrain and frustrate the smooth implementation of a project. The identified factor include: the problem of underfunding or underinvestment in a project's physical assets, the disputes associated with the realization of an outcome sub-optimal outcome, and the problems associated with controlling interest. Specifically, the study has found how the issues associated with a partners' ability or inability to implement their individually preferred decisions in a PPP lead to conflicts and serious problems of coordination, and how such issues originate from the allocation of rights and entitlements in the contract.

In addition, the case studies provided some insights on the nature of the relationship between the consequences of underinvestment and the legal definition of poor performance, default and the terms of termination in a PPP. The study's findings also provide some insights on how the inefficiencies and strategic issues that practitioners attribute a PPP's failure and termination originate from the contract-type governing the partnership. These findings also attest to the pervasive roles that endogenous and largely human factors that lie beyond the project's sector, the sponsor's nationality, and the exogenous socio-economic environment play in contractual relations.

## 7.2 A Recap of the Study's Contributions

This study has examined the problem of contract termination in a PPP. The initiation of the study was based on some outstanding questions regarding the determinants of a contract's differential vulnerability to termination in Sub-Saharan Africa. The main

objective of the study was to identify how theories contribute to our understanding on the issue of contract termination in a PPP. In view of this objective, the study argued in favor of examining the strategic issues involved in a PPP contract, using formal theories and models.

The results of this study show that contract-type is the significant factor in contract termination. Besides having a higher explanatory power and certainty coefficient, the results of the regression analysis also confirmed that the relationship between contract-type and contract termination is very significant. These results address one of the important questions in the literature regarding the factors that make some PPP contracts more vulnerable than others. In particular, in view of the previous conclusion that the rates and patterns of PPP contract termination in Sub-Saharan Africa "are less easy to explain" (Harris & Kumar, 2009, p. 4), the findings of this study can be referred to as a major contribution to the understanding on some of the fundamental issues and factors. In terms of the practical and policy implications, the discovery made in this study clearly illustrates how some of the specificities in a PPP contract interact to shape the partners' incentives and actions. The findings also embody some suggestions on the type of contracts that governments and policy makers should consider in relation to the minimization of the problems associated with the incidences of contract termination in a PPP project.

Another major significance of the study lies in its ability to navigate the complexities associated with real-life PPPs and contract implementation, using the theories in the field of contracts, transaction costs and industrial organizations. In so doing, the study succeeded in formalizing the process and mechanism through which the partners' actions and incentive problems affect a partnership's outcome. The study's strong theoretical foundations and empirical findings clearly demonstrates that it is possible to theoretically analyse the problem of contract termination in a PPP.

In addition to the measures associated with how counterfactually relevant contract-type is to the explanation of contract termination, this feature (the relationship between an expalation and theory) is an important criteria in the evaluation of how good an explanation is. In this regard, the two main principles often "used as an argument in favour of the theoretical perspective from which the preferrred explanation is derived" (Ylikoski & Kuorikoski, 2010, p. 207) are relative sensitivity and the degree of integeration. Further to the reliability and higher eplanatory powers associated with contract-type, the theoretical perspective that forms the basis of the explanation, the

extent to which an contract-type explanatory perpective integerates into existing knowledge is attests to the quality of the study's findingns and conclusion. In the literaure (Kitcher, 1989; Ylikoski & Kuorikoski, 2010) on scientific expalantons and the logic of expalantory power, an explanation's unification or connectedness to a larger theoretical framework is often referred to as an important strength and quality. In this regard, it is argued that: an explanation that is well integrated into a theoretical framework facilitates the identification of some grounded answers to different what-if-question in real life. The inferential connections the study's explanation to already existing body of knowledge and formal analysis has also facilitated the identification of some unforeseen dimension of the complexities and frustrations that can lead to the failure of a PPP project. Moreover, the study has helped lessen the gap between the theory and practice of PPP.

