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PHD

The performance of traditional and non-traditional forms of infrastructure procurement options in Africa

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ABSTRACT

Africa's infrastructure financing deficit has been large for most countries for a considerable amount of time. Many African countries have historically depended on their government's resources to meet the important infrastructure needs. However, public finances are wholly insufficient to meet the growing infrastructure financing gap. Financing sources for infrastructure can be broadly delineated in public, private and donor sources. A growing source of infrastructure procurement is through public private partnerships (PPPs).

The underlying rationale for a procurement approach is that it must offer value for money in terms of the outputs provided when compared with the investment made. There is a prevailing notion the PPPs provide greater value for money than projects implemented by governments through their own financial and technical means. This view has been strongly advocated by the developed markets and adopted in developing countries. Thus, the growing adoption of PPPs in Africa has been adopted based on this rationale that PPPs offer greater value for money. However there is a limited evidence base of empirical studies confirming that this notion holds in Africa.

This dissertation focuses on examining whether this well argued notion holds true in reality in Africa. Firstly, it assesses the framework by which value for money should be considered – either through a narrow shareholder or a broader stakeholder view, Secondly, the study assesses the drivers for value for money for PPP and government projects. Importantly, the study interrogates the evidence base of PPP and government projects to determine whether PPPs have indeed resulted in greater value for money for a sample of infrastructure projects in Africa. Through these lines of inquiry, the study contributes to knowledge by deepening the understanding of how PPP and government procured projects have performed in Africa.

Broadly, the results show that PPPs cannot be categorically said to always deliver greater value for money. PPPs are relevant to the narrow value for money but contrary to expectations have an adverse impact. Certain additional factors, such as the project's cost, sector and scale appear to be more important in determining whether value for money is achieved. Importantly a country's

initial conditions, such as the existing infrastructure endowment, GDP per capita and GDP growth have some relevance to achieving value for money at a project level. Further, the study then identifies the drivers of value for money, showing that not only technical and financial factors are important, but also social and political factors play a role, particularly for government implemented projects. The findings reveal important implications for how infrastructure procurement should be approached, based on a more comprehensive evidence historical base of previous projects, but also drawing on a keen understanding of the drivers of value for money and specific contextual factors such as a project sector, scale as well as the prevailing economic and institutional conditions in a country.

DEDICATION

I dedicate this thesis to my Great God and Saviour who guided me through this thesis and gave me the strength to complete it.

I also dedicate this thesis to my family, my wife Dr. Bemah Barnor as well as my two children Liana and Nathan, without your support achieving this dream would not have been possible. And to my parents Joseph and Marian Barnor, as well as my sister Josephine. Thank you for the support and belief in me.

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A huge note of gratitude to all the respondents that participated in the interviews, sharing of their time, knowledge, wisdom and insight. Any deficiencies are ultimately my own.

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ABBREVIATIONS AND ACRONYMS

AfDB – African Development Bank
AIDI - Africa Infrastructure Development Index
AVE - Average Variance Extracted
CFA - Confirmatory factor analysis
CFI – Comparative Fit Index
CR - Composite Reliability
CSF – Critical Success Factors
DAC – Development Assistance Criteria
DFID – Department for International Development
FI – Financial Institutions index
GDP – Gross Domestic Product
GFI - Goodness of Fit Index
HM – Her Majesty
ICT - information and communication technologies
IDI – Infrastructure development index
IMF – International Monetary Fund
LSDV – Least Squares Dummy Variable
LSDV - least squares dummy variables
ML - maximum likelihood
NFI – Normed Fit Index
OECD – Organisation for Economic Development
OLS – Ordinary Least Squares
PCA – Principal Component Analysis
PFI – Private Finance Initiative
PPI – Private participation in infrastructure
PPP – Public Private Partnership
RMSEA – Root Mean Square Error of Approximation
SEM – Structural Equation model
SRMR – Standardized Root Mean Square Residual
SSA – Sub-Saharan Africa
TP – Traditional Procurement
UK – United Kingdom
VfM – Value for Money

1 INTRODUCTION

The dire position of sub-Saharan Africa's infrastructure endowment has been well documented, with various sources estimating that Africa needs between $130 - $170 billion a year to bridge its infrastructure gap. This figure was recently estimated by the African Development Bank (AfDB) (2016). Public finances, although heavily constrained, continue to be the main source of funding for infrastructure in Africa. As of 2016, approximately 30% of Africa's existing infrastructure needed significant repair (Dykes and Jones, 2016). Arezki and Sy (2016) note that there has been some increase in infrastructure funding as many countries have dedicated 5-6% of their GDP to infrastructure investment.

Infrastructure development is one of the critical pillars necessary to accelerate Africa's economic development. Thus, there is a clear need for a rapid scaling up of infrastructure provisioning in the African region; yet, significant constraints remain, including the financing and procurement challenges faced by most governments (Arezki and Sy, 2016). Financing of infrastructure projects can be structured in a variety of ways to effectively secure the required capital for the project, given a particular level of risk, as well as considering affordability constraints. There are, broadly, three types of infrastructure funding - public sector, donor, private sector sources, with varying degrees of combinations thereof (Arezki and Sy, 2016). While public sector and donor financiers have historically constituted the largest proportion of infrastructure financing in Africa, the contribution from private sector is growing. Recent estimates show that the substantial capital costs of most infrastructure projects are unlikely to be met fully through public sector and donor financing (Gutman *et al*. 2015). Therefore, there is a need to crowd greater amounts of private sector capital into such projects.

1.1 Background of the study

Financing arrangements can be grouped into several procurement approaches. A procurement approach refers to the means through which the design, financing and delivery of an infrastructure project is executed. At one end of the extreme is delivery of infrastructure fully or mostly by the public sector, and at the other end is significant private sector involvement in infrastructure delivery. The two prominent procurement approaches have become broadly termed as Traditional Procurement (TP), where the government finances (through taxes, official development assistance, debt etc.) and owns the asset, and at the other extreme private infrastructure investment, where the private sector finances and owns the asset – termed a

Public Private Partnership (PPP) (Chong and Poole, 2013). The choice of procurement approach for a large infrastructure project may have an impact not only on the future stream of financing costs and contingent liabilities that society is burdened with, but more broadly, on the overall success of the project (Henn *et al*., 2016).

In TP, the government entity is responsible for all key components of the procurement – design, financing, delivery and operation of the asset - the private sector may get involved typically as a delivery agent. The PPP arrangement is an alternative mechanism in which the private sector plays a large role in financing, procuring and managing infrastructure projects. A PPP is a long-term contract between a private party and a government agency, for providing a public asset or service, in which the private party bears significant risk and management responsibility (Arimoro, 2018). It is important to state at the outset that this study is concerned with infrastructure delivery that has a direct link to a specific infrastructure project/asset – project finance transactions. There are a range of other financing mechanisms that follow a more corporate financing approach – e.g. privatization of a state-owned utility, which is not the focus of this research.

There are various definitions and forms of PPPs, however one of the most widely used definitions has been provided by the OECD. This definition aims to distinguish PPPs from traditional procurement methods based on the extent of risk transferred to the private sector:

'*One can define a public-private partnership as an agreement between the government and one or more private partners…according to which the private partner delivers the service in such a manner that the service delivery objectives of the government are aligned with the profit objectives of the private partners and where the effectiveness of the alignment depends on a sufficient transfer of risk to the private partners'* (OECD, 2008).

Arimoro (2018) provides a useful set of conditions that a transaction must meet to be termed a PPP – (i) there is a transfer by the public authority of land, property or a facility to a private sector entity (ii) the private sector entity builds or renovates a facility (iii) the public sector entity specifies the operating services of the facility (iv) services are provided by the private sector entity for a defined period (v) the private sector entity agrees to transfer the facility to the public sector entity at the end of the arrangement.

The PPP model has been applied extensively over the last twenty years, with some demonstrable success, particularly in developed economies (Eadie and Miller, 2013). PPPs are gaining traction in developing economies where a significant infrastructure financing gap exists. While TP has historically been the route by which infrastructure projects have been procured in Africa, increasingly, many African countries, backed typically by funding and institutional support from regional and international donor agencies, are exploring PPPs as an infrastructure procurement model.

The important distinction between the two approaches is centred on three core features – ownership, financing/affordability and risk (Arimoro, 2018). In TP, the three features all sit with the public sector, while in a PPP, these factors sit with the private sector, for a defined period termed a concession (usually 20 to 30 years). The decision about a particular procurement is therefore based on considerations of these factors. Altogether, the assessment of these principles has been captured in the concept of value for money (VfM). VfM has been broadly defined as '*the optimal use of resources to achieve the intended outcomes'* (UK National Audit Office, 2003). Barnett *et al.,* (2010) consider VfM to entail an explicit commitment to ensuring that the best results possible are obtained from the money spent on some investment.

The underlying rationale for any infrastructure procurement option is that it must offer VfM to the procuring entity, as well as the beneficiaries of the infrastructure asset or service. This therefore forms the foundation on which a TP or PPP project must be assessed. While VfM as a concept is applicable to all forms of government expenditure, its need for infrastructure procurement is heightened due to the often-significant upfront investment costs, as well as the long-time horizon of an infrastructure asset's operational period. Thus, the right choice of a procurement option upfront may have an important bearing on the ultimate performance of the project.

There are claims that PPPs provide greater value for money than TP projects (Mott macdonald, 2002; Pollock *et al*., 2007; Raisbeck *et al*., 2010). The underlying rationale for undertaking a PPP has been to provide a public service without incurring significant fiscal expenditure. Furthermore, the strong justification for PPPs put forward by their proponents is that PPPs are a superior procurement option to TP in terms of effectiveness and efficiency (Delmon, 2017; Danau and Vinella, 2015; Hart, 2003; Iossa and Martimort, 2016).

Assessments of TPs and PPPs have been based on two approaches – studies providing theoretical arguments, and secondly studies where a practical assessment of either TP or PPP projects, or in some cases, both, were assessed. The *a priori* position in assessing TP and PPP projects is that PPPs offer greater value for money, particularly in terms of cost and time, due to their relative efficiency and incentives for increased performance by the private party. This study is focused not on the *a priori* arguments but rather establishing the *a posteriori* position of TPs and PPPs based on assessments of actual projects' performance.

Dykes and Jones (2016) assert that Africa has been involved in PPPs for more than 20 years, with approximately 135 PPPs, with a value in the region of US$ 79 million, undertaken between 1993 and 2003. Using this as a base, the number of PPP projects appears to have increased significantly since then. The World Bank reports about 469 PPP type projects in Sub-Saharan Africa between 1990 and 2005. The definition used here is not of projects where a formal PPP was registered, but projects that followed the PPP concept in that a significant amount of private sector financing and participation was involved. As Figure **1** shows, PPP projects have been dominated by the electricity sector, with 64% of such projects in the sector. This is followed by ports, ICT, railways, and roads, in that order.

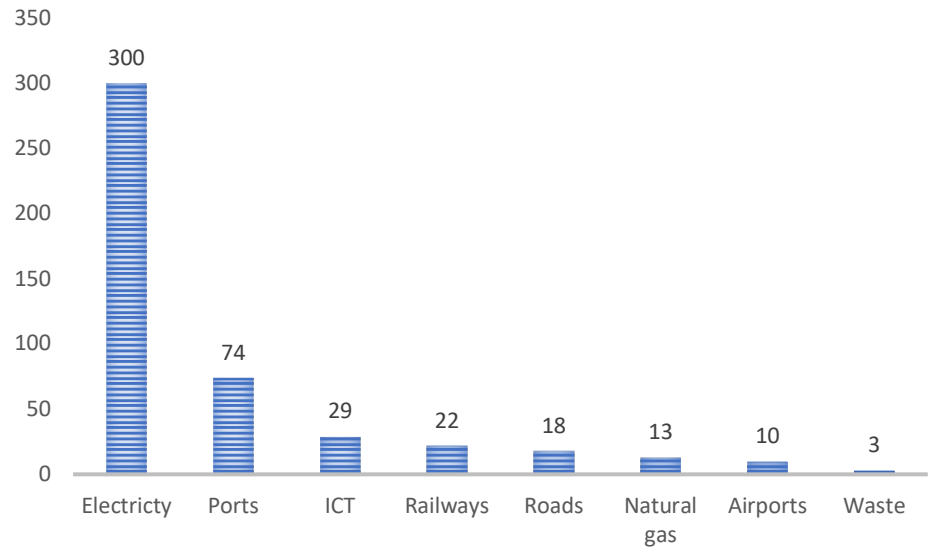


Figure 1: PPP projects in Africa per sector, 1990 - 2023

Source: World Bank PPP Database, 2024

1.2 Research Problem

The rationale for selecting a particular procurement option is that it must offer VfM to the public sector procuring entity in the provision of the key infrastructure asset or service required. This implies that whichever procurement option is chosen must provide the most efficient and cost-effective means of delivering the required infrastructure asset or service, relative to the alternate procurement option. To determine this upfront, a robust assessment of procurement options should be a prerequisite to choosing either the TP or PPP approach. Furthermore, a detailed experience of previous TP and PPP projects should be available to procuring entities, to inform their decision-making processes. However, it appears that the decision of a procurement approach is made more based on a geo-political preference for PPPs, rather than a technical assessment of their performance (Romero, 2015).

Both TP and PPPs have clear advantages and disadvantages. TPs allow the government to retain control of the delivery of key infrastructure projects, but this has been beset with inefficiencies and poor service delivery in many instances. On the other hand, whilst PPPs have gained popularity as a means for public sector institutions to finance much needed infrastructure projects, particularly in developing economies, there are potential drawbacks of undertaking a project through a PPP. This implies that Government decision makers need to have a clear and unambiguous basis on which to select either procurement option for a particular project. Such a basis must be centred on a diagnosis of the prevailing constraints of either approach, plus an assessment of whether the posited proposition that PPPs offer superior value for money to TP has held true in the African context.

The PPIAF (2012) notes that PPPs may "appear" to solve a funding problem for a government, but this may be elusive as the government's fiscal commitments to PPPs may not be immediately explicit. PPPs may result in the government taking on higher fiscal commitments and risk under a PPP arrangement than would have been observed under a prudent public financial management approach. In such a scenario, the anticipated VfM at the feasibility stage of the project is reduced, if not altogether eliminated. In many instances, PPP projects are not bankable[1] without some form of government financial support (Gutman *et al*., 2015). Even in instances where the project itself is commercially viable, many private sector investors require

[1] Bankability implies that the project, on a standalone basis, is able to cover its capital and operational costs, and provide a return to investors

some form of government guarantee to cover any default by the government entity they are entering a contract with or to cover off-takers' possible cash flow shortfalls. Ter-Minassian (2004) stated that ideally a government should be able to gauge the risk to which it is exposed under a PPP contract, and to thereby assess the fiscal implications of such risk. The study notes however, that this is extremely difficult to do, even in the relatively straightforward case of explicit guarantees and subsidies.

A central point made by Sclar (2015) is that the advancement of PPPs has not been purely due to evidence of their superiority to traditional procurement, but more due to a push from the dominant political-economy viewpoint. He notes that given the sizeable political and corporate power aligned to accommodate private investors in PPP arrangements, it should not be surprising that serious transaction cost problems often arise from the increasingly passive public partner (Sclar 2015).

Despite these concerns, and the demonstrated growing preference for PPPs, the performance of PPPs relative to TP projects has not been extensively evaluated empirically, particularly in developing countries, such as in Africa. Even in developed countries, the substantive evidence of a formal evaluation of the relative efficiency of PPPs over TP has not been widespread. Romero (2015) stated that "*UK's National Audit office* has *been unable to identify a robust evaluation of the actual performance of private finance at a project or programme level."* The report further indicated that an analysis of a group of PPP projects in the education sector revealed that the actual project costs were approximately 40% higher than the costs of a project undertaken through government procurement. This calls into question the fundamental rationale for PPPs – value for money. While there has been an extensive discourse on the issues of financing/affordability (e.g. Arezki and Sy, 2016; Gutman *et al*., 2015), much less analytical work has been done on the true value for money for PPP and TP projects over a project's lifespan.

Given these observations, policymakers choosing between PPP and TP options do not have a well-defined scientific rationale for making such choices. These concerns relating to the lack of a robust and extensive assessment of the performance of TP and PPPs as alternative procurement options, highlights a significant gap in the academic literature on infrastructure procurement. This is further exacerbated in the case of African countries, where much fewer empirical analyses have been attempted. To support the further investment of resources into

developing PPPs in Africa, a robust evaluation of their performance, compared to TP is required. This study is an important first attempt to address these concerns in the African region.