In the context of this study, while it is relatively easier to establish the connection and the consistency of the explanations derived from contract-type with well-supported theories on contract, holdup and other forms of strategic behaviour in economic transactions, the same cannot not be said for the explanations derived from the competing explanations (i.e., a project's sector and the sponsor's nationality). Also, the connectedness of the explanations (for contract termination) derived from the contract-type to some already established body of knowledge has facilitated the identification of the nature of the dependencies between factors in the different aspects of contract-type and the problems that lead to contract termination. The formal analysis that proceeded from exisiting theories has helped address some questions regarding the kind of changes (especially in terms of underinvestment and controlling interstes) that would result if the contract-type changes from one form to another. Moreover, the contract-type perspective helped bridge the gap between the holdup problem, and the effect of underinvestment in the realisation of inferior outcomes in partnership. The presence of larger theoretical frameworks that forms the basis for the explanations derived from the role of contract-type makes such explanations more credible or less controversial.

Finally, this study can be referred to as basis for further studies, policy making and new perspectives on the implementation of a PPP. The suitability of the study in this regard is based on the special attention the study paid on the practical implications of the findings. Besides lessening the gap between the factors in the formal model and typical PPP contracts and outcome, another contribution of the study lies in its ability

to operationalize the apparently abstract aspects of the theoretical model in a manner that facilities the interpretation of their strategic and practical importance.

### 7.3 Recommendations for Future Studies

It is worth noting that some type-β contracts are still operational, despite what theory suggest in relation to their predisposition or vulnerability to the underinvestment problem. The results of the sensitivity analysis also indicate that the nature of the relationship between contract-type and contract termination can be quite complicated and somewhat difficult to separate from a number of factors that deserve further exploration on. As an example, the result shows that type-β contracts that involve domestic investors are relatively more successful than those that involve foreign investors or sponsors. Given the possible connection between underinvestment and risk aversion, it would be useful to explore the drivers of the significant difference between the risk tolerance of domestic and foreign investors in a PPP (in terms of the partners' differential capacities to accept or absorb risk of being held up), and the possible ways of mitigating them effectively.

Also, given the complexity of real-life project construction, operation and management, this study could not exhaust the need for more research, particularly case studies, in relation to contract termination in a PPP. On the contrary, this study has established the fact that it is possible to theoretically analyse the problem of contract termination, and that such theoretical analysis is promising. Besides revealing some of the hidden incentive problems that can affect a PPP contract, the study's findings indicate that it is possible to expand the scope of the explanatory variables used in study of contract termination in a PPP. More theoretical analysis is therefore highly recommended. In particular, it would be interesting to incorporate the roles of time and sub-contracting in future studies and formal analysis.

Besides the limited number of case studies (due to time and some practical constraints), and the absence of time dynamics in the payoff structure of the partners in the model used for this study, the study relied mainly on publicly available information. This constrained the number of the contracts and other confidential documents that were needed for a closer look on the specificities of the contract's terms and provisions. As a result, the classification of the contracts relied mainly on the available data. In view of this limitation, more studies that involve a closer and unlimited look at actual concession agreements governing a given a PPP are needed in the future.

## References


ADB - Asian Development Bank. (2007). *Public-Private Partnership Handbook.* Source: http://www.adb.org/Documents/Handbooks/Public-Private-Partnership/Public-Private-Partnership.pdf.

Adugbo D. (December 15, 2014). Nigeria: Fresh Controversy Dogs NITEL/MTEL sale. *AllAfrica News.*

Alvaro Escribano A., Guasch L. J., & Pena J. (2010). Assessing the Impact of Infrastructure Quality on Firm Productivity in Africa Cross-Country Comparisons Based on Investment Climate Surveys from 1999 to 2005. *Policy Research Working Paper 5191*, the World Bank.

Ashurst (2012). *Terminating Contracts*. Ashurst LLP, London.

Aumann R. J. (1997). Rationality and Bounded Rationality. Games and Economic Behaviour. Vol. 21, pp. 2-14.

Babbie, E. (2007). *The Practice of Social Research.* 11th Edition. Belmont: Thomson and Wadsworth.

Badaru S. (August 18, 2008). IIL Negotiates for Sake in New NITEL. *Financial Nigeria.*

Banerjee S., Wodon Q., Diallo A., Pushak T., Uddin H, Tsimpo C., & Fosteret V. (2008). Access, Affordability, and Alternatives: Modern Infrastructure Services in Africa. Background Paper 2, Africa Infrastructure Country Diagnostic, World Bank, Washington, DC.

Barnard C. I. (1938). The Economy of Incentives. *The Function of Executives.* Chapter XI, pp. 139-160. Harvard University Press: Cambridge.

Bazan J., Szczuka M., Wojna A., Wojnarski M. (2004). "On the evolution of rough set exploration system". *Proceedings of the RSCTC 2004*: 592–601.

BBC News (18 February 2008). Nigeria phone privatization off., http://news.bbc.co.uk/2/hi/business/7251154.stm, 16:28 GMT.

Blumer H. (1969). *Symbolic Interactionism*. Englewood Cliffs, NJ: Prentice Hall.

Bolton P. (1990). Renegotiation and the Dynamics of Contract Design. *European Economic Review*, 34, pp. 303-310.

Bolton P., & Dewatripont M. (2005). *Contract Theory*. MIT Press: Cambridge, London.

Bolton P., & Whinston M. D. (1993). Incomplete Contracts, Vertical Integration, and Supply Assurance. *The Review of Economic Studies*, Vol. 60, No. 1, pp. 121-148.

Bryman A., & Bell E. (2011). *Business Research Methods* (3rd edition*)*. University Press: Oxford.

Bull, J. (2006). Costly Evidence Production and the Limits of Verifiability. Source: http://casgroup.fiu.edu/pages/docs/2244/1275230187_06-11.pdf

Burger, P., Tyson, J., Karpowicz, I., & Delgado, M. C. (2009). *The Effects of the Financial Crisis on Public-Private Partnerships.* IMF (International Monetary Fund) Working Paper WP/09/144.

Business News (August 14, 2011). BPE Probe: World Bank Report in Nonsense – El Rufai.

Che Y. K. & Hausch D. B. (1999). Cooperative Investment and the Value of Contracting. *The American Economic Review*. Vol. 89, No. 1, pp. 125-147.

Cheng W. (2000). Renegotiation-Proof Dynamic Contracts with Private Information. *Review of Economic Dynamics*, 3, pp. 396-422.

Chung T. Y. (1991). Incomplete Contracts, Specific Investments, and Risk Sharing. *The Review of Economic Studies*, Vol. 58, No. 5, pp. 1031-1042.

Clark, G., L & Root, A. (1999). Infrastructure shortfall in the United Kingdom: the private finance initiative and government policy. *Political Geography*, 18, 341–365.

Corbin J., & Strauss A. (2008). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory 3e*. Sage Publications: Los Angels, New Delhi, London, Singapore.

Creamer Media (November 12, 2009) Africa's energy problems threatens growth, says Nepad CEO: http://www.engineeringnews.co.za/article/africas-energy-problems-threatens-growth-says-nepad-ceo-2009-11-12

Cumming, D. (2007). Government policy towards entrepreneurial finance. Innovation investment funds. *Journal of Business Venturing* 22 (2), 193–235.

De Meza, D., and Lockwood B. (1998). Does Asset Ownership Always Motivate Managers? Outside Options and the Property Rights Theory of the Firm. *Quarterly Journal of Economics*, 113, 361-386.

Demsetz, H. (1968). Why Regulate Utilities? *Journal of Law and Economics*, 11, 55-65.

Domberger, S., & Jensen, P. (1997). Contracting Out By The Public Sector: Theory, Evidence, Prospects. *Oxford Review of Economic Policy*, 13(4), 67-78.

Doran D. (Fereuary 12, 2002). Nigeria hopes six-week extension can save NITEL sale. *Total Telecom, Terrapinn Holdings Ltd.*

Edkins, A. J & Smyth, H. J (2006). Contractual management in PPP projects: evaluation of legal versus relational contracting for service delivery. *Journal of Professional Issues in Engineering Education and Practice,* 132(1), 82-93.