1.3 Study Objectives

The purpose of this research is, therefore, to investigate the approaches to determining VfM for PPP and TP projects. While the VfM concept has become common in the assessments of PPP projects, they are in principle applicable to TP projects as well. This assertion is well put by Burger and Hawkesworth (2011), who state that any project, whether it is a PPP or a TP project, should be undertaken only if it creates VfM. Specifically, the research aims to identify whether it can confidently be concluded that PPPs offer greater VfM than TP in Africa.

This study will attempt to provide answers to the following major research questions:

1. What has been the actual performance of TP and PPPs undertaken in Africa to date?
2. What are the key drivers of value for money in TP and PPP projects in Africa?

Based on these research questions, the specific objectives of this study are:

- To perform a comparative analysis of the performance of projects procured under traditional and non-traditional methods in Africa, based on the existing value for money assessment framework.
- To identify and document, the drivers of VfM, associated with the utilization of each of non-traditional or traditional infrastructure procurement options in Africa.
- To propose and test a framework for analyzing value for money for traditional and non-traditional infrastructure procurement methods in the African context.

1.4 Significance of the study

As with most other regions, infrastructure development in Africa was historically driven by traditional procurement, with PPPs emerging as a more recent phenomenon over the last twenty years or so. There is limited literature on traditional procurement, with much more narrative on PPPs. Majority of the discussions on which procurement option is preferred has been based on two positions – a theoretical, neoclassical view of private sector investment as the key route to

economic development and growth; and secondly a drawing from the experiences of PPPs in developed countries.

Dykes and Jones (2016) comment that, to their knowledge, there has been very little empirical publications related to the performance of PPPs in Africa. Most of the available information on PPPs in Africa is based on studies by regional development institutions and policy agencies, rather than scientifically driven inquiries. These studies do not delve into a detailed assessment, backed by theory, of the underlying factors driving the reasons to undertake the selected projects as PPPs, and whether a detailed assessment of PPPs vs TP was conducted prior to choosing PPPs as the preferred procurement approach. Estimating the performance and impact of traditional procurement has therefore been limited to assessing the public expenditure spend on infrastructure.

Given the growing prominence of PPPs as an infrastructure procurement option, particularly pushed by global development institutions, it is critical that an objective assessment of the performance of TP and PPP projects be performed on a substantive scale. It is striking that to date such an assessment has not been conducted, to the best of our knowledge, in the African region. Decisions on which procurement option to use should be driven by an assessment of which option provides better value for money, rather than a notional preference of one option over another.

Furthermore, due to the significant infrastructure deficit facing African countries, it is important that the choice of the procurement method by which the required large and complex projects are undertaken be based on a careful, theoretical and empirical evidence base, rather than primarily on the experience from the developed world. This study aims to significantly contribute to the theory and evidence on the performance of TP and PPP projects in Africa.

This highlights the significance of this research. In addition, the value of the study is that it aims to go beyond the existing simple analytical quantitative comparison of the upfront costs of traditional and non-traditional forms of procurement, which is unlikely to yield novel insights. Rather, the substantive contribution of the study will be to unpack the latent drivers (e.g., socio-political, institutional, economic) underlying the performance of the two procurement approaches and understand how they influence the value derived from each procurement approach to all stakeholders.

1.5 Organisation of the study

The thesis is organised into seven chapters, structured as follows:

Chapter one provides the introduction, background, problem statement, study objectives and significance of the study.

Chapter **two** provides an overview of infrastructure procurement approaches, and then reviews the literature on the performance of PPP and TP, globally and in Africa, noting the gaps in the approaches used to date.

Chapter **three** presents the approaches to VfM measurement, focusing on the VfM analytical specification as well as the common measurement approaches for VfM.

Chapter **four** presents an analysis of the drivers of VfM for PPP and TP projects, based on the Structural Equation Modelling approach.

Chapter **five** provides a quantitative assessment of the performance of PPPs and TPs in Africa to date, utilising a panel regression approach.

Chapter **six** concludes the study by providing a summary of the study, notes the implications of the findings, notes the contribution of the study and highlights area for future research.

2 LITERATURE REVIEW

2.1 Introduction

Assessments of TPs and PPPs have been based on two approaches – studies providing theoretical arguments, and secondly studies where a practical assessment of either TP or PPP projects, or in some cases, both, were assessed. The predominant position in assessing TP and PPP projects is that PPPs offer greater value for money, particularly in terms of cost and time, due to their relative efficiency and incentives for increased performance by the private party. This study is focused not on the *purely assessing the theoretical* arguments but rather establishing a practical evidence base of the performance of TPs and PPPs based on assessments of actual projects' performance. It is however necessary to properly position the theoretical arguments that form the basis on which the practical assessments are based.

This chapter succinctly provides a summary of both the theoretical and empirical literature on VfM as it relates to PPPs and TP. The aim of the discussion here is two-fold – firstly to unpack the findings of these studies in terms of which procurement approach appeared superior and under what conditions, and secondly to outline the analytical/measurement frameworks used in the assessment of VfM. The chapter begins by setting the context of PPPs and TPs, with a discussion on these two procurement approaches, focusing on the advantages and disadvantages of each. The next section presents the theoretical literature, while the final section provides a summary of the empirical literature.

2.2 Infrastructure procurement approaches

Design, financing and implementation of the high initial cost of constructing infrastructure and the subsequent payments for services provided by the infrastructure can take a number of forms. These are captured in what is terms a procurement approach. These different approaches are embedded in either TP or PPP as their basis. In between, there are variants of these arrangements that involve both public and private parties (Chong and Poole, 2013). The traditional view of whether, and to what extent, the government should assume responsibility for the financing and delivery of public infrastructure services has shifted substantially over the last few decades. Calitz and Fourie (2010) argue that the complex decisions regarding infrastructure finance are a function of certain distinctive economic characteristics of

infrastructure – typically a high capital outlay, significant externalities, elements of natural monopoly, and geographic constraints. They assert that all of these affect the nature and extent of government involvement and private sector incentives to commit significant long-term capital to infrastructure investments.

Table 1: Summary of Procurement Approaches

Procurement option		Asset ownership	Operations & maintenance	Capital investment	Commercial risk	Typical duration
TP	Service contract	Public	Public & private	Public	Public	1 – 2 years
TP	Management contract	Public	Private	Public	Public	3 – 5 years
TP	Lease	Public	Private	Public	Shared	8 - 15 years
PPP	Concession	Public	Private	Private	Private	25 – 30 years
PPP	BOT	Public & private	Private	Private	Private	20 – 30 years

Source: Chong and Poole, 2013

Table 1 above provides a brief delineation of the main procurement approaches. The key differentiating features of the various forms of TP and PPPs are the asset ownership, sources of capital investment, the operational and maintenance structure, commercial risk arrangement and duration of the contractual arrangement. We now turn to a brief discussion of the two main procurement approaches for infrastructure – TP and PPP.

2.2.1 Traditional Procurement

Infrastructure has traditionally been seen as a public good, and therefore the burden for provision of a country's infrastructure services has traditionally rested with governments. The prevalence of this approach has led to the term traditional procurement (TP). In TP, the government entity maintains the liability for the financing, construction and operation of the required infrastructure asset. Burger and Hawkesworth (2011) provide a concise description of TP as where the government specifies the quantity and quality of service required, while the infrastructure asset is constructed by private companies to whom the construction is typically awarded through a tender. Once the construction is completed, the asset is transferred to and operated by the government entity. Rebollo (2016) notes that the inclusion of private parties in the construction phase has been a more recent trend. In the past, many governments had their own means for delivering public infrastructure, including their own equipment and personnel.

However currently almost all public works are contracted under a public tender to a private construction company. This traditional model relies on continued government ownership and operation once construction is complete (Makovsev and Veryard, 2016). The involvement of private entities in this form of infrastructure provision is only as a delivery agent.

TP usually takes two forms, a build only contract – where a design has already been completed and a contract is tendered to build the infrastructure asset, or a design-build contract – where a single contract is tendered for both the design and construction of the infrastructure asset. In many countries, this is referred to as Engineering, Procurement and Construction (EPC) (Rebollo, 2016). The contractor designs the required infrastructure to the specifications provided by the public sector entity and constructs the project. Figure 2 below presents an illustration of the relationship between the public sector party and the private party (contractor), in a build only or design-build arrangement.

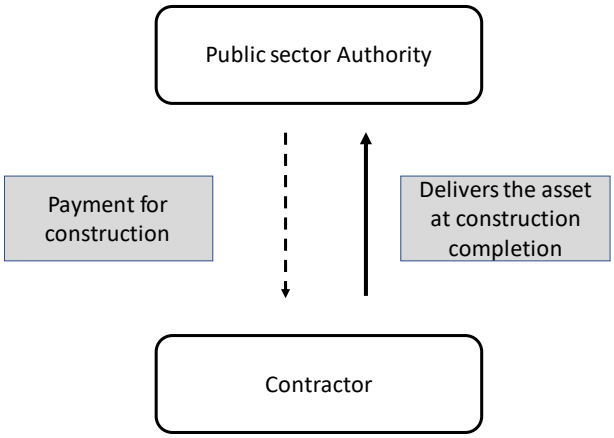


Figure 2: Basic outline of build only or design build TP

The financing for a TP remains the responsibility of the government. Public financing for infrastructure has typically drawn on tax revenues and/or national savings as the basis to provide the required funds for an infrastructure project. These projects are financed on the budget of the country, and the public sector entity with overall oversight for the sector/region in which the infrastructure service is being provided takes on the full responsibility for the financing, delivery and maintenance of the infrastructure service.

There are instances where in a TP, the financing may not be sourced from the public sector budget, but through a range of other financing mechanisms. Chong and Poole (2013) provide

a useful outline of the forms that public financing for infrastructure can take, as either general budget appropriations for infrastructure projects financed through tax revenue or government debt, loans from commercial banks, grants or concessional loans from international development agencies, loans from institutional investors such as pension funds, revenue bonds tied to specific infrastructure projects, or infrastructure investments by government trading enterprises (e.g. National Development Banks). In certain instances, one government may issue a loan/bond to another government to finance an infrastructure project. This has usually been under the condition that the executing parties are from the lending country. China has been the main proponent of such financing to African countries.

Pros and cons of TP

There are certain obvious advantages for a government to undertake a TP. The first is that the government maintains control over the project at all phases of the project's timeframe, from design, construction, through to operation. However, while this is in principle advantageous, one concern with the TP approach is that the flexibility it affords the public sector entity to change the scope of the project during construction potentially creates moral hazard by making it easier for public sector project sponsors to conceal the true costs/benefits of a project during the project selection stage where a number of different projects are been considered for investment (Flyvbjerg *et al*., 2002).

One of the key advantages of TP relates to the transaction costs associated with executing a project. TPs generally have a low cost of tendering to contractors. The public sector entity retains most of the risk of cost or time overruns and also controls the possibility of changing the scope of the project during construction, with relatively small transaction costs.

While TP enables the government to allocate its limited resources to meet its most pressing needs, the decision of which project to fund is often not driven by key project specific measures, such as efficiency and value for money, but rather by greater political considerations. Yoshino and Hirano (2010) caution that distortions in budget allocation may result in inefficient allocation of capital. Politicians are likely to favour the construction of infrastructure projects in their constituencies to benefit their voters, rather than making allocative decisions purely based on economic and project specific criteria.

In terms of financing for TP, in general, due to the lower cost of government debt versus private sector financing, public financing, TP in theory at least, is expected to have certain advantages of private financing. Platz (2009) cautions that while project/revenue bonds can be an attractive financing mechanism for SOEs and municipalities, they may result in impracticable profit-making pressures on the issuer, particularly in a developing country context.

A primary drawback of TP is that the public sector retains the risk for the overall project, both financing, design, construction and operation risks. A further downside is that there is often no link between the efficient operation of the project, and financial payments. The efficient operation and maintenance of the project is more a function of a socio-economic imperative of the public sector entity, rather than a financial rationale.

2.2.2 Public Private Partnerships (PPPs)

PPPs have become an important vehicle for financing, implementing and operating public investment projects, particularly in developing economies where a significant infrastructure financing gap exists. PPPs may be used for the provision of new infrastructure but can also be used for upgrading and/or managing existing public infrastructure assets. In most PPPs, there is a financial contribution in some form from both the private and public-sector parties. The private sector usually bears the upfront capital costs or ongoing operation and maintenance costs; the government may pay for the service provided, provide the land required or contribute to the provision of further assets required to support the core infrastructure at the centre of the project. It must be noted that not all projects are suitable to be structured as PPPs. Projects being considered for PPP arrangements must be carefully assessed to ensure that the potential for private sector participation is clearly demonstrated, particularly when countries are in their infancy of developing and implementing successful PPP projects.

There are four core characteristics of PPPs:

- PPPs are based on long-term agreements with significant capital investment by the private sector (and public sector in certain instances);
- the agreement is framed by a set of clearly outlined, measurable outputs that define the required service availability and quality;
- the private company receives a revenue stream – either from users of the infrastructure asset or the government;

- risk allocation between the government and private party is clearly outlined and legally enforceable (National Treasury, 2005).

The rationale for undertaking PPPs is that they offer value for money to the public sector in the provision of key infrastructure and furthermore afford the public sector the opportunity to transfer risk to the private sector. Three principles therefore form the core foundation for PPPs:

- Affordability considerations for the public-sector partner
- Risk transfer
- Value for money

These three concepts are inherently linked, with affordability and value for money being the two upmost considerations. Extensive discourse has been provided on the issues of affordability, but much less analytical work on the best approaches to determining value for money, and equally as important, what the true value for money is over a project's lifespan. The risk transfer assessment forms a critical component of the value for money determination and is therefore assessed within the broader value for money framework.

Eadie and Miller (2013) provide a useful history of the evolution of PPPs, noting that the United Kingdom (UK) can be considered as a pioneer in the progress of PPPs from its inception as far back as the 1660s in infrastructure development. They note that while the PPP concept has been in existence for centuries, it gained prominence in the late 1970s through the UK Conservative government, who initially focused on contracting out service operations and, thereafter, leading to the private finance of public sector activities on a broader scale. This has more broadly become crystallised in the PPP transactions seen across the world today. This historical view is supported by research from Spackman (2002); Allen (2001) and Weiche (2008) amongst others.

It is important to note that not every arrangement to deliver infrastructure between a public and private entity may be termed a PPP. For instance, a management contract or outsourcing of a public facility does not fall within the formal confines of a PPP, these are TP arrangements as described above. Arimoro (2018) provides a useful set of conditions that a transaction must meet to be termed a PPP – (i) there is a transfer by the public authority of land, property or a facility to a private sector entity (ii) the private sector entity builds or renovates a facility (iii) the public sector entity specifies the operating services of the facility (iv) services are provided

by the private sector entity for a defined period (v) the private sector entity agrees to transfer the facility to the public sector entity at the end of the arrangement.

Figure 3 presents a spectrum of the type of transactions that can be classified under the PPP banner, with a brief description in the subsequent Table 2.

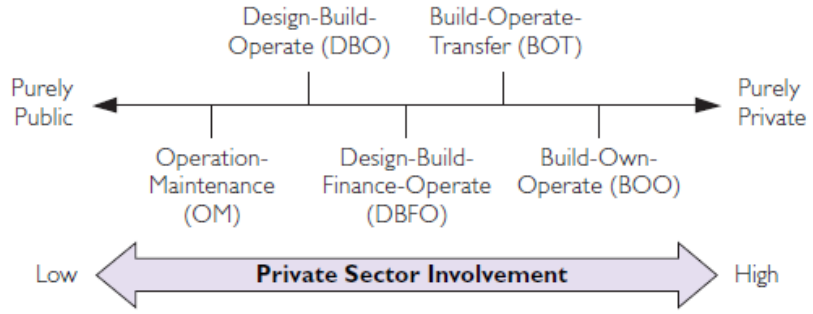


Figure 3: Spectrum of PPP categories

Source: Kwak et al. 2009

Table 2: Forms of PPPs

Transaction Type	Description
Operation–Maintenance (OM)	• The private sector is responsible for all aspects of operation and maintenance • Although the private sector may not take the responsibility of financing, it may manage a capital investment fund and determine how the fund should be used together with the public sector
Design-Build-Operate (DBO)	• The private sector is responsible for the design, construction, operation and maintenance of a project for a specified period prior to handing it over to the public sector
Design-Build-Finance-Operate (DBFO)	• The private sector is responsible for the finance, design, construction, operation and maintenance of a project for a concession period • In nearly all cases, the public sector retains full ownership over the project
Build-Operate-Transfer (BOT)	• The private sector is responsible for the finance, design, construction, operation and maintenance of a project for a concession period • The asset is transferred back to the government at the end of the concession period, often at no cost
Build-Own-Operate (BOO)	• The private sector retains the ownership of the asset in perpetuity • The government only agrees to purchase the services produced for a fixed length of time

Most discussions of PPPs refer to DBFO and BOT transactions, where the private party plays a significant role in the financing, construction and operation of the project, and where this is for a defined period after which the asset returns to the control of the public sector authority. The design and operational terms are based on a service level definition (an output specification) set by the procuring entity.