Elden A. S., and Reichelstein S. (1996). Holdups, Standard Breach Remedies, and Optimal Investment. *The American Economic Review,* Vol. 86, No. 3, pp. 478-501.

Ellingsen T., and Johannesson M. (2004). Is There a Hold–up Problem? *The Scandinavian Journal of Economics,* Vol. 106, No. 3, pp. 475-494.

Foster V. (2008). Overhauling the Engine of Growth: Infrastructure in Africa. Executive Summary, Africa Infrastructure Country Diagnostic, World Bank, Washington, DC.

Foster V., & Briceno-Garmendia C. (2010). Africa's Infrastructure: A Time for Transformation. *The World Bank*, Washington, DC.

Fudenberg, D. & Tirole, J. (1990). Moral Hazard and Renegotiation in Agency Contracts. *Econometrica*. 58, pp. 1279-1319.

Gbenga A. (December 19, 2003). Management Contract – the wrong way for NITEL, *Nigeriaworld Feature Article*.

Gibbons R. (2010). Transaction-Cost Economics: Past, Present, and Future? *Scandinavian Journal of Economics*. Vol. 112, Issue 2, pp. 263-288. 23.

Glaser B. G., & Strauss A. L. (1967). *The Discovery of Grounded Theory: Strategies for Qualitative Research*. Adline de Gruyter/ New York.

Glymour, C. (1980). Explanations, Tests, Unity and Necessity. *Nous* 14, pp. 31–49.

Graham D. A., and Peirce E. R. (1989). "Contract Modification: An Economic Analysis of the Hold-Up Game". *Law and Contemporary Problems,* Vol. 52: No. 1, pp. 9-32.

Green J., & Laffont J. J. (1994). Non-verifiability, Costly Renegotiation and Efficiency. *Annales D'Economie et de Statistique*, 36, pp. 81-95.

Grossman S., and Hart O. (1986). The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy,* 94, pp. 691-719.

Guasch J. L., Laffont J.J., & Straub S., (2006). "Renegotiation of Concession Contracts: A Theoretical Approach", *Review of Industrial Organization*, pp. 29, 55-73.

Gutman J., Amadou S., & Soumya C. (2015). Financing African Infrastructure: Can the World Deliver? *Global Economy and Development*, Brookings.

Hamby D. M. (1994). A Review of the Technique for Parameter Sensitivity Analysis. Environmental Monitoring and Assessment, 32, pp. 135-154.

Hammami, M., Jean-Francois, R., & Etienne, B. Y. (2006). *Determinants of Public-Private Partnerships in Infrastructure.* IMF Working Paper.

Harris C., & Kumar V. P. (2009). What Drives Private Sector Exit from Infrastructure? *Gridlines*, Note No. 46. Public-Private Infrastructure Advisory Facility (PPIAF).

Harris C., Hodges J., Schur M., and Shukla P. (2003). *Infrastructure Projects: A review of cancelled Private Projects*. The World Bank Group Private Sector and Infrastructure Network. Note Number 252.

Harris, C. (2003). *Private Participation in Infrastructure in Developing Countries: Trends, Impacts, and Policy Lesson*. World Bank Working Paper No. 5. The World Bank Washington, D.C.

Hart O., & Moore J. (1988). Incomplete Contracts and Renegotiation. *Econometrica*, Vol. 56, No. 4, pp. 755-785.

Hart O., & Moore J. (1999). Foundations of Incomplete Contracts. *Review of Economic Studies*, 66, pp. 115-38.

Hempel, C. G. (1965). Aspects of Scientific Explanation. *Aspects of Scientific Explanation and other Essays in the Philosophy of Science*, pp. 331–496. New York: Free Press.

HermaIin, B. E., & Katz M. L. (1991). Moral Hazard and Verifiability: The Effects of Renegotiation in Agency. *Econometrica*, 59, pp. 1735-53.

Holmstrom B. (1979). Moral Hazard and Observablity. The Bell Journal of Economics, Vol. 10, No. 1, pp. 74-91.

Hoy M., Livernois J., McKenna C., Rees R., & Stengos T (2011). *Mathematics for Economics*. The MIT Press: Cambridge. London.

Huxham, C., & Vigan, S. (2000). What Makes Partnerships work? In Osborne S. P (Ed.), *Public-Private Partnerships: Theory and Practice in International Perspective*. 292-310. New York and London: Routledge.

IFC- International Finance Corporation. (2007). Project Database. : *Tanzania Railway: Summary of Proposed Investment*.

ILO – International Law Office (February 12, 2003) Pentascope Appointed to Manage NITEL. *Global Business Publishing Ltd*.

Iossa, E., & Martimort D. (2008). *The Simple Micro-Economics of Public-Private Partnerships*. CMPO Working Paper Series No. 08/199 CMPO, Bristol Institute of Public Affairs. Retrieved from http://www.bristol.ac.uk/cmpo/publications/papers/2008/wp199.pdf.

iREPORT Nigeria (August 14, 2011). Privatization Scam: World Bank indicts El-Rufai for lack of Transparency in Sale of Govt. Assets.

IT NEWS Africa (June 3, 2009). Nigeria Terminates Sale of NITEL to TransCorp. *IT NEWS Africa,* Gauteng, South Africa.

Jenkins B. (1986). "Obsolescing Bargain": A Study of Canada's National Energy Program. *International Organization*, Vol. 40, No. 1, pp. 139-165.

Jonah N. Schupbach & Jan Sprenger (2011). The Logic of Explanatory Power. *Philosophy of Science* 78 (1), pp. 105-127.

Katz A. W. (2005). Contractual Incompleteness: a Transactional Perspective. *Case Western Reserve Law Review.* Vol. 56: 1. pp. 169- 186.

Kelly J. (2008). Nigeria Government Cancels Sale of NITEL, Seeks new Investor. *IHS Country Industry Forecasting*, https://www.ihs.com/country-industry-forecasting.html?ID=106597117

Kitcher, P. (1989). Explanatory unification and the causal structure of the world. In Philip Kitcher & Wesley Salmon (eds.), *Scientific Explanation*. Minneapolis: University of Minnesota Press, pp. 410-505.

Kleijnen, J.P.C. (1995). Sensitivity analysis and optimization: design of experiments and case studies. In: C. Alexopoulos, K. Kang, W.R. Lilegdon and D. Goldsman (eds), *Proceedings of the 1995 Winter Simulation Conference.* pp. 133-140. Source: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=478715

Klein B., Crawford R. G., and Alchian A. A. (1978). Vertical Integration, Appropriable Rents, and the Competitive Contracting Process. *Journal of Law and Economics,* Vol. 21, No. 2, pp. 297-326.

Komorowski J., Polkowski L., & Skowron A. *Rough Sets: A Tutorial*. Sourse:http://secs.ceas.uc.edu/~mazlack/dbm.w2011/Komorowski.Rough Sets.tutor.pdf.

Laffont J. J., & Tirole J. (1988). The Dynamics of Incentive Contracts. *Econometrica.* Vol. 56, No. 5, pp1153-1175.

Levin K. A. (2006). Study Deign III: Cross-sectional Studies. *Evidence-Based Dentistry*, 7, pp. 24-25. doi:10.1038/sj.ebd.6400375.

Li, B., & Akintoye, A., (2003). An Overview of Public–Private Partnership. In: Akintoye, A., Beck, M., Hardcastle, C. (Eds.), *Public–Private Partnerships: Managing Risks and Opportunities*. 1- 22. Oxford, UK: Blackwell Science Ltd.

Markard J. (2011). Infrastructure Sector Characteristics and Implications for Innovation and Sectoral Change. *Journal of Infrastructure Systems*, 17(3), pp. 107-117.

Martimort, D., & Pouyet, J. (2008). To build or not to build: Normative & positive theories of public–private partnerships. *International Journal of Industrial Organization*, 26, pp. 393–411.