Pros and cons of PPPs

The advantages of PPPs have been well documented by advocates for PPPs. In economics it has long been theoretically argued (and empirically established under certain contexts) that the performance of private ownership in a competitive market is superior to public ownership (Meginson and Netter, 2001). The main advantages of PPPs that are commonly posited are the bundling of infrastructure contracts, crowding in private sector investment into infrastructure, enhanced innovation, transfer of risk, and greater efficiency in infrastructure delivery. Delmon (2017) summarizes the purported advantages of PPPs – improved prospects for delivering projects on time and budget; increased innovation and competition leading to better design, a focus on minimizing lifecycle costs and managing lifecycle risks; a greater emphasis on project evaluation and due diligence; and a focus on value for money as the main criterion for choosing projects to be delivered by the PPP procurement option.

Chong and Poole (2013) argue that there are two main expected advantages of PPPs, compared with provision of infrastructure by governments. Firstly, the private party can be expected to deliver projects on time and at a lower cost over the life of the asset, and secondly the involvement of the private sector allows governments to pursue projects even when facing short-term fiscal constraints. While there is consensus that the second reason is a valuable approach, there is less agreement that the private party can always be expected to be more efficient in delivery than the public sector. Other noted advantages of PPPs relate to the building of infrastructure contracts, crowding in private sector finance, leverage private sector innovation and the efficient transfer of risk. These are discussed briefly below.

One of the most common arguments put forward as a rationale for PPPs relate to the efficiency gains of bundling the various project phases, from design through construction to the operation and maintenance. The argument is that given the synergies between project phases, bundling and endogenous risk transfer incentivize the private party to minimize the lifecycle costs of the project. (Hart, 2003; Iossa and Martimort, 2016). This is one of the key components of a PPP

that differentiates it from a TP. Whilst a TP project may use a private party as a delivery partner, with a PPP, the separate design, build, finance and operate mandates are combined into one contract Grimsey and Lewis (2007).

One of the key values of PPPs, particularly in the context of the burden of a high capital-intensive infrastructure project, is the financing that the private party can mobilize and deploy. PPPs provide an opportunity to leverage private sector resources to develop the public infrastructure the country needs. One of the primary differences between a PPP and TP, is that the private party in a PPP takes on the upfront financing responsibility for the project, in return for a claim on the revenues of a project. PPPs permit investors to potentially claim revenues from three separate sources – returns on invested capital, equity appreciation, and fee income as the project service manager (Shaoul *et al*., 2012).

Under the fulfilment of certain conditions, it has been argued that such PPP financing, by leveraging private sector capital, does not increase the public debt – they are considered as off-balance sheet for public accounting purposes (Makovsev, 2013). While this is one prominent argument for PPPs, there are dissenting views on whether this is entirely true. Di Liddo and Vinella (2019) argue that the common assertion that PPPs relieve public budgets is deceptive, since although account measures allow for liabilities to be hidden, they remain as contingent liabilities and offer require government guarantees, which are accounted for in future budgets.

One of the strongest arguments for PPPs is that it provides a scope for improved innovation in the design and construction of infrastructure assets, thereby resulting in overall improved service quality (Yescombe, 2007; Engel *et al*., 2014). The scope for improved innovation is attributed firstly to the fact that the PPP tendering process is undertaken on the basis of an output specification of service requirements rather than a prescriptive input specification, the private sector has more freedom to innovate, and also that the long term nature of the contracts encourages the use of designs that reduce the life-cycle operating costs (Audit Commission, 2003, Roumboutsos and Saussier, 2014). Oshea *et al*., (2019) however contend that this notion has failed to be proven empirically. They cite some studies (Eaton *et al*., 2006; Leiringer 2006; Barnow and Koberle-Gaiser, 2008; Winch 2012; Rouboutsos and Saussier 2014) which have examined the argument about greater innovation in PPPs and have produced no clear consensus in favour of this argument.

The notion of risk transfer is central to the PPP structure. In principle, PPPs transfer risk to the party best able to manage it. Under a TP project, most project risks are borne by the public procuring authority, whereas with a PPP, the various risks are identified and contractually allocated to the party best suited to manage them (Cooper *et al*., 2005). According to Burger and Hawkesworth (2011), this implies that the party best able to manage a risk is either in a position to prevent a risk from realising (ex-ante risk management) or is best able to manage the results of realised risk (ex post risk management), whichever option is the cheapest.

Despite the growing prominence of PPPs, its implementation has experienced some drawbacks requiring critical attention. These include the high costs of such transactions. Lengthy procurement processes, lack of appropriate skills, unattractive financial markets, incomplete risk transfer and high end-user charges (Osei Kyei and Chan, 2014). Makovsev (2013) asserts that given the posited strengths and weaknesses of PPPs, the question of whether they meet the expectation of superior performance over traditional procurement is still open. He argues that the true test would be an analysis over the entire project life cycle but concedes that due to the large timespan of such projects, such data is still scarce, and ex-post empirical analysis have not been made.

Sclar (2015) notes that the emergence of the PPP approach reflects the anti-statist ideology that begun to dominate policymaking in the late 1970s. Previous approaches presumed a strong state actor competent to carry out complex social tasks such as public infrastructure service delivery. In his view, the rationale for PPPs invariably embeds an indictment of public sector competence by anecdote and ideology. The extent to which this has been observed in practice, in the African context, is a core objective of this research.

A central point made by Sclar (2015) is that the advancement of PPPs has not been purely due to evidence of their superiority to traditional procurement, but more due to a push from the dominant political-economy viewpoint. He notes that given the sizeable assemblage of political and corporate power aligned to accommodate private investors in PPP arrangements, it should not be surprising that serious transaction cost problems arise from the increasingly passive public partner. (Sclar, 2015).

In terms of disadvantages, the main ones noted for PPPs are that they tend to be more expensive, they result in contingent liabilities, there is often incomplete risk transfer, and the

procurement process is extensive, complicated and costly. These drawbacks are discussed briefly below.

One disadvantage of PPPs is that while they bridge the financing gap of the public sector to undertake large infrastructure investments, they tend to be more expensive than traditional procurement. The IMF (2019) noted that the financial cost of private capital can be significantly higher than the cost of government debt, and further, the administrative costs are often much higher in PPPs through procurement costs etc. However, Grimsey and Lewis (2007) argued that the argument about PPPs having a higher financial cost than TP projects is flawed. In their view, this does not take into consideration the risk of the project. They contend that PPP projects build this risk into their cost of funds, whereas the financial cost of TP projects, based on the government's cost of borrowing does not.

The balance of the greater cost of PPP projects versus the transfer of risk has become a central discussion point. Pollock *et al.,* (2007) note that the UK Government accepts that private finance is more expensive than conventional procurement, but the Government argues that the extra costs of private finance are offset by the transfer of risk and responsibility for performance to the private sector.

Although a PPP contract aims to provide as much fiscal certainty as possible over the contingent period, the risk analysis and contracting process imposes certain fiscal commitments and contingent liabilities on the public-sector institution, and typically the country's Ministry of Finance. This provides guarantees to the private sector party in the case of certain defaults in key contracting terms. PPPs therefore impose a fiscal obligation and exposure to the government. A government's exposure to PPP fiscal risk varies widely across projects. Ter-Minassian (2004) stated that ideally a government should be able to gauge the risk to which it is exposed under a PPP contract, and to thereby assess the fiscal implications of such risk. She notes however, that this is extremely difficult to do, even in the relatively straightforward case of explicit guarantees.

Critics of PPPs note that there is often no substantive risk transfer under a PPP, just the pricing in of risks by the private sector. Froud (2003) argues that certain risks are only 'theoretically' transferred to the private party. This is because in the event of a significant breakdown in the service required, the public authority would be required to step in, as it cannot allow the lack

of service delivery to the public. Further Demirag and Khadaroo (2009) notes that often in practice, risks are not always managed and are simply insured or hedged against, which in turn adds cost to the project, as the cost of the risk insurance is priced into the cost of the project to the public or government.

PPP projects are also known to take a long time in the procurement phase prior to construction. This is due to the time taken to agree on issues related to the bid specifications and legal arrangements, risk transfers arrangements and payment terms acceptable to both parties. The average procurement time for PPP projects was estimated at around 22 months in the UK and 12 – 18 months in Australia by Grimsey and Lewis (2007).

The above discussion has provided an overview of TP and PPP procurement approaches and presented the key advantages and disadvantages of each procurement option. One of the earliest theoretical comparative assessments of TP and PPPs was conducted by Grimsey and Lewis (2007). They argue that the difference between the two procurement approaches can be narrowed down to the extent of responsibility and accountability. With TP, their view is that the government operates largely in an environment removed from the economic signals to which a private entity would be exposed. This is because the government's cost of fundraising bears no relationship to the project's risks or likely success of failure. The limitation of this argument by Grimsey and Lewis (2007) is that it only applies where the source of funding is the government's budget, or a general obligation bond. Their argument does not hold where the source of finance is related to the specific project, as is the case with a project bond. Grimsey and Lewis (2007) further argue that with TP performance outcomes can be swept under the administrative mat, and the key individuals involved are often insulated from the consequences of poor performance of the project.

2.3 Theoretical literature

The foregoing narrative has shown that there are a range of advantages and disadvantages of TP and PPP projects. Discussions of the TP and PPP concepts have been driven more by their practical application, rather than by an academic/theoretical grounding. As such, no single dominant economic theory has been conclusively determined as the underlying framework on which these procurement approaches have been established. There has been limited research into the theoretical underpinnings of PPPs. From a review of the available literature, most

research has focused more on the structural and practical applications of the concept, rather than attempting to ground PPPs or TPs in a theoretical home. That being said, when looking at the relationships and incentives that underlie infrastructure procurement approaches and VfM, two theoretical frameworks are deemed relevant – the principal-agent framework, and the theory of value.

2.3.1 A Principal – Agent framework

Where a theoretical justification has been posited, the most relevant appears to be the Agency Theory. This is understandable given that the procurement approaches are underpinned by the relationship between the procuring entity and the party engaged to deliver the infrastructure asset. Given that the focus of this research is on a practical examination of the performance of PPP and TP projects, this main theoretical position is summarized below but not interrogated in detail in terms of an extensive theoretical discourse.

The Agency theory deals with a specific social relationship – delegation, in which two actors are involved in an exchange of resources (Braun and Guston, 2003). The principal is the actor who holds of a number of resources but not those of the appropriate kind to fully realize his interests (e.g. has money but not the appropriate skills). He or she therefore needs the agent, who accepts these appropriate resources and is willing to further the interests of the principal (Braun and Guston, 2003). The principal-agent theory finds it home in the broader agency theory of the new institutional economics paradigm.

Raganelli (2007) notes that at the heart the principal-agent theory is the assumption that each member of society depends on others to exercise his functions. These bilateral relations are marked by the presence of information asymmetries which make the principal-agent contract necessarily incomplete, enabling the agent to pursue private interests possibly conflicting with those of the principal. Principal-agent problems arise when a supplier is contracted to provide a service (agent), where it is not in the agent's interest to deliver the service to the standard or in the manner that the procurer (principal) of such service would want (Shrestha and Martek, 2014).

The principal has two main issues in relation to the agent: first that of selecting the best agent, and second that of ensuring that the agent carries out the service to the required standard. With

the first, the principal usually does not have sufficient information on the abilities of potential agents to find the one best suited to do the task – this is the adverse selection problem. On the second issue, the principal does not know for sure if the agent will really do his best when delegated certain tasks – this is the moral hazard problem (Braun and Guston, 2003, Shrestha and Martek, 2014). Shrestha and Martek (2014) summarise the principal-agent issue as arising from information asymmetry that is maintained because of an environment of conflicting interests. Both parties use undisclosed information to gain advantage over the other in matters such as quality of service, risk allocation and pricing.

In relating the principal-agent theory to infrastructure procurement, the government is the principal who seeks a supplier as the agent for the delivery of a project. In the context of TP, the agent is usually a private contractor, thus the private sector party is purely a delivery agent who provides the necessary infrastructure to the design specifications of the principal and is also usually not responsible for raising finance. However, in PPPs the private agent plays a much greater role (designing, financing and operating for an extended period), increasing the relevance of principal-agent dynamics to PPPs in particular. The principal-agent theory is quite relevant to PPP projects given that while private participation off-sets the governments financing burden, it also puts the private party in significant control of the project, inviting actions that siphon off benefits to themselves at the cost of the government, whose interests they are supposed to serve (Greiling, 2009).

The principal-agent theory provides a useful framework for assessing the decision to be made by the public sector procurer of an infrastructure service (the principal). Essentially, the choice is which agent – either a public sector entity and/or private contractors, or a private agent who finances, builds and operates the asset for a defined concession period. Several past studies have investigated principal-agent relationships in PPPs. Hart (2003) and Greiling (2009) use the principal-agent theory to look at transaction costs in PPPs. Others like De Palma's *et al*. (2009) and Shrestha *et al*., (2013) have used principal-agent theory to look at risk allocation. Mu *et al*., (2010) explore strategic behavior of the private sector in PPP transport projects in China where they find moral hazard problems.

Though PPPs are defined as partnerships, some aspects of PPPs do not sit within the traditional norms of partnerships where the two partners work together in achieving the same goals and where the profits as well as risks are shared (De Palma *et al*., 2009). The government may

implement PPP projects for the purpose of improving social benefits and economic development. Private firms may not share these goals as a priority and are motivated by profit and consequently may focus more on innovation and efficiency. On the other hand, private firms may also favour reducing short-term expenses which can lead to cost-cutting and reduced outcomes (Shrestha and Martek, 2014).

The drawback in applying the principal-agent theory to infrastructure procurement is that it assumes a benevolent principal (government procurer) whose sole objective is a well delivered infrastructure project. This is however not the case in many instances. There are several factors and incentives driving the objectives of the principal, for instance political pressures, which influence the principal's selection of a procurement approach, as well as how they monitor and judge the performance of the agent. Consequently, a wholistic evaluation of which of the two approaches is most suitable to deliver infrastructure projects in Africa, must take account of the potential opportunism of the principal, and account for that in the decision-making process. These issues lead us to the question of how to determine which agent will be most suitable, and further how to determine the drivers of success of an agent's service (technical, financial, political and social).

2.3.2 The concept of value

The starting point of developing an effective assessment of any project is a clear determination of the strategic objective and measure of success of the project. Infrastructure projects can be said to have a common strategic objective, regardless of the financing option – the achievement of best value, which encompasses concepts such as effectiveness, efficiency, and performance standards (Akintoye *et al*., 2003; Zhang, 2006; Lui *et al.*, 2014). The rationale of best value implies balancing the general requirement for quality and efficient public infrastructure and services, with a cost-effective financing and procurement structure.

The starting point is therefore the question of 'value', and what this implies. The traditional view of value creation examines how companies create value by using resources to make products to be sold in the market. In the value creating chain, actors are subcontractors, vendors, employees, and sales agencies, to mention a few (Kujala *et al*., 2019). From a theoretical standpoint, it raises the question of how is such value determined? In neoclassical theory, economic value is generated by the sum of consumer and producer surplus. Consumer

surplus is defined as the difference between the highest price that consumers would be willing to pay for a good or service and the price they actually pay, while the producer surplus is the difference between the price at which sellers actually sell and the cost of the resources employed (Argandona, 2011). While this standard approach has been widely accepted, it presents a narrow view of the concept of value, limited to a monetary return.

Lui *et al*., (2014), assessing this concept of value from an infrastructure perspective, argues that that the true determination of value focuses on overall outcomes achieved, covering a wide range of issues within quantitative and qualitative contexts, such as whole life costs, service quality, environmental and social benefits, sustainability and maintainability of the service. At the heart of this assertion is the notion of who value accrues to. The key question is, therefore, value to whom? This leads to the discussion of two alternative views on measuring value – the shareholder value theory vs the stakeholder value theory.

Shareholder vs Stakeholder value

Shareholder value theory as argued by Friedman (1970) states that a firm has one objective – to use its resources to engage in activities designed to increase its profits. The shareholder value theory is well established, particularly in corporate finance theory. The main principle of this theory is the concept of profit/value maximization. Value maximization says that managers should make all decisions so as to increase the total long-run market value of the firm. Total value is the sum of the values of all financial claims on the firm – including equity, debt, preferred stock, and warrants (Jensen, 2001).

Mansell (2013) argues that the profit maximization approach as the core theme of the shareholder value theory, is because management of the firm is bound to pursue shareholder interests by an obligation intrinsic to the principal-agent relationship. In summary, the sole objective of the agent (firm) is to deliver value as measured by the principal (the government 'shareholder'). This position is confirmed by the work of Sternberg (2004), Marcoux (2003).

The most referenced argument in support of the shareholder theory is Friedman (1970): '*There is one and only social responsibility of business – to use its resources and engage in activities designed to increase its profits so long as it stays within the rules of the game, which is to say, engages in open and free competition without deception and fraud*."

Mansell (2013) argues that the shareholder theory is built on three postulates: there exists a moral right to property; the relationship of the shareholders to the business is the same as an individual to his/her property; and thirdly that the relationship of the shareholders to management is one of a voluntarily entered contract, where management takes on the delegated responsibility for the property of the shareholders. Building on this, Mansell (2013) contends that there is therefore only one responsibility of management (the agent) – act in accordance with the wishes of the property owners, which will usually be to maximise the value of that property, or to maximise profit as the means to achieving this end.

The shareholder theory therefore defines value linked to a narrow definition of the principal – the shareholder. Value in this instance is therefore limited to what the shareholder perceives it to be, usually a monetary return for a service rendered. The main critique of the shareholder view is that it does not sufficiently consider the needs and expectations of a broader group in society. Due to its primary focus on the shareholder, it justifies the focus on profit maximization without paying attention to societal outcomes (Kujala *et al*., 2019).

Since the early 1990s the normative justifications of shareholder theory, have been criticised in a growing body of literature known as 'stakeholder value theory' (Mansell, 2013). In this alternative stakeholder theory, the concept of value creation implies that all those who create or capture value, or who in their relationship with the firm assume risks, either inside the firm (owners, managers, employees) or outside the firm (consumers, suppliers), or who suffer the impact of the firm's externalities or misinformation (local community, environment, future generations, society at large) must be considered stakeholders (Argandona, 2011). Stakeholder theory, the main contender competing with value maximization, has its roots in sociology, organisational behaviour, the politics of special interests, and managerial self-interest (Jensen, 2001).

Stakeholder theory says that managers should make decisions to take account of the interests of all stakeholders in a firm. This implies that in effect the value derived must account for as many stakeholders as is feasible. Stakeholders include all individuals or groups who can substantially affect the welfare of the firm: not only the financial claimants but also employees, customers, communities and government officials – and under some interpretations, the

environment, terrorists, blackmailers and thieves (Jensen, 2001). This broader approach is the key departure of stakeholder theory from shareholder theory.

Kujala *et al*., (2019) note that over the years, the stakeholder approach has been established as an important approach in conceptualising the relationship between business and society. The approach has been used to examine multiple phenomena in various fields such as strategic management (e.g., Haksever *et al*., 2004; Harrison *et al*., 2010; Sachs & Rühli, 2011), corporate responsibility (e.g., Sachs & Maurer, 2009; Smith & Rönnegard, 2016; Strand *et al*., 2015), business ethics (e.g., Phillips, 1997; Purnell & Freeman, 2012; Wicks, 1996), international business (e.g., Lehtimäki & Kujala, 2017), and non-profit organisations (Heikkinen *et al*. 2018).

In discussing value creation for stakeholders, Kujala *et al*., (2019) cautions that this is a complex concept with different dimensions. Mele and Colurcio (2006) identified five value dimensions: customer value, human resource value, shareholder value, firm value, and societal value. Lerro (2011) presented four stakeholder value dimensions: economic value, socio-cultural value, environmental value, and knowledge value.

The main contention between stakeholder theory and shareholder theory is that in the shareholder value theory, the firm has the primary duty to maximise shareholders value, whilst stakeholder value theory argues that the shareholders financial interests must be balanced against interest of other stakeholders such as employees, customers and the local community (Smith, 2003). Jensen (2001) states that the comparison between the two theories is based on two questions – should the firm have a single value objective? And secondly should that objective be value maximization or something else e.g. maintaining employment or improving the environment?

While both the shareholder and stakeholder theories speak primarily to a corporate finance structure of a firm with shareholders and stakeholders, we argue that there is applicability to an infrastructure procurement transaction. The firm here is the implementing agent of the infrastructure service, responsible for the construction and/or operation of the asset for a defined period. In TP this may be a government entity or private subcontractor, whilst in a PPP this is the Special Purpose Vehicle (SPV) created by the private party, which has as its sole mandate the execution of this project. This party essentially operates like a ‘corporate firm’

with similar structures and incentives. Ultimately, the profit maxisimisation objective is the most important similarity that allows the corporate finance firm approach to value to be applied to infrastructure procurement. Thus, in the narrative above, where the 'firm' is referred to, one may easily align this to the infrastructure implementing agency.

The above concepts of value have been crystalised in the infrastructure procurement literature into what has been termed 'value for money', and the discussion on whether a narrow (shareholder) or broader (stakeholder) view should be taken when measuring value in VfM. The narrow value for money notion argues that value for money is simply where a PPP project is delivered more efficiently (in terms of cost, time and outputs) than a TP approach. The focus is on the monetary value that the shareholder derives by choosing a particular procurement option. This monetary value is measured mainly in terms of profit gained or cost savings to the shareholder by pursuing a particular procurement option.

However, the use of absolute revenue/cost and time quantitative measures only may be deemed as an insufficient means to measure the complexity associated with infrastructure projects, particularly PPP projects (Lui *et al*., 2014). More recent discussions have highlighted the importance of a broader value for money framework. This has particularly been in studies such as (Liu *et al*., 2014; Henjewele *et al*., 2011; and Yong, 2010). This is confirmed by Decorla-Souze and Lee (2013) who argue that the narrow definition of VfM excludes benefits that may accrue from the project to other levels of government, users of the service provided by the project, as well as potential benefits to non-users – in essence the externalities of the project. These studies are essentially arguing that the term 'value' in the value for money assessment must be seen as a broader perspective of value, akin to the stakeholder theory of value.

It is important therefore to evaluate value for money not only from this narrow financial point of view, but also more broadly from the point of view of social returns. For instance, one can evaluate roads infrastructure not just by evaluating its NPV (financial analysis focusing on, say, value loss avoided when perishable goods arrive in the markets on time) – a narrow stakeholder view of the principal, but also by evaluating its social impact/welfare effects such as employment creation, lives saved when people reach hospitals timeously etc – a broader shareholder view of the principal.

2.4 Empirical literature

2.4.1 PPP and TP performance globally

Based on the above discussion on the theoretical frameworks and the pros and cons of TP and PPP projects set out above, it is critical for public sector agents to have a clear basis on which to select a particular procurement option, hopefully driven by a clear assessment benchmark and previous evidence of the performance of these procurement options. Policymakers recognize that the choice of financing approach not only influences the future stream of financial commitments and contingent liabilities that the government and society is burdened with, but also impacts on the success of projects (Henn *et al*. 2016). However, Chen *et al*. (2016) notes that the choice of infrastructure financing model is often driven by public debt limitations, or a default approach to maximize private sector financing. The implication of this is that many procurement approaches are not being thoroughly investigated by public sector decision-makers prior to embarking on financing decision for a particular infrastructure project. This view is confirmed by Burger and Hawkesworth (2011) who argue that across several OECD countries they surveyed, many do not have clear criteria to identify how projects get to be either a TP or PPP. It is often left to the discretion of line departments and so-called project champions to make this decision.

There is a myriad of studies that have assessed the performance of either TP or PPP projects separately, within a specific context, region and or sector. Majority of these studies have focused on PPP projects, due to their growing prominence and have assessed a range of issues including the legal and regulatory context, institutional arrangements, contracting and procurement issues, and financing considerations (see Table 3 below). While these have provided very useful outcomes, their results have focused on mechanisms to improve the specific procurement approach under consideration, rather than answer the critical question of whether that approach is superior to the alternative means by which that specific infrastructure project/asset could have been procured. Oshea *et al.,* (2019) assert that although there is a breadth of literature on the use of PPPs, there is 'still a distinct scarcity' of studies that compare the performance of PPPs relative to more traditional forms of public procurement.

The focus of this research is on this latter question; hence the review of relevant studies focuses on assessments where TP and PPP projects were compared together, drawing inferences on which approach emerged more suitable.

Table 3: Summary of comparative studies

Study	Sector	Country	Years examined	Study type	No. of projects examined	Measurement metrics	Stage of examination	Results
Mott MacDonald (2002)	Building & civil engineering works	United Kingdom	1981 - 2001	Consulting report	50	Time and cost	Ex-ante commercial operation	Found that TP more likely to exhibit optimism bias and underestimate construction time and costs. Validity questioned by Pollock et al. (2007)
Pollock *et al*. (2007)	Building & civil engineering works	United Kingdom	1981 - 2001	Academic	50	Time and cost	Re-examination of Mott MacDonald (2002)	No evidence to support the claims of Mott MacDonald (2002) that PPP performs better than traditional procurement on time and cost
Audit Commission (2003)	Schools	United Kingdom	1997 - 2003	Audit report	18	Time, cost and quality	Commercial operation	No evidence that PPP delivered schools quicker or better designed than traditional procurement. No improvement in cost savings or facilities management quality
Blanc-Brude *et al*. (2006)	Road	European Union	1990 - 2005	Academic	227	Cost	Ex-ante commercial operation	Ex-ante PPP costs 24% higher than traditional procurement. This difference, however, tends to match the cost overruns of traditional procurement
Raisbeck *et al*. (2010)	Transport, water, IT, social infrastructure	Australia	2000 - 2007	Academic	54	Time and cost	Ex-ante commercial operations	PPPs between 11.4% and 30.8% cheaper than TP. PPPs ahead of time on average, while traditional procurement behind time
Whitington (2012)	Transport	United States	1995 - 2005	Academic	2	Time and cost	Ex-ante commercial operation	PPP was faster to completion, however there was no evidence that it was more cost effective than TP
Atmo *et al*. (2017)	Energy	Indonesia	2000 - 2014	Academic	56	Time, cost and quality	Commercial operation	PPP power plants had superior time and availability performance than traditional procurement, however no difference in cost performance identified

Source: Oshea et al. (2019)

One of the earliest documented comparative assessments was conducted by Mott MacDonald (2002) of 39 large infrastructure projects procured by TP and 11 PPP projects in the UK over a twenty-year period. The study was commissioned by HM Treasury in the UK as part of an exercise to revise the Green Book[2]. The study found that completion time for TPs exceeded the estimated duration by 17%, while capital expenditure costs exceeded estimates by 47% on average. The study found that the for the 11 PPP projects studied, on average they came in under-time for construction, and their capital expenditure was on average 1% over budget (Mott MacDonald, 2002). However, the study notes that the performance levels were measured at different points for TP and PPP projects. For PPP projects, the initial data points for the project estimates were at the full business case stage, but for TP projects, the data points were much earlier at the strategic/concept phase (Mott MacDonald, 2002). This distinction in measurement points is a critical factor as at the concept stage of a project development, the degree of confidence in the data is expected to be a lot lower than at the full business stage. This impacts the reliability of the results, given that different measurement points were used.

The findings of this study have subsequently been widely quoted in many studies advocating for PPPs over TP. A further study was conducted by HM Treasury (2003), examining 61 PPP projects. The study found that 89% of the projects were delivered on time or earlier than their scheduled completion time, and all projects were on budget. The UK National Audit office (2003) compared the construction performance of TP and PPP projects. It found that only 30% of TP projects were on time, and just 27% were constructed on budget. By contrast, 76% of PPP projects were delivered on time, and 78% were on budget.

Both studies have been criticized as having a bias towards PPP projects, particularly given that their authors had a vested interest in promoting PPP projects, rather than academic studies which pursue a more objective empirical assessment (Oshea *et al*. 2019). Pollock *et al*. (2007) provides a strong criticism of the Mott MacDonald study, arguing that it suffered from numerous flaws in the study design and methodology. These led to sample and measurement biases that rendered the results uninterpretable.

They note three potential biases or error that could distort the results of the study conducted by Mott Macdonald (2002). The first is non-comparable populations - they argue that the TP

[2] The UK Green Book provides the guidelines for the appraisal and evaluation of projects by the Central Government' HM Treasury

projects included in the Mott Macdonald study cover an extensive historical period under different policy guidance periods. Most of these projects predated the procurement reforms in the UK of 1999, and some which predate the introduction of PFI by more than a decade, thus should not be considered with PPP projects.

The second bias is sample bias – where the cases being sampled are not adequately representative of the procurement option or selected on a fully objective basis. This was a strong critic of the Mott MacDonald study by Pollock *et al*. (2007), that there appeared to have been a bias in the selection of projects to suit the narrative of better performance by PPP projects. They argue that it is not known how the 11 projects were selected, out of a population of about 500 PPP projects that had been signed at that time. The third bias is measurement bias – where different baselines are used to compare the two groups – in the case of the Mott MacDonald study, this arose in the selection of the business case measurement point, as mentioned above. Pollock *et al*. (2007) state that Mott MacDonald explained the use of different baselines as "an accident of data availability not a deliberate part of the study design." In Pollock *et al*. (2007)'s view however, this rationale was 'misleading'. These conclusions were consistent with those of another study by Unison (2005), who also criticized the Mott MacDonald study citing problems related to transparency of the sampling methodology, consistency and relevance of the period, a lack of detail on the population from which the TP and PPP projects were selected, and measurement bias.

Pollock *et al*. (2007) also provide brief commentary on the HM Treasury (2003) and National Audit office (2003). They note that it is not possible to interrogate these studies in detail as the reports were not made public. They submitted a request to HM Treasury for the report and data in 2005, but only a summary of the results was provided, without the underlying data process and methodology employed. In the case of the National Audit office (2003) report, the underlying data was from an even earlier study in 1999, whose data sources could not be assessed. Pollock *et al*. (2007) therefore argue that the purported results of these studies cannot be analytically interpreted. This therefore calls into question the reliability of these studies as a justification for PPP projects over TP projects.

Blanc-Brude *et al*. (2006), in a study commissioned by the European Investment Bank, examined the ex-ante cost of constructing road projects under TP and PPP. The research assessed 227 road projects financed by the European Investment Bank (EIB) between 1990 and

2005, of which 65 were classified as PPP type transactions. The projects cut across all European Union countries. They note upfront that a limitation of their study was that it focused only on the construction phase, but ideally the relative costs and benefits must be evaluated over the whole project lifecycle. However, at the time of their study, they note that most PPP projects were in the early stages of operations, thus there was limited data to conduct a whole lifecycle assessment. The authors therefore concede that their study cannot draw normative conclusions about the economic desirability of PPPs over TP projects, as such analysis can only be undertaken based on a sufficiently large number of PPP contracts which have completed their life cycles are assessed Blanc-Brude *et al*. (2006).

The study employed a reduced-form Ordinary Least Squares (OLS) regression with the explanatory variables consisting of economic determinants of construction cost, including the procurement approach and labour costs; technical determinants of costs, such as the type of road, number of lanes, terrain; and a third group of explanatory variables comprising country dummies, meant to capture any further unspecified country-specific effects, likely political or institutional Blanc-Brude *et al*. (2006). This is therefore one of the few studies to conduct an empirical regression technique to assess how PPP and TP projects have performed.

The study by Blanc-Brude *et al*. (2006) found that on average, the ex-ante constructions costs were 24% higher if the road was procured via a PPP rather than through a TP. They argue that the difference could be attributed to higher construction phase investment by the private partner in a PPP in order to achieve cost savings in the operations phase, although this theory could not be verified in the paper. The authors rather try to provide a qualitative rationale for this justification of the difference, which counters their empirical finding. They eventually conclude that despite starting out to compare the cost difference in construction between TP and PPP, this is 'a comparison of apples and oranges', as the incentives to present realistic construction budgets are, in their view, weaker in TP given weaker accountability in the event of cost overruns Blanc-Brude *et al*. (2006). Thus, while their approach was theoretically encouraging and a departure from other studies more simplified approaches, the use of budget data rather than actual project costs limited the interpretability of their results.

There have been many studies comparing TP and PPPs in Australia. The Australian PPP market, though not as large as the UK's PFI market has been among the most sophisticated PPP markets in the world (Raisbeck *et al*. 2010). By 2004, it was estimated by the Country's

National PPP forum that over $9 billion in PPP project investments had already be contracted Raisbeck *et al*. (2010). The spurt of PPP projects generated the need for studies to comparatively assess PPP projects with TP projects.

Allen *et al*. (2007) report that their study was the first such comparative analysis in Australia. They note that prior to their study, Australian research had tended to focus on non-empirical methods in relation to examining aspects of PPP contracting or operation, with 'scant quantitative research' Allen *et al*. (2007). The purpose of the study was to test whether PPP projects delivered better results in terms of time and cost outcomes compared with TP projects. From a population of 206 projects, the study compared 54 projects, 33 TP and 21 PPP projects. The study followed the Mott MacDonald (2002) approach but corrects for some of the obvious methodological concerns.