Martin P. Y., & Turner B. A. (1986). Grounded Theory and Organizational Research. *Journal of Applied Behavioural Science*, 22, pp. 141-157.

McQuaid, R. W. (2000). The Theory of Partnership: Why have Partnership? In Osborne Stephen P (Ed.), *Public-Private Partnerships: Theory & Practice in International Perspective*. pp. 8-35. New York & London: Routledge.

Mutambatsere E. (2014). *Public-Private Partnerships (PPP's) and Other Innovative Ways of Financing Infrastructure: Regional and International Experience.* Paper prepared for the Bank of Namibia 16th Annual Symposium, African Development Bank.

Nasiri J. H, & Mashinchi M. (2009). Rough Set and Data Analysis in Decision Tables. *Journal of Uncertain Systems*, Vol.3, No.3, p. 232-240.

Neeman Z., and Pavlov G. (2013). Ex-post Renegotiation-proof Mechanism Design. *Journal of Economic Theory*, 148, pp. 473–501.

Nigerian Communications Commission (2015). *Industry Overview: Percentage Market Share by Operator, February 2015*.

Noldeke G., & Schmidt K. M. (1995). Option Contracts and Renegotiation: A Solution to the Hold-up Problem. *The RAND Journal of Economics*, Vol. 26, No. 2, pp. 163-197.

OECD (2006). *Concessions*. Policy Roundtable. DAF/COMP/GF(2006)6. Retrieved from http://www.oecd.org/dataoecd/0/28/39531515.pdf

Okonjo-Iweala N. (2012). Reforming the Unreformable: Lessons from Nigeria. MIT Press. Cambridge, Massachusetts.

Pannell D. J. (1997). Sensitivity Analysis of Normative Economic Models: Theoretical Framework and Practical Strategies. *Agricultural Economics*, 16, pp. 139-152.

Parker, D., & Hartley, K. (2003). Transaction costs, relational contracting & public private partnerships: a case study of UK defence. *Journal of Purchasing & Supply Management*, 9, 97–108.

Pawlak Z. (2002a). Rough sets and intelligent data analysis. *Information Sciences* 147: p. 1–12.

Pawlak Z. (2002b). Rough sets theory and its applications. *Journal of Telecommunications and Information Technology* 3/2002, p. 7-10.

PPPIRC - The PPP in Infrastructure Resource Center for Contracts, Laws and Regulations (2014). *Joint Venture/ Joint Stock Company Checklist*. The World Bank Group.

RAHCO - Reli Asset Holding Ltd. (2011). *Statement of Managing Director in a Week of the Ministry of Transport to Mark 50 Years of Tanzania Mainland Independence*.

Ramamurati R. (2001). The Obsolescing Bargain Model: MNC-Host Developing Country Relations Revisited. *International Journal of Business Studies*, 32: 1, pp. 23-39.

Ramamurati R. (2003). Can governments make credible promises? Insights from Infrastructure Projects in Emerging Economies. *Journal of International Management*, 9, pp. 253 – 269.

Renato, R. E. (2009). *Global Determinants of Stress & Risk in Public-Private Partnerships for Infrastructure*. ADBI Working Paper 133. Tokyo: Asian Development Bank Institute.

Rubinstein A. (1998). Modelling Bounded Rationality. *Zeuthen Lecture Book Series*. MIT Press, Cambridge. London.

Russell A.D., Tawiah, P., & Zoysa, S. D. (2006). Project innovation — a function of procurement mode? *Canadian Journal of Civil Engineering*, 33, 1519–1537.

Salanie B. (1998). *The Economics of Contracts: A Primer.* The MIT Press: Cambridge.

Shen, L.Y., Platten, A., Deng, X.P. (2006). Role of public private partnerships to manage risks in public sector projects in Hong Kong. *International Journal of Project Management* 24 (7), 587–594.

Simon A. H. (1972). Theories of Bounded Rationality. *C. B McGuire & Roy Radner (eds.), Decisions and Organizations. North-Holland Publishing Company. Chapter 8, pp. 161-176.*

Skowron A., Jankowski A., & Swiniaski R. W. (2015). Foundations of Rough Sets. (Eds.) Kacprzyk J. & Pedrycz W., *Springer Handbook of Computational Interligence*. Springer: Dordrecht, Heiderlberg, London, New York.