Allen *et al*. (2007) state that in response to the criticism of the Mott Macdonald and other UK studies, they formulated a more robust methodology, and their paper provides an extensive appendix on their population and sampling approach. They further argue that they have not biased their research by comparing different timelines between the two procurement methods, and not comparing different measurement baselines. Their findings align with their expectation at the outset. They find that PPPs were more likely to be concluded on budget and on time. On average, the study found PPPs to have a negligible degree of optimism cost bias, but for TP projects the dispersion of cost outcomes was much wider Allen *et al*. (2007). Similarly, in terms of time overruns, they found that PPPs were timelier on a value weighted basis compared with TPs; however, smaller TP projects tended to be completed on time, but larger TP projects tended to run well behind schedule Allen *et al*. (2007).

Duffield (2008) conducted a study to compare PPP and TP projects in Australia, primarily in terms of deviations from the predicted construction cost. The study compared twenty-five PPP projects and forty-two TP projects. Duffield (2008) argues that unlike previous studies, his study was more transparent in the sampling methodology, clearer in describing the population, and sample of projects selected, the period for both TP and PPP projects was the same, and there was consistency in the comparison, removing measurement bias.

Duffield (2008) noted that one of the main constraints in many comparative assessments conducted in the early 2000s was the lack of accurate data that covers the full project lifecycle,

particularly in the case of traditional procurement. Duffield (2008) further notes that PPP project data are often also difficult to access due to them being commercially sensitive and confidential. They point particularly to the Mott MacDonald report as an example of a study that suffered from a lack of sufficient data on which to draw credible inferences.

The study included a representative sample of projects from the following sectors – social infrastructure, transport and what they termed a sustainability sector (water, waste and energy). There were also a few information technology projects included. The main conclusion of the research was that the PPP projects delivered a price that was much closer to the expected cost prior to the project commencement, rather than if a project was procured through TP. Duffield (2008) found that PPP contracts had an average cost escalation of 4.3% post contract execution, compared to TP projects with an average cost escalation of 18.0%, over the same period. In terms of time, the results showed that there was very little difference between the TP and PPP projects in terms of time over-runs over the whole period. However, there were interesting differences in time over-runs within the sub-periods. Whilst PPP projects took much longer in the initial conceptual phases, they performed very well – 1.4% over-run once the construction began, whiles TP projects had a construction overrun of 25.9% (Duffield, 2008).

Raisbeck *et al*. (2010) compared projects across the transport, water, IT and social infrastructure sectors in Australia, over the period 2000 to 2007. They examined time and construction cost performance of expected and actual outcomes of 33 TP and 21 PPP projects. The authors note the weaknesses of the Mott MacDonald (2002) study and argue that their methods were designed to address the key drawbacks of that study. However, they note that achieving 'comparative parity' when comparing TP and PPP projects is very difficult. This is because a 'whole of life' solution in a PPP is difficult to compare with the traditional design and construct TP project which relies on a separate operations and maintenance frameworks (Raisbeck *et al*. 2010).

Raisbeck *et al*. (2010) note that their study was plagued with the difficulty of most of the previous studies – a lack of whole of life costs associated with TP projects and the commercially proprietary nature of actual project data for both TP and PPP projects. Their study was able to surmount one of these obstacles, by obtaining commercially proprietary data, but lacked information on whole of life costing, thus the comparisons are only for construction costs (Raisbeck *et al*. 2010). The authors concluded that PPP procurement delivered projects

faster than TP and was between 11 – 31% more cost efficient. The authors therefore concluded that much greater cost discipline is applied to PPP projects versus TP projects. In terms of time overruns, over the full period, TP projects were 15.5% over the original timeframe, but PPP projects were 24.3% over the original timeframe.

Raisbeck *et al*. (2010) offered several reasons for this difference – it is more common for conceptual documentation to be available for TP projects at the time the project is announced, while this is not the case for PPP projects; PPPs involve design, construct, operate and maintain components, hence the contracting is bound to be more complex, and thirdly that the process by which PPPs obtain finance is more involved than for TP projects (Raisbeck *et al*. 2010). It however appears that these are somewhat convenient reasons for the time overrun, driven by a preconceived notion that PPP projects offer better value for money, and where the empirical evidence suggests otherwise, this can always be explained by theoretical arguments.

In their conclusion, Raisbeck *et al*. (2010) lean towards aligning their findings with the previous studies by Mott MacDonald (2002) etc. However, they concede that it is difficult to draw general conclusions due to the somewhat different research methods. They also note that their analysis is made more complex by the fact that their study cut across various sectors, while most other studies focus one a particular sector in one jurisdiction (Raisbeck *et al*. 2010). The broad sectoral approach of their study was a source of criticism by Cheung and Chan (2011) who argue that given the inherent complexities across sectors such as water, transport and energy, assessments of project performances in these sectors should be considered separately. This is even though Raisbeck *et al*. (2010) argue that there was no noticeable difference in their findings between economic sectors and social sectors.

One of the more recent studies was by O'shea *et al*. (2019) who assessed TP and PPP projects in the education sector in Ireland. The authors note that apart from contributing to the 'low stock' of comparative studies on TP and PPPs, their study aims to address most of the criticisms of previous studies and the challenges involved in comparing the two procurement approaches. The study conducts a detailed case-based comparison of traditional versus PPP procurement in the same sector (schools) and jurisdiction (Ireland) over the same time period (2013 – 15) Oshea *et al*. (2019). Further, rather than only focusing on construction cost performance, they examine the comparative performance in terms of overall VfM.

For the TP projects, they examined projects that were bundled into a single contract. Once contracted the TP schools were handed back to their respective schools' board for management of the operations of the infrastructure. The PPP projects were also a bundle of schools issued under one contract, around the same time as the TP bundle. The projects were therefore very similar, except for the categorization of some into PPP projects, and others as TP. The assessment criteria of the study by O'shea *et al*. (2019) were certain qualitative VfM indicators, and the time taken to complete the construction of the schools, from the tendering period to the completion of construction. Their research approach was case study based, involving semi-structured interviews with key stakeholders, and face-to-face interviews.

The study found that the PPP tendering process was relatively long compared with the tendering process for the TP project. In terms of construction time, PPP projects were superior, taking 1.77 months per 1000 m^2 compared with 4.59 months per 1000 m^2 for TP projects. Overall, the authors find that when the tendering and constructing timeframes are considered together, the aggregate speed of delivery under TP and PPP are relatively the same. O'shea *et al*. (2019) therefore make the important point that assessments of the time to deliver the infrastructure asset under TP and PPP, must include the entire process from project conception to construction completion, which many previous studies failed to do, only looking at the actual construction period. This tended to favour PPP projects who often had a shorter construction period, but much longer tendering period than TP.

In assessing VfM, O'shea *et al*. (2019) assessed three indicators – the level of competition in bidding, risk transfer and innovation. They find that the level of competition has been greater for PPP projects than TP projects, dominated by large global firms with the capacity to manage the bundled components of a PPP project. On risk transfer, the study fails to find unequivocal evidence that the PPP projects delivered a better allocation of risks compared to the TP projects. Rather, they find that the scope for greater efficiency with PPPs is based on the trade-off between the benefits derived from transferring risks, with the increased transaction costs arising from the inflexibility related to long-term contracts. Similarly, the authors fail to find substantial additional innovation in PPP projects over TP projects. On all accounts therefore O'shea *et al*. (2019) state that they cannot confirm the general hypothesis that PPP projects almost always outperform TP projects.

O'shea *et al*. (2019) note that while on the one hand the specificity of their study allowed them to narrow in on the comparison between TP and PPPs in a particular sector, on the hand a limitation was that the study had limited generalizability. They note that until detailed datasets become available in Ireland based on a large number of observations that enable statistical analysis, it is necessary to address the comparative efficiency of TP and PPP using an in-depth case-based approach. This is particularly relevant for this research as there is unlikely to be a large set of credible data on TP and PPP projects in many countries in Africa, thus resulting in a similar constraint faced by Oshea *et al*. (2019).

One study that assessed TP and PPP projects in the developing world is Atmo *et al*. (2017), who assessed TP and PPP projects in the power sector in Indonesia. Their comparison was based on an assessment of time, cost and quality measures. The period of investigation was from when contractual commitments were made until the completion of construction and commissioning of a project. The assessment also included some component of the operations period, based on an assessment of the power plant's availability during the first two years of operation (Atmo *et al*. 2017). 28 TP projects were compared with 28 PPP projects based on selection criteria to minimize differences between the projects that could render the results uninterpretable. The criteria for selection of projects was firstly power projects that had been constructed after 2000, projects that were in operation, projects with a capital cost in excess of $20 million, and projects of similar technical complexity (Atmo *et al*. 2017).

The study found that Indonesian PPPs had better time performance than traditional power projects. Although this study demonstrated that both PPPs and traditional procurement had experienced project completion delays, traditional projects had suffered from significantly longer delays than PPPs (Atmo *et al*. 2017). However, it was found that on average, there was no significant cost difference between TP and PPP projects. The benchmarking performance of operational availability between PPPs and TP in Indonesian power projects discovered that the average availability of PPPs was much higher than that of TP projects. It appears that contractual arrangement linking power plant operating performance and service payments has motivated PPPs to operate at a higher operating standard than TP projects (Atmo *et al*. 2017).

Overall, despite a leaning towards PPP projects, the comparative studies have failed to present a clear consensus on the a priori expectation that PPP projects offer greater value for money than TP projects. Hodge and Greve (2017) note with concern that non-academic literature has

often been quite favourable towards PPPs while the academic studies have been far more mixed. They surmise that the studies funded by industry practitioners or governments may have a vested interest in portraying PPP projects favourably. Even more stark is the lack of studies in developing countries. It is important to note that while PPP projects have been strongly advocated for to African governments, and many countries have implemented PPP projects over the last twenty years, this research has not found one existing study that has empirically compared the performance of PPP and TP projects in Africa. This provides a strong rationale and justification for this research.

2.4.2 PPP and TP performance in Africa

Most empirical studies in Africa have been focused on PPPs and not on traditional procurement. PPPs have been steadily increasing across the continent but are still largely concentrated in a few countries. Most private sector investments in Africa go to a select few countries – particularly South Africa and Nigeria, with Kenya coming third. Between 2009 and 2012, South Africa and Nigeria received PPI worth $11.6 billion and $10.0 billion respectively (Gutman *et al*. 2015). Figure 4 below shows the number and value of PPP transactions in Africa since 1993.

The figure shows that the number and value of PPPs per year has mainly between 10 - 30 transactions each year, with total investment in the range of $2 – 4 billion per year. This is much lower than in other regions, and significantly lower than the large infrastructure financing needs in Africa.

South Africa has implemented the most PPP projects in Africa by far. As the figure below shows, there have been 35 PPP undertaken since the formal PPP regulations were implemented. They have been funded through a combination of equity, debt and in certain instances, government capital contribution (National Treasury, 2022). This list does not include the large number of renewable energy projects concluded under South Africa's renewable energy independent power producer program, which also has significant PPP type investments.

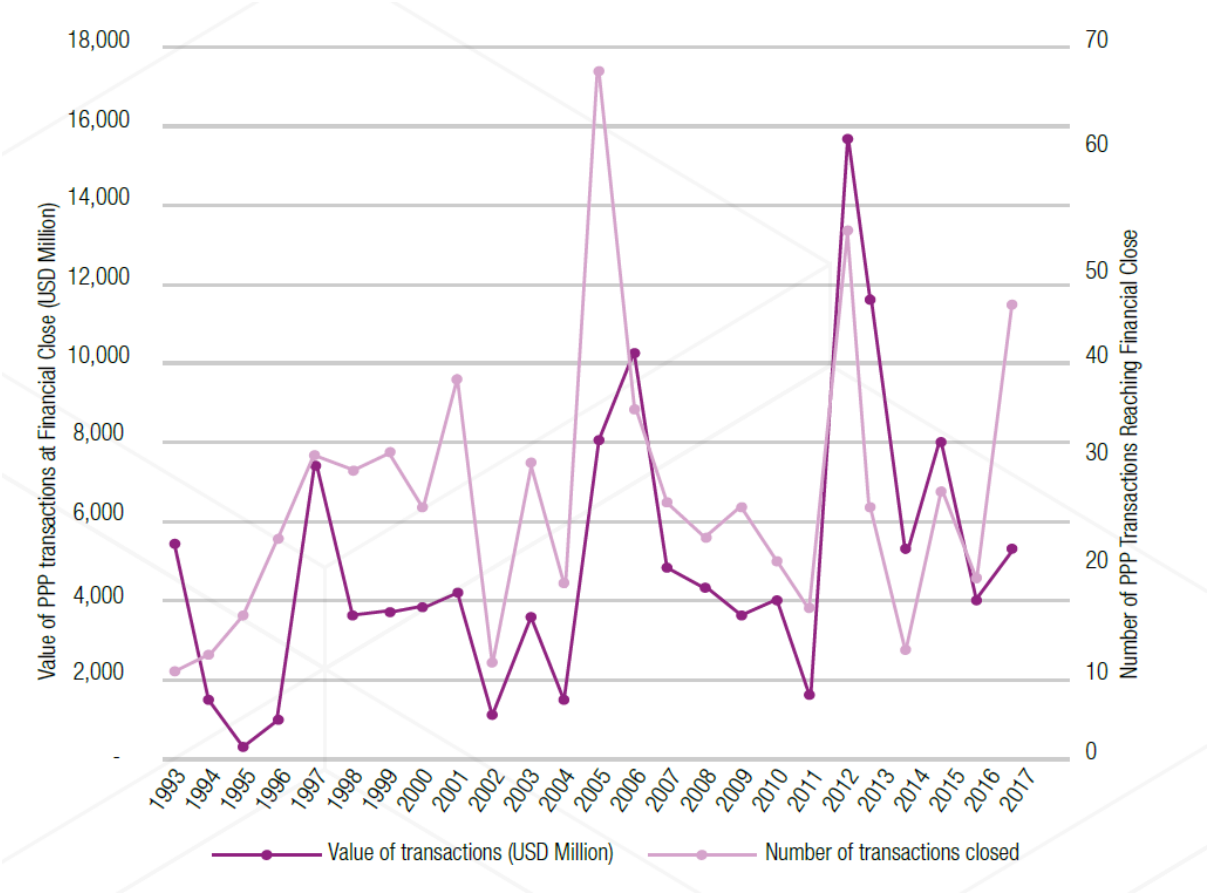


Figure 4: Trend of PPP investment (number and value in USD millions) in Sub-Saharan Africa

Source: AfDB, 2017

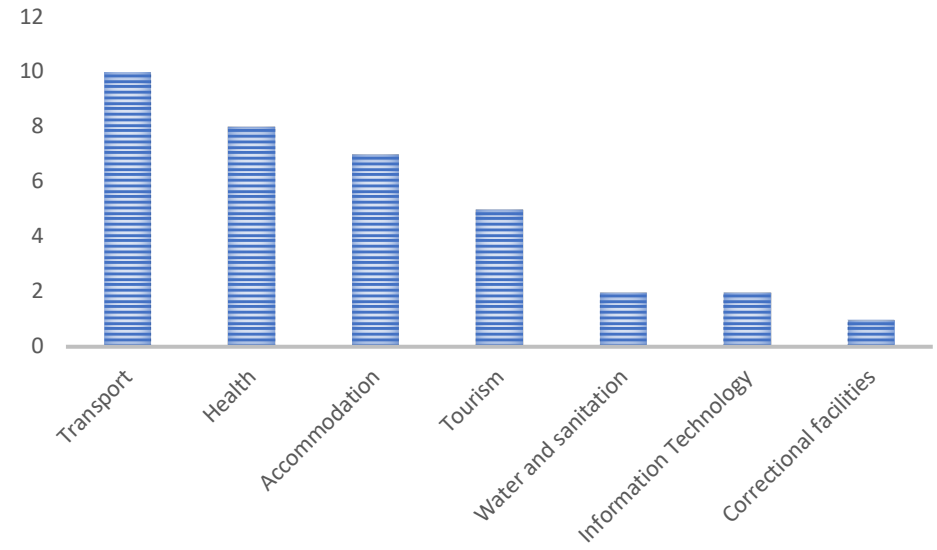


Figure 5: Number of PPP projects in South Africa, by sector

Source: National Treasury, 2022

Despite the large number of projects in South Africa, there is limited empirical information on the performance on these projects in terms of VfM. A few case studies have been conducted but mainly focusing on institutional and governance factors affecting the performance of these projects. It is quite interesting that with such a large number of projects compared with other countries in Africa, there has not been a large empirical study measuring the ex-post VfM derived from these projects.

However, this has not been without challenges, and the pace of PPPs has slowed considerably in the last five to ten years. A few PPPs, particularly in the healthcare sector, have faced challenges with performance standards, leading to calls in certain sectors of society for PPPs in key sectors such as healthcare to be scrapped (Farlam, 2005; Arimoro, 2018).

There are a few studies that have provided high-level summaries of the performance of a few PPP projects in Africa. One of the earliest studies on PPPs in Africa was conducted by Farlam (2005). This study provided eight case studies of PPP-type projects in South Africa, Mozambique, Uganda, and Gabon. The projects cut across the transport sector, prisons, telecommunications, water & sanitation, power and tourism sectors Farlam (2005). The approach of the study was a qualitative assessment of the perceptions of these projects, rather than a rigorous empirical examination of the performance of the projects. The finding of the study was that projects that have been most successful were characterized by detailed planning, clear communication and strong commitment from both the public and private parties, as well as effective monitoring, regulation and enforcement by government. One of the key conclusions of the study was that the complexity of PPPs and the high costs involved require African governments to take a carefully considered approach to undertaking PPP studies (Farlam, 2005).

Doxley (2013) provides a summary of PPPs in Africa between 2000 and 2005. At the time of their study, they noted that the problem with evaluating performance of PPPs in Africa is that so little is known about the details of individual projects. Without access to contracts and detailed value-for-money calculations, it is impossible to properly evaluate projects (Doxley, 2013). They however argue that based on information they could obtain, PPPs have been successful in the telecoms sector, but more problematic in water and roads sectors. They attribute this to the need to heavily subsidise these sectors in Africa, making the PPP model difficult to execute in such markets.

A few studies have provided details on PPPs in other SSA countries. A study by Macroeconomic and Financial Management Institute for Eastern and Southern Africa (MEFMI) in 2016 assessed PPPs in Kenya, Lesotho, Malawi, Tanzania, Uganda, and Zimbabwe. The two main PPP projects in Uganda have been the Bujagali Hydro Power project in (Country), which involves a 250MW power plant and transmission line between the government and Bujagali Energy Ltd, a special purpose consortium. The total costs for the project at the time of appraisal was about US$ 735.5 million, with the African Development Bank (AfDB) giving out a loan of US$ 110 million (MEFMI, 2016). The second is the Kalangala Infrastructure Services project in (Country). This PPP project involves the development of infrastructure in Kalangala District comprising of two passenger ferries, road upgrade and water supply system, as well as power generation, transmission and distribution (MEFMI, 2016).

For Tanzania, one of the main PPP projects executed is the Tanzania International Container Services. Harding (2009) provides the details of the project. The concession contract was signed in 1999 with a consortium consisting of International Container Terminal Services, Inc (ICTSI) of the Philippines and Vertex Tanzania. The initial concession was for 10 years, but with a review after five years.

One project that has not been very successful is the Tanzania City Water Services Limited PPP project. The PPP contract was awarded to Biwater Gauff Tanzania Limited (BGT) and a Tanzanian investor, Super Doll Trailer Manufacture Company Limited (STM). These two created a firm through which the PPP would be implemented, known as City Water Services Limited (CWS), with BGT owning 51% shareholding and Super Doll with the remaining 49%. Under the terms of the contract, the Dar es Salaam Water and Sewerage Authority (DAWASA) was the asset holder and Leasor while CWS became the Operator (Triche, 2012). It is noted that one of the reasons for the project failure was that CWS, the party responsible for the operations, was unable to meet the high-performance targets and other contractual obligations. A decision was made to terminate CWS services, which saw the government quickly creating a new public operating company, the Dar es Salaam Water and Sewerage Corporation (DAWASCO), to take over from CWS. The engagement of DAWASCO was done on new terms, marking the collapse of the CWS PPP project (Triche, 2012).

The experience of Tanzania highlights the importance of property structuring PPP projects and the effective allocation and management of responsibilities and risks. Harding (2009) concludes that for the TCTS project, the initial project structure of a short-term operating contract resulted in limited initial interest until the structure was corrected, and Triche (2012) notes that in the Water Service project, the project was easily undermined due to a weak accountability framework, and vest interests that were not assessed early in the project structure. These are important lessons for future PPP projects.

In 2009, an 18-year PPP agreement was brokered in Lesotho between the Lesotho government, and Tsepong (a consortium of Netcare, a South African hospital group, and local private sector partners in Lesotho) to establish a healthcare service consisting of a hospital and several referring clinics. The Queen 'Mamohato Memorial Hospital project is a Build, Operate and Transfer including an element of design and finance which will last for 18 years, after which assets would be handed over to the government (MEFMI, 2016). The cost of the project was approximately US$100 million, with the financing coming from the Development Bank of Southern Africa, a government contribution, and private equity (SAIIA, 2012).

The SAIIA (2012) review argued that there was, at the outset, very little capacity in the Government of Lesotho to understand, plan and manage PPPs. There was limited understanding of the PPP model, of the different options for structuring the deals, how long it would take the private partner to recoup the investment, and the extent of the services that the private sector should provide. Also, there was no clear understanding that the very nature of a PPP is long-term, with all associated benefits and risks. Another barrier is that at the time of the deal, there was no national PPP policy adopted and promulgated in Lesotho.

MEFMI (2016) confirms the assertions by SAIIA and goes further to argue that a lack of a clear legal framework and clarity in the financing model result in inconsistent and retrospective application of various taxes to the private party. Further, the government's non-payment of the required unitary fees resulted in the operator being unable to consistently service is debt obligations. The International Finance Corporation was bought on board to act as impartial transaction advisors, and they did much to build understanding of the potential of the deal.

One of the findings of the AfDB (2017) study was that there is no centralized repository of PPP knowledge or experience that can guide future projects. This limitation is evident when a

researcher aims to obtain data on how PPP projects have actually performed, not on conceptual VfM ex-ante estimations, or ex-post narrative conclusions with no empirical assessment.

In a recent 2021 study by the AfDB, the assessed the performance of a portfolio of road projects financed by the AfDB but procured either through PPP or TP process. A sample of 18 transport projects were assessed, heavily weighted towards TP projects (16) and just two PPP projects. The OECD DAC evaluation criteria was used to assess the projects. The projects were mostly found to have challenges in terms of budget and time efficiencies, with no specific difference between the PPP and TP projects. Given the small sample size, the study was more to provide indicative qualitative outcomes, rather than a substantive VfM assessment.

2.5 Conclusion

This chapter has fulfilled three main purposes – to quickly describe the two infrastructure procurement approaches, noting their advantages and disadvantages; secondly to discuss the theoretical literature to identify a underlying basis for VfM assessments; and thirdly to discuss the empirical literature globally and in Africa. In doing this, the chapter provides an analytical base on which to proceed, and also highlighting the gaps in the literature, which enhance the contribution of this study.

Firstly, from a theoretical perspective, the principal – agent theory provides a suitable foundation on which the issue of VfM can be explored, unpacking the relationships and incentives between the principal and agent. The question of value posed an interesting theoretical position which needs to be explore further. As noted above, most approaches to value for money focus on a narrow definition of value, linked to a shareholder perspective, rather than a broader stakeholder view in defining value. This limitation implies that the value for money assessments are subsequently flawed and render a comparison of TP and PPP projects based on this narrow approach inadequate.

While the literature review provided an extensive summary of the empirical studies globally and in Africa, it also exposed a few clear gaps in the empirical studies requiring further research. Firstly, there is limited existing literature that has conducted a detailed comparison of traditional procurement and PPPs in developing countries. Most studies have focused on one of the procurement options only, mostly PPPs and thereafter assessed their performance and focused on means of improving the performance of PPPs.

Secondly, the analytical approaches undertaken in the comparative studies have suffered from certain well documented drawbacks. These included a lack of sufficient samples, bias towards PPP projects and other measurement issues. The studies have focused on one component of the procurement process – the ex-post cost and time analysis of the projects. Furthermore, while the existing literature acknowledged that any comparison must be of a sample of projects with relevant similarity to conduct a meaningful comparison, in practice such projects were often not available in a sufficient enough quantity to drive a useful conclusion. Even more stark, this study could not find one comparative study that has been conducted in Africa.

This study therefore aims to address these gaps, in the context of Africa. As will be outlined further, the study will aim to conduct an ex-post assessment of value for money across a number of TP and PPP projects in Africa. Importantly, the study will assess value for money both from a shareholder view, and then also from the stakeholder view. This will be an important contribution to the discussion on the appropriate means to measure value for money and practically add to the body of evidence on the performance of TP and PPP projects.

3 MEASURING VALUE FOR MONEY

3.1 Introduction

Value for money (VfM) is a concept that in its simplest form, involves an assessment of the value derived from an asset or service, compared with the investment made into that same asset/service. While VfM can be applied across most disciplines, in the infrastructure sector, it has been used to determine the value derived from an infrastructure asset or program. Narrowing further into the infrastructure finance/procurement realm, value for money has mainly been used to assess whether a PPP project is likely, in theory, to provide better value than a traditional procurement alternative.

The underlying rationale for VfM in PPP projects is that such projects enable the public sector to leverage supposedly more efficient private sector management techniques and are therefore more likely to provide better value than traditional procurement options (HM Treasury, 2003). There are a variety of reasons why governments undertake PPPs, but, according to Grimsey and Lewis (2005), achieving improved value for money or improved services for similar amounts of money to public sector spend for a similar project are of paramount importance. Moreover, HM Treasury (2007) states that the UK Government's main objective in procurement decision-making is to secure best value for money.

This chapter begins with a brief specification of VfM in terms of its quantitative expression. The chapter then presents the different measurement approaches for VfM and then provides a discussion on the drivers used to identify VfM. The chapter provides an important basis on which the subsequent analyses in this study are conducted and sets the context in which the key research questions are explored.

3.2 VfM Specification

In summary a value for money assessment helps to determine which procurement option, TP or PPP, offers greater cost-effectiveness from the public perspective (Park *et al*. 2018). It aims to do so by comparing the financial burden on the part of the government in either procurement option, through an analysis of the costs, revenues, and risk flows which would be generated from each procurement option, assuming the same quality of service provided (Park *et al*.

2018). The process for determining this can however be quite complex. Different theoretical and analytical approaches have been adopted to define and measure VfM.

While various authors have proffered definitions for value for money in an infrastructure context, the definition by Grimsey and Lewis (2005) is particularly useful. They define value for money as 'the optimum combination of whole-life costs and quality of an infrastructure investment to meet the user's requirement.' In other words, value for money measures the quality of a service by delivering a project at the same cost or lower cost than alternative means to deliver the same or similar projects. It is important to note that value for money is not about achieving the lowest price but rather the optimum combined whole-life costing and quality. (Eadie and Miller, 2013).

The purpose of a VfM assessment is to understand how best to maximise the impact of each unit of investment. As mentioned earlier, VfM assessments for infrastructure assets are typically done to compare whether a PPP project would be more appropriate compared with the alternative government procurement. The underlying rationale is that PPPs on a risk adjusted basis, should offer greater VfM than traditional procurement. This is critical for the delivery of public infrastructure services, to ensure that limited public and/or private financial resources are effectively and efficiently allocated in the best way to deliver the optimum outcomes. Importantly, VfM is a relative concept. EPEC (2015) argue that knowing the VfM of one option is not particularly useful on its own. It is when VfM is used to compare between different options that it becomes a useful tool.

The VfM analysis can be expressed mathematically, as set out below by Grout (2005). A project delivers a flow of benefits. We use the notation $v_t(g)$ to denote the benefits in period t if the project is conducted in the public sector and $v_{ti}(p)$ to denote the benefits in period t if the project is delivered by consortium i in the private sector. A project also generates a flow of costs. We use $c_t(g)$ and $c_{ti}(p)$ to denote the costs in period t associated with a public-sector project and a project delivered by consortium i.

Grout (2005) presents a mathematical expression of VfM, as follows:

$\int_0^\infty V_t(g)e^{-r_v(g)t}$ = present value benefits of a public project (3.1)

$\int_0^\infty V_{ti}(p)e^{-r_v(p)t}$ = present value benefits of a private project (3.2)

$\int_0^\infty C_t(g)e^{-r_c(g)t}$ = present value costs of a public project (3.3)

$\int_0^\infty C_{ti}(p)e^{-r_c(p)t}$ = present value costs of a private project (3.4)

where $r_v(k)$ and $r_c(k)$ are the relevant discount rates for benefits and costs, k = p, g.
For ease of presentation, we will assume that $r_v(p)$ and $r_c(p)$ are the same for all contractors.

In a comprehensive VfM assessment, the test would involve a full assessment of the cost and benefits of both options, thus incorporating all four equations above, as follows:

$\int_0^\infty V_t(g)e^{-r_v(g)t}$ - $\int_0^\infty C_t(g)e^{-r_c(g)t\,di} > 0$ (3.5)

$\int_0^\infty V_{ti}(p)e^{-r_v(p)t}$ - $\int_0^\infty C_{ti}(p)e^{-r_c(p)t\,di} > 0$ (3.6)

Equation (3.5) represents the VfM test for a TP project, and equation (3.6) represents the same VfM test, for a PPP project. If two projects of a similar nature (size, complexity, duration etc.) are being compared, then the decision of which procurement option presents the greater VfM is determined by which equation, (3.5) or (3.6), yields the greater positive value.

A VfM analysis is therefore essentially an analysis of the benefits/value and costs. The cost component usually represents the cost over the lifetime of the project, including the cost of managing the associated risks. The whole-of-life costs should include – the initial purchase price of the goods or services; maintenance costs; transition out costs; licensing costs (where applicable); the cost of any additional features procured after the initial procurement; and any other consumable cost (HM Treasury, 2007). The value/benefits derived entails the outputs (financial and nonfinancial) as well as the quality and quantity of the service or the performance level of the asset or service (EPEC, 2015). These concepts form the analytical basis of VfM, and the measurement of these underpins the various approaches.

The cost component of VfM is somewhat more straightforward to measure. Often a project's construction cost or whole lifespan are considered. Burger and Hawkesworth (2011) argue that existing VfM approaches at the time focused only on supply side assessments – i.e., the cost of delivering the required service. This relates to the cost component of the equations above and excluding the benefits. They contend that defining VfM in terms of outcomes per unit of

expenditure excludes considerations of demand-side efficiencies. In such an instance a VfM assessment in essence becomes a comparison of which approach is more cost effective, neglecting the important aspects of benefits or value derived.

On the benefits side, there are two approaches – one looks purely at benefits in financial terms, either greater revenues or lower costs. The second approach encompasses a broader concept of VfM by considering a broader range of factors beyond financial parameters, such as benefits to the society, environmental impacts etc. These approaches underlie how 'value' is perceived. The issue of identifying and measuring the value from an infrastructure project is a critical element in the VfM approach.

3.3 VfM measurement

Building from the theoretical framework set out, there are a number of approaches by which VfM can be measured. There is no one specific approach to VfM assessment, as the objectives of undertaking the assessment, and therefore related methodologies, reflect government policies and different administrative processes (EPEC, 2015). Measuring VfM has therefore become more of a practical than theoretical exercise, while noting the fundamentals of value (either broad or narrow) vs costs.

The first primary difference in the approaches is one of timing – whether an ex-ante or ex-post assessment is conducted. VfM could be determined through an ex-ante mechanism to inform project choice, such as the public-sector comparator or cost-benefit analysis. Alternatively, VfM may be measured through an ex-post mechanism to assess the quality of an existing choice to inform future decision making. Ex ante VfM evaluation studies are popularly used for the selection of infrastructure PPP projects during the identification and proposal phase, and ex post VfM evaluation is used as a measurement against specific pre-specified performance benchmarks in the implementation and operations phase of a project (Burger and Hawkesworth 2011).

3.3.1 Ex-ante VfM assessment

Public sector comparator

The most common approach has been to undertake an ex-ante comparison of PPP procurement against a "Public Sector Comparator" (PSC) – that is, what the project would cost if it was delivered through TP. This analysis is typically based on comparing a proposed PPP project with a hypothetical version of the project, which is expected to deliver an identical service. The most straightforward way to do this is to compare the fiscal costs under the two options – the risk-adjusted cost to government of procuring the project through traditional procurement, with the expected cost to government of the PPP project (PPIAF, 2012). The assumption here is that the benefits accrued from each option are identical, thus only an analysis of the costs in the two approaches is required. In this analysis, VfM is said to be realized where the discounted cash flows from the PPP are less than those from the PSC, which aims to mimic the traditional procurement alternative. VfM, through this method, has therefore become the central means of assessment between TP and PPP projects in most jurisdictions. Figure 6 below presents a schematic of how this VfM assessment is conceptualized.