Sorrell, S. (2007). The Economics of Energy Service Contracts. *Energy Policy*, 35, pp. 507–521.

Sorriwei, F. (April 2, 2013). Atiku Lied about Pentascope Deal – El Rufai. The Punch, Nigeria.

Suddaby R. (2006). From the Editors: What Grounded Theory is Not. *Academy of Management Journal*, Vol. 49, No. 4, pp. 633-642.

SUMATRA - Surface and Marine Transport Regulatory Authority (2011). : *Performance Indicators and Benchmarks for Railway Subsector in Tanzania*.

Tang, L. Y., Shena Q., Eddie W. & Cheng, L. (2009). A Review of Studies on Public–Private Partnership Projects in the Construction Industry. *International Journal of Project Management*, xxx–xxx, pp. 1-12.

TeleGeography (March 18, 2003). NITEL IPO Back on Track. *TeleGeography, PriMetrica*: Washington D. C, San Diego, Exeter, Singapore.

The Nigerian News Service (June 7, 2009). Transcorp's NITEL Broken Pipe.

Tirole J. (1998). *The Theory of Industrial Organization.* MIT Press: Cambridge, London.

Tirole J. (1999). "Incomplete Contracts: Where do we stand? *Econometrica,* Vol. 67, No. 4, pp. 741-781.

Transparency for Nigeria (October 24, 2011). Five Failed Attempts to Wake up a Sleeping Giant.

Udo B. (April 2, 2003). Atiku, El-Rufai in war of words over controversial Pentascope deal. *The Premium Times, Nigeria.*

Williamson E. O. (1973). Markets and Hierarchies: Some Elementary Considerations. *American Economic Review*. 63, pp. 316-325.

Williamson E. O. (1979). "Transaction-Cost Economics: The Governance of Contractual Relations" *Journal of Law and Economics*, Vol. 22, No. 2, pp. 233-261.

Williamson E. O. (1985). *The Economic Institution of Capitalism*. New York, NY: Free Press.

Williamson, E. O. (1983). Credible Commitments: Using Hostages to Support Exchange. *American Economic Review*, 73 (4), pp. 519-540.

World Bank (2009) *Attracting Investors to African Public-Private Partnerships A Project Preparation Guide*. World Bank, Washington, DC.

World Bank (2010). *Implementation Completion and Results Report: Central Transport Corridor Project*. United Republic of Tanzania. Report No: ICR00001299.

World Bank (2011). *Project Performance Assessment Report: Central Transport Corridor Project*. Report No.: 62433. Public Sector Evaluation Department & Independent Evaluation Group.

World Bank (April 7, 2014) Africa's Growth Set to Reach 5.2 percent in 2014 With Strong Investment Growth and Household Spending. Source: http://www.worldbank.org/en/news/press-release/2014/04/07/africas-growth-set-to-reach-52-percent-in-2014-with-strong-investment-growth-and-household-spending

World Bank/PPIAF (August, 2014). Glossary: *Acronyms used in the Private Participation in Infrastructure Projects Database*, http://ppi.worldbank.org/resources/ppi_glossary.aspx

Yao Y. (2008). Probabilistic Rough Set Approximations. *International Journal of Approximate Reasoning*, 49, pp. 255-271.

Yin, R. K. (2009). *Case Study Research: Design & Methods.* 4th Ed. Thousand Oaks. New Delhi. London & Far East Square: Sage Publications.

Ylikoski P., Kuorikoski J. (2010). Dissecting Explanatory Power. Philosophical Studies, 148(2), pp. 201-219. Source: DOI 10.1007/s11098-008-9324-z.

Ylikoski, P. (2007). The idea of contrastive explanandum. In J. Persson & P. Ylikoski (Eds.), Rethinking Explanation, pp. 27–42. Dordrecht: Springer.