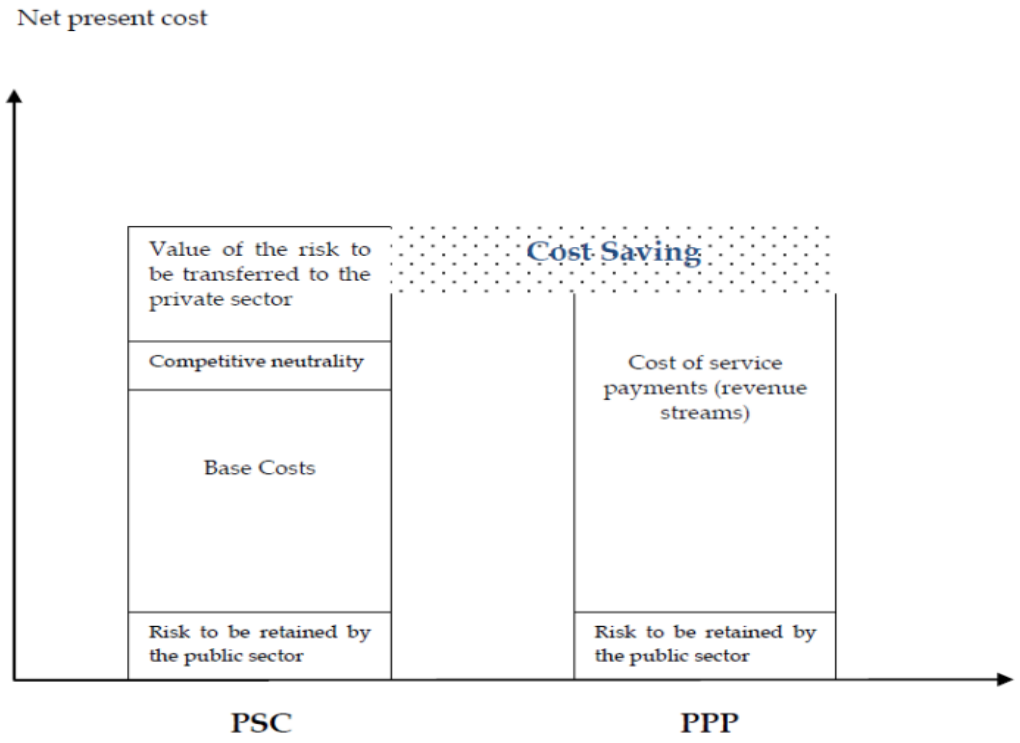


Figure 6: PSC comparator schematic

Source: Desgrees de Lou (2012)

A PSC assessment has three main steps:

- Creating a public-sector comparator hypothetical model that estimates the whole life financial impact of procurement of the project by government (traditional procurement), including operating costs and cost of risks
- Estimating the whole-life financial impact of procuring the project through a PPP alternative
- Comparing the risk adjusted, net present value of the cash flows for the PSC and PPP

Benefit cost analysis

An alternate approach, less commonly used, is the benefit cost analysis (BCA) which aims to include an estimation of the benefits into the VfM analysis. BCA is a framework designed to apply economic efficiency concepts to public investment decisions Decorla-Souze *et al*. (2013). It is a comprehensive assessment of the full range of economic costs, risks, and benefits, while taking into account impacts that cannot easily be quantified, such as external costs and benefits. The BCA has been used to enable the inclusion of broader benefits, particularly societal benefits than those that accrue mainly to the public sector sponsor only. This approach seeks to identify the net benefits of each possible option. The option with the highest net benefit is undertaken unless net benefits are anticipated to be negative regardless of how the project is undertaken in which case the project should not be undertaken (Grout, 2005).

Decorla-Souze *et al*. (2013) argue that BCA is a more comprehensive tool than the PSC due to the fact that non-financial impacts, such as benefits to users of a facility that are normally ignored in the PSC analysis or relegated to a qualitative discussion, are incorporated in the BCA. The analytical logic for conducting the BCA generally follows a similar method to the PSC, with the main difference here the emphasis on including as broad a measure of benefits as is feasible. It is however mainly based on estimates prepared at the planning/feasibility stage of projects. This is the major drawback of this approach, that it is highly conceptual and dependent on the assumptions made by the researcher.

3.3.2 Ex-post VfM assessment

While the VfM concept provides a means of justifying a PPP project at the feasibility stage, this is a conceptual exercise based on the best available assumptions. Often, a potential PPP project is compared with an actual TP project implemented at a different time and under different conditions, rendering the analysis prone to many criticisms. Thus, concerns have been

raised regarding the extent to which the VfM derived at the feasibility stage is a true reflection of the actual VfM that transpires over the project's lifetime. This emphasises the need for ex-post VfM assessments. Ex post VfM assessments of projects are conducted by measuring the performance of the project against specific pre-specified performance benchmarks (Burger and Hawkesworth, 2011).

It is however a lot more complex to assess VfM of completed or active projects – ex-post VfM assessments. This involves obtaining data on certain key performance metrics of a project – costs (both construction and operation) as well as the outcomes of a project; and comparing these with the anticipated costs and benefits at the project conceptualization phase. To assess whether PPPs or TPs have fared better in general, one would need a group of projects that are either completed or at an advanced stage of operation and then compare the performance of these sets of projects.

It is common to take a group of past schemes and to ask whether the private schemes have displayed better value for money than the equivalent public scheme (Grout, 2005). Methodologically, there have been a number of approaches to conducting ex-post VfM assessments. The three approaches discussed are comparative analysis of a set of projects, the use of case studies or thirdly an econometric approach.

Comparative analysis of a database of projects

The first approach has been to compare certain descriptive statistics from a pool of PPP and TP projects. Ideally, the relative costs and benefits of PPPs should be evaluated over the entire project lifecycle, from start of construction through operations and maintenance to the end of the contract period (Blanc-Brude *et al*. 2006). However, this is difficult, mainly due to a lack of data and information. The two main indicators have been the construction cost and time overruns of TP and PPP projects respectively. This approach relies on available data on a large set of projects, from which such descriptive analytics can be drawn, and for any meaningful conclusions to then be made. Averages and standard deviations are drawn from a database of TP and PPP projects and used as the basis for a comparison of the relative performance of either procurement route.

As will be shown in the literature review, this approach has been criticized as not being robust enough and limiting an assessment of VfM to two factors – construction cost and time performance is quite inadequate. VfM is a much more complex concept and requires a more rigorous assessment approach. Lui *et al*. (2014) notes that a proper evaluation of VfM is a complicated process, and the use of absolute time and cost measurement indicators do not comprehensively reflect the complexity associated with PPP delivery.

The alternative approach, much less used, has been more in-depth assessments of a small sample of projects. For instance, Park (2018) conducted an ex-post quantitative value for money assessment on three road projects in Korea. The approach here was to conduct the quantitative value for money test on the actual projects and compare it with the PSC comparator for the same projects conducted at feasibility level. Such an analysis, while very insightful, requires access to the primary data on the projects that was used to calculate the initial PSC at the feasibility stage, and then to conduct some primary data collection on the projects during the construction and operation phase to essentially re-calculate the value for money, and observe any changes.

Case studies

A case study approach allows the researcher to interrogate in detail whether (and the extent to which) value for money was achieved for selected TP and PPP projects. Baskarada (2014) notes that case studies are particularly well-suited for extensive and in-depth descriptions of complex social phenomena, which would apply to the subject matter of VfM in infrastructure projects. Case studies allow for deductive as well as inductive findings (Hyde, 2000; Yin, 2009). They can be based on single or multiple cases and can include qualitative and/or quantitative data (Gerring, 2004).

O'shea *et al.* (2019) conducted a case study-based comparison of TP and PPP schools in Ireland. They developed a comparative case study approach assessing the performance in terms of overall value for money of two schools, one procured through TP and the other through a PPP. Importantly, in discussing the approaches to ex-post value for money assessments, O'shea *et al.* (2019), noted that '*until detailed datasets based on a large number of observations that enable statistical analysis become available, it is necessary to address questions about the comparative efficiency of different procurement approaches using an in-depth case-based*

approach." Further, the case-based approach uncovers unexpected complexities and nuances which are less likely to emerge when alternative methodologies based on large data sample sizes only are adopted (O'shea *et al*. 2019).

Detractors to the case study approach cite two potential disadvantages. The first argument posits that the case study approach is often specific to a particular set of circumstances i.e. the research subject itself, and the conclusions derived cannot be applied in other conditions. As a result, the theory that is generated from a case study may be idiosyncratic and lacking in general applicability. Secondly, some of the outcomes of case study research have resulted in deep and detailed observations and intricate theories and concepts. The complexity of the theories generated however mean that they lose the potency of overarching and accessible theoretical concepts, and the ease of general application in the respective field is as a result compromised (Eisenhardt, 1989).

Drawing on these issues, one important consideration when adopting a case study approach is the extent to which the findings from the cases can be generalized or are deemed to be quite specific to the case being observed. This is sometimes seen as the drawback of using this approach, where a general view of VfM is sought. While case studies do not aim to generalise to populations (statistical generalisation), like experiments, they aim to generalise to theories (analytical generalisation) (Yin, 2009). Yin (2009) states further that replication may be claimed "*if two or more cases are shown to support the same theory*". Infrastructure projects are by their very nature complex and have certain nuances, thus when conducting case studies, the researcher must ensure sufficient similarities in the pool of projects selected, which is not always easy to achieve.

The success of a case study is heavily reliant on the collating of detailed relevant data and information required to complete a comprehensive case study. The relevant data may be collected through documents, archival records, interviews, direct observations, and physical artefacts (Yin, 2009). This presents the biggest challenge to a case study approach for PPP and TP projects in Africa. Majority of the infrastructure projects, even for PPPs have very limited in-depth data and information easily available. Case studies of government projects (traditional procurement) are even more challenged because most governments have not kept detailed and accurate reports on their projects, right from conceptualisation to implementation.

Econometric analysis

There has been very limited econometric analysis of VfM in PPP and TP projects. One study that conducted an econometric analysis of VfM was Blanc-Brude *et al*. (2006). The study however used construction costs as the dependent variable, which is a limited measure because it does not incorporate all costs and completely leaves out benefits. It in fact presupposes that two projects of the same scale will have similar benefits; thus, the only question of analysis becomes whether PPPs or TPs are more costly. The paper concedes that 'over the long-term ex-ante construction costs will have to be weighed against the benefits of timely delivery and service quality. Only then can an objective assessment be made of whether PPP procurement represents value for money' (Blanc-Brude, 2006). Secondly, such an approach is ideally suited to a large sample of projects, the Blanc-Brude (2006) study was based on a sample of 227 road projects across Europe, of which 65 were PPPs. It is feasible however to attempt a similar analysis for a smaller database, which would most likely be the case in the African context where much fewer PPP projects have been completed.

3.3.3 Comparison of the different approaches

Table 4 provides a quick summary of the different approaches with their associated pros and cons.

Table 4: Comparison of VfM measurement approaches

Approach	Project phase	Quantitative/ Qualitative	Theory of value	Costs (actual vs estimates)	Pros and Cons
Public sector comparator	Ex-ante	Quantitative (estimates)	Shareholder (narrow)	Estimates	Pros: • Easier to conduct • Widely adopted so easier for benchmarking Cons: • Highly conceptual and mainly based on assumptions • Broader benefits not taken into account
Benefit cost analysis	Ex-ante	Quantitative (estimates)	Stakeholder view (broader)	Estimates	Pros: • Includes a wider application of benefits

					Cons: • Highly conceptual and mainly based on assumptions • Difficult to estimate societal benefits
Comparative project analysis	Ex-post	Quantitative	Shareholder (narrow)	Actual	Pros: • Analytically simple to conduct Cons: • Requires a large set of projects to generate meaningful results
Case studies	Ex-post	Qualitative	Both shareholder and stakeholder	Actual	Pros: • Enables the exploration of various elements of VfM Cons: • Limited generalisation to broader conclusions • Requires extensive, in-depth primary research
Econometric analysis	Ex-post	Quantitative	Both shareholder and stakeholder	Actual	Pros: • Enables rigorous examination of VfM relationships, as well as unpacking other factors impacting VfM Cons: • Usually requires a large database • Dependent on obtaining the right VfM indicator

What is clear from the above measurement approaches is that obtaining the right measurement metrics is critical to a VfM assessment, to ensure that the right outputs are generated. Three main considerations emerge – the objective of the analysis, the broader purpose and thirdly the availability of data.

Objective of the analysis

The objective of the analysis informs mainly whether an ex-ante or ex-post approach is adopted. If the VfM analysis is being conducted to decide between a number of options by which a project can be executed, then naturally an ex-ante approach is required (rather than an ex-post measurement approach), which would not be suitable in this case. Ex ante VfM evaluation studies are popularly used for the selection of infrastructure PPP projects during the identification and proposal phase, and ex post VfM evaluation is used as a measurement against specific pre-specified performance benchmarks in the implementation and operations phase of a project (Burger and Hawkesworth 2011).

Secondly the objective of the analysis, in terms of whether a specific project case is being evaluated, or a broader view of VfM in a group of projects has an impact on the approach. The ex-ante PSC and BCA approaches are designed for detailed assessment of individual projects, whereas the other approaches such as a comparative assessment, case study and econometric approach all lend themselves towards a larger VfM assessment involving a group of projects. Therefore, if the objective is to assess the performance of one project, then these approaches would be inadequate.

Stakeholder or shareholder view of value

To effectively make a decision on a financing approach for large infrastructure projects, Chen *et al*. (2016) proposes that the two major issues to be answered are, which approach (i) will be in the public's best interest, and (ii) could efficiently finance and manage a large public infrastructure project. While these questions are quite broad, they provide a useful means of combining the shareholder and stakeholder value concepts. This is that the infrastructure financing model must meet both the requirements of a feasible/affordable financing structure, but must also, and equally importantly, meet the broader public social needs of public infrastructure provision.

This research notionally supports this contention and will aim to test the assessment of value for money through the prevailing shareholder lens, and then as a broader concept through a stakeholder view of value. That being said, regardless of whether a narrow (shareholder) or broader (stakeholder) approach is being considered, VfM must be achieved in a demonstrable manner for all parties.

Availability of data

An effective VfM analysis is highly reliant on the ability to obtain quality data and information. VfM assessment's require data on a project's costs, benefits or value, and price of outcomes. These may be sourced directly from the project's sponsors, but also from budgeted data or estimations/projections using 'historic' information, as actual evidence can only be obtained during project implementation.

The challenge with VfM assessments, particularly ex-post analysis is on obtaining available and reliable data to conduct the analysis. In most instances, collating primary data on benefits and costs to measure VfM is in itself a daunting exercise. Most project sponsors, particularly public sector sponsors, do not keep accurate data that can enable the computation of VfM. This is one of the reasons why very few ex-post assessments on a large scale have been conducted.

3.4 Drivers of VfM

Apart from assessing how PPP and TP projects have performed from a VfM perspective, it is also quite important to understand the factors that underpin VfM. In essence what factors drive or influence whether VfM is achieved. It is also relevant to unpack such drivers in the context of a shareholder vs stakeholder approach to VfM. Cui *et al*. (2019) argued that the factors and relationships among them that often contribute to increasing the VfM in PPP projects is often understated or ignored. Rogers (2001) noted that compiling relevant evaluation factors is an important step in determining VfM for PPPs. A few studies have assessed the key drivers or critical success factors of VfM, particularly for PPP projects, but in a few instances for TP projects as well.

There are a few papers that have provided useful insights into the issue of VfM drivers. Nisar (2007) identified price certainty, timely delivery, reputation as a quality asset, affordability, and project management capability as the critical factors that increase the VfM for PPP projects using a case-study approach. Morallos and Amekudzi (2008) considered that VFM also depends on several determinants, such as affordability, limited budget allocations and legally imposed budgetary limits, role and nature of risk transfer, level of competition, and nature of the service.

Chan *et al*. (2009) refined 15 VfM drivers of PPP projects in the UK and China, and four drivers were identified as the most important: solving the problem of public sector budget constraints, providing an integrated solution (for public infrastructure/services), reducing the amount of public money tied up in capital investments, and reducing public sector administration costs. These 15 factors have also been accepted as key drivers for increasing VfM in PPP projects by Chou and Pramudawardhani (2015). Ismail (2013) found 20 factors that ensure and enhance the VfM of PPP projects. Among these factors, private sector technical innovation and competitive tendering are perceived to be the most important for driving VfM achievement, together with efficient risk allocation, optimal use of assets/facilities, project efficiency, government support, output-based specification, private management skills, improved and additional facilities for the public sector, and risk transfer. Cui *et al*. (2019) provides a useful summary of the most relevant drivers from all the previous studies, as captured in Table 5.

Table 5: VfM drivers

VfM drivers	References
Private sector technical innovation and transfer	Cheung et al. (2009), Ismail (2013), Chan et al. (2009), and Chou and Pramudawardhani (2015)
Skills and expertise of the private sector	Cheung et al. (2009), Ismail (2013), Nisar (2007), and Morallos and Amekudzi (2008)
The perceptions and acceptance of stakeholders	McKevitt (2015) and Ameyaw et al. (2015)
Skills and expertise of the public sector	Ismail (2013) and Ameyaw et al. (2015)
Improve buildability and maintainability	Chan et al. (2009) and Chou and Pramudawardhani (2015)
Optimal use of asset/facility and better services delivery	Ismail (2013), Nisar (2007), Chan et al. (2009), Chou and Pramudawardhani (2015), and Henjewele et al. (2014)
Output-based specification	Cheung et al. (2009), McKevitt (2015), Ismail (2013), and Morallos and Amekudzi (2008)
Service delivery on time or in advance	Ismail (2013), Nisar (2007), Chan et al. (2009), Chou and Pramudawardhani (2015), and Ameyaw et al. (2015)
Product or service meeting users' demand	McKevitt (2015) and Santandrea et al. (2016)

Complementary advantages of public–private partnerships	Hu et al. (2014), Nisar (2007), Chan et al. (2009), and Santandrea et al. (2016)
Efficient risk allocation	Cheung et al. (2009), Ismail (2013), Nisar (2007), Santandrea et al. (2016), and Yuan et al. (2009)
Long-term nature of contracts	Ismail (2013), Santandrea (2016), and Morallos and Amekudzi (2008)
Nature of financial innovation	Ismail (2013), Chan et al. (2009), Chou and Pramudawardhani (2015), and Ameyaw et al. (2015)
Performance-based payment mechanism	Ismail (2013), Santandrea et al. (2016), and Morallos and Amekudzi (2008)
Service delivery at the agreed-upon price to the public sector	McKevitt (2015), Nisar (2007), Chan et al. (2009), and Chou and Pramudawardhani (2015)
Low project life-cycle cost	Ismail (2013), Chan et al. (2009), Chou and Pramudawardhani (2015), and Henjewele et al. (2014)
Environmental consideration	Ismail (2013) and Ameyaw et al. (2015)
Stable macroeconomic condition	Ameyaw et al. (2015) and Yuan et al. (2009)
Favorable legal framework	Yuan et al. (2012), Ameyaw et al. (2015), and Chowdhury (2011)

Source: Cui *et al*. 2019

Ng *et al*. (2010) after comprehensively reviewing many other papers, concluded that the evaluation factors for VfM can be grouped into four categories – technical, financial/economic, political/legal, and social. Within these, the specific factors in the table above can be delineated.

Beyond these social and environmental factors at a project level, there is also the school of thought that macroeconomic factors also have an impact on PPP and TP performance. Casady *et al* (2020) make a strong argument that at the micro-level, the decision on the extent of government and/or private sector participation in PPP projects may be somewhat influenced by an appreciation of the impact of different macroeconomic variables on PPP success. It is the understanding of the drivers of these factors, which in turn will hopefully shed light on which conditions are more suitable for either a private financed or government financed option.

One of the earliest studies to macroeconomic indicators as determinants of private sector investment in infrastructure was Hammami *et al*. (2006). The research examined a number of indicators that were effective on governments' and firms' PPP activities. According to the study, countries with large budget deficits were more likely to use PPP whereas countries with natural

resource endowments were less likely to use PPPs. The impact of population and GDP per capita were used to capture the effect of the size of the market on the intensity of the use of PPP. The relationship between macroeconomic stability in a country, which was measured by the level of inflation, money supply, international reserves and stability of the exchange rate, and the use of PPP was also investigated. Their findings revealed that debt level and country size were the most important determinants of PPP activities.

Mengistu (2013) investigated the impact of several macroeconomic indicators on PPP infrastructure investments for Sub-Saharan African (SSA) countries through a dataset that comprised the period of 1995 to 2008. The findings indicated that market size was an important driver of PPP. Additionally, heavy tax burden and inflation showed negative correlations with the PPP activity. The assessment has been broadened in recent literature to account for institutional factors as important elements of the investment enabling environment, even if discussed conceptually but not examined empirically. These factors are important to consider as it is theoretically accepted that they have an impact, perhaps somewhat nuanced, on investment flows into infrastructure projects. The empirical assessment of this impact, on a large scale, across countries in Africa has however been lacking. Yurdakul *et al.* (2021), who although do not include these factors, concede that the effect of governance related factors on PPP activities is important to consider, and measure empirically. It is therefore important for this study to include these factors in the analysis.

3.5 Conclusion

Considering the measurement approaches discussed, the most ideal approach appears to be an examination of a large set of projects – as large as is feasible due to the data demands. This aligns with the objective of this study – to develop a general view on how VfM has been observed in PPP and TP projects across Africa. Thus, an in-depth study of a small set of projects, while valuable, will not assist in achieving this objective. This, therefore, excludes the case study approach or a quantitative public sector comparator/benefit cost analysis assessment of a few projects, which would work where a specific aspect was under observation. This leaves the general descriptive comparative assessment or econometric analysis. The descriptive comparative assessment has been criticized as not being robust enough, and mainly only capturing the aspects of costs, not benefits. Therefore, this study will aim to conduct to main exercises – (1) unpack the drivers of VfM in PPP and TP projects in Africa; and (2)

conduct an econometric assessment of VfM, drawing on the most available detailed database of PPP and TP projects available, and critically, where a VfM indicator has been measured.

It is important to note some drawbacks of the selected approaches. Firstly, no two projects are alike, and secondly specific procurement processes differ both within projects and between project types, even within TP and PPP procurement approaches (Raisbeck *et al*. 2010). This limits the ability to make conclusive findings between individual projects. This does not diminish the usefulness of VfM exercises. This is because this analysis is aiming for a more general view of VfM between PPP and TP across a portfolio of projects, which is of value. In such an instance, the above limitations are greatly reduced by having a sufficient sample of projects to compare, to reduce the project specificities and nuances (Raisbeck *et al*. 2010).

4 UNPACKING DRIVERS OF VfM

4.1 Introduction

As discussed in Chapter 2 and Chapter 3, the predominant approach to assessing VfM has been to focus primarily on the costs and financial benefits of a project. This is akin to a shareholder view of VfM. This is a somewhat narrow view, with limited attention paid to broader dimensions such as the social, environment, legal/institutional and political variables that may have a notable bearing on the VfM of an infrastructure project (Ng *et al*. 2010). While the narrow definition of VfM has dominated previous analyses and is often the main means by which projects are assessed prior to investment, it is also increasingly understood that the VfM can be influenced by many factors, termed 'VfM drivers'. A more complete analysis must incorporate these broader considerations – the stakeholder view of VfM. This chapter aims to remedy this, and as noted in previous chapters, the key contribution of this study is to move the assessment of VfM of infrastructure projects beyond the current mainly quantitative cost and time estimations of previous studies to attempt a broader assessment involving a wider set of factors.

To do this, first one must examine which broader factors are, in fact, relevant to VfM. As a starting point, this chapter assumes the broader definition of value for money, so it extends beyond the simplistic view where VfM is represented by the monetary value of the public sector capital saved by adopting a PPP project, or for a TP project, essentially the lowest cost option by which an infrastructure service may be delivered. A more in-depth analysis is conducted to unpack the contextual issues that drive VfM. To achieve this, variables driving VfM are identified based on existing theory, for both PPP and TP, and the extent of their impact on VfM then measured empirically. The analytical tool by which this is done is Structural Equation Modelling (SEM). In summary, the focus of the chapter is on assessing VfM drivers and their relationships, to provide evidence of their influence on both PPP and TP success.

4.2 VfM Drivers and project success factors

Ng *et al*. (2010) argue that given the focus on costs in assessing VfM, less attention has been paid to qualitative elements such as the social, environmental, legal and political elements that impact the value of a project. The underlying notion here is that there is a range of factors that drives VfM. Understanding these factors, and importantly which ones o9f them are more

relevant under certain conditions, can help inform the decision of which procurement option to pursue. Unpacking this concept, the implication thereof is that there is a set of factors by which VfM in the shareholder view can be observed – these can be termed the VfM success factors. On the other hand, there is also a set of drivers that influences or determines the extent to which VfM may be achieved – these are the VfM drivers. These two sets of factors – the success factors and the drivers – form the core instruments of analysis in this chapter and are briefly discussed below.

4.2.1 Project success factors

Value for money is assessed in terms of the broader 'stakeholder' view, rather than the narrow 'shareholder' view which focuses primarily on monetary benefits and costs. An infrastructure project should be considered as delivering 'value for money' only if the key interests of all stakeholders are satisfied. Ng *et al*. (2010) note that therefore, the degree of stakeholders' satisfaction, based on a set of success factors, should be a more reliable measure of PPP project success. Lui *et al*. (2014) also assert that identifying the critical success factors for PPPs is a prerequisite for the development of a workable and effective PPP procurement protocol as it helps indicate how PPPs can achieve success and facilitate efficient allocation of limited resources. We argue here that this point applies to TP projects as well.

As such, it is necessary to identify several 'success factors' for stakeholders that incorporate this broader view of value for money. The success factors are in essence the factors that provide the evidence that stakeholder satisfaction has been achieved, or in other words, VfM is realised. Success can broadly encompass monetary returns, cost savings, reduction in construction time, a high-quality service, innovative solutions, better relationships between the public and private sectors, and beneficiary/community acceptance of the project. Drawing on these, and the work of Ng *et al*. (2010), Lui *et al*. (2014) and other studies, a set of critical success factors were determined for analysis. These are shown in Table 6.

Table 6: VfM (Stakeholders satisfaction) success factors

1. The output meets the required standards of users
2. The service delivery is prompt, stable and reliable
3. The project results in cost savings to the procuring entity
4. There is time saving in the construction of the facilities
5. The procurement process is inclusive and involves significant local providers
6. There are innovative solutions in the project that meet various stakeholder demands
7. There is well-functioning channel of communication amongst all stakeholders
8. The project sufficiently considers social factors
9. The project aligns with the development mandate of the Government at the national and local levels
10. The project sufficiently considers environmental factors in its design

It is important to note that the 10 factors in Table 6 include elements of project quantitative success factors such as cost and time savings, but also importantly incorporate the broader qualitative success factors of social, environmental, and political/institutional factors.

4.2.2 Value for money drivers

VfM drivers are defined as the factors that determine the VfM of PPP and TP projects. There are many notable studies identifying VfM drivers. Arthur Andersen and Enterprise LSE (2000) identified the most significant VfM drivers by surveying a sample of public agency officials, and academics and professionals, regarding their perceptions of risk transfer, output-based specifications, long-term nature of contracts (including whole-life costing), performance measurement and incentives, competition, and private sector management skills. Ismail (2013) found 20 factors that ensure and enhance the VfM of PPP projects. Among these factors, private sector technical innovation and competitive tendering were perceived to be the most important for driving VfM achievement, together with efficient risk allocation, optimal use of assets/facilities, project efficiency, government support, output-based specification, private management skills, improved and additional facilities for the public sector, and risk transfer.

Rogers (2001) in Wong (2010) argued that the compilation of evaluation factors is a critical step in conducting a feasibility study for PPP projects, and critical success factors (CSFs) could

serve well as determinants for PPP feasibility evaluation. Adopting this logic, this framework should apply to TP projects as well.

The VfM drivers are the factors that drive a project's overall viability, i.e., VfM, which ultimately impacts the stakeholders' satisfaction. The drivers can be grouped into five categories – technical, financial/economic, social, legal/political and others. As discussed, this draws from many studies (Akintoye *et al*. 2003: Kanji, 2002; Campbell and Finch, 2004; Bryde and Robinson, 2005). In addition to those listed, Ozdogan and Birgonul (2000) identified four different approaches for assessment of BOT/PPP project viability, such as financial and commercial factors, political and legal factors, and technical factors, and social factors. Based on a comprehensive review of 50 previous studies, Thomas *et al*. (2010) and Wong (2006) developed 4 main VfM drivers, and within these a number of factors/indicators of these drivers to assist in determining the feasibility of PPP projects. The 4 driver categories adopted in this study are discussed briefly below:

Technical – The extent to which a project is sufficiently designed and packaged is an important VfM driver, both for PPP and TP projects. Infrastructure projects by their nature are complex and require sufficient flexibility to ensure effective delivery. The experience of the public and private partners in an infrastructure scheme is also critical to its success, as it can help to resolve how the scheme should be packaged and delivered, especially when it is complex and sensitive in nature (Ng *et al*. 2010). Pearson (2008) considered the prospect of creating innovative solutions as influential if VfM is to be achieved. When the infrastructure service provider is to be financially rewarded based on their performance, decision makers should assess whether service quality can be objectively defined and measured before considering the use of the PPP approach.

Financial/Economic – The key question for any infrastructure project is whether there is a cost-effective solution. This has become the key comparator between PPPs and TP projects. A project regardless of whether it is a PPP or TP project, should be financially sustainable, and ideally profitable. For a project to be successful, be it a PPP or TP, the project must be financially sustainable, affordable and ideally profit making. This in turn depends both on project specific features but also on the economic environment and other factors such as the level of competition.

Social – Social acceptance of infrastructure projects is very important for their success, particularly to ensure there is the demand for the service, especially where a user-pay system underlies the revenue structure of the project. Engaging the public to make sure the benefits of a project are understood and gaining their trust and support are particularly important factors. The social category also includes environmental factors, which are an important consideration for the infrastructure projects.

Legal/political – A clear legal and regulatory framework is fundamental for effective delivery of projects, and to attract funding to a project. Lack of political support can also be a fatal flaw for project success. Any changes in the legal framework/institutional arrangements, and a perceived lack of political support creates uncertainty and increases the risk of failure of a project.

Within these categories, specific factors have been identified by previous research as outlined above. Table 7 provides a list of the VfM factors considered in this study, under each of the above categories.

Table 7: Value for money driver and factors

VfM Drivers and Factors	Relevant studies
Technical factors 1. Adequate Project scope and complexity 2. Effective skills and expertise of the private sector 3. Government contract management experience 4. Output based specifications 5. Efficient project governance structures	Rogers, 2001; Frillet, 1997; Grant, 1996; Jaselskis and Ashley, 1991; Pearson, 2005; Qiao *et al*. 2001; Tam, 1999; Tiong, 1996; Zhang *et al*. 1998
Financial and economic factors 1. Development of local capital market 2. Access to international capital for transactions 3. Efficient risk allocation 4. Stable macroeconomic conditions 5. Clear revenue/tariff model 6. Long-term demand for the products/services 7. Affordability of tariffs/fees	Rogers, 2001; Frillet, 1997; Hambros, 1999; Pearson, 2005; Qiao *et al*. 2001; Tam, 1999; Tiong, 1996; Zhang *et al*. 1998; Duffield, 2005

Social factors 1. Community support for the project 2. Local participation in the project 3. Job opportunities created by the project 4. Environmental impact considerations	Rogers, 2001; Frillet, 1997; Heinke and Wei, 2000; Pearson, 2005; Qiao *et al*. 2001; Tam, 1999; Tiong, 1996; Zhang *et al*. 1998;
Political and legal factors 1. Stability of political environment 2. Supportive legal framework 3. Efficient procurement process Clear process for legal recourse	Rogers, 2001; Frillet, 1997; Pearson, 2005; Qiao *et al*. 2001; Zhang *et al*. 1998; Duffield, 2005

In total, 20 factors were identified as important value for money drivers. While each of these factors can be theoretically said to be relevant, the key question is whether some of these factors are more relevant to TP or PPP projects than others. Understanding the relative importance of certain factors can help in the decision of which procurement option will be more appropriate under certain conditions. It is this analysis that this chapter is seeking to unpack, particularly in the African context.

4.3 SEM Methodology

Structural equation modelling (SEM) is a collection of statistical techniques that allows a set of relationships between one or more independent variables (IVs), either continuous or discrete, and one or more dependent variables (DVs), also either continuous or discrete, to be examined (Ullman and Bentler, 2013). SEM is a multivariate technique to simultaneously estimate a series of interrelated dependent relationships (Cui *et al*. 2019). It is useful for exploring the factors that drive VfM, particularly given the complex relationships underlying the financing, construction and operation of infrastructure projects. SEM is also referred to as causal modelling, causal analysis, simultaneous equation modelling, analysis of covariance structures, path analysis or confirmatory factor analysis (Ullman and Bentler, 2013).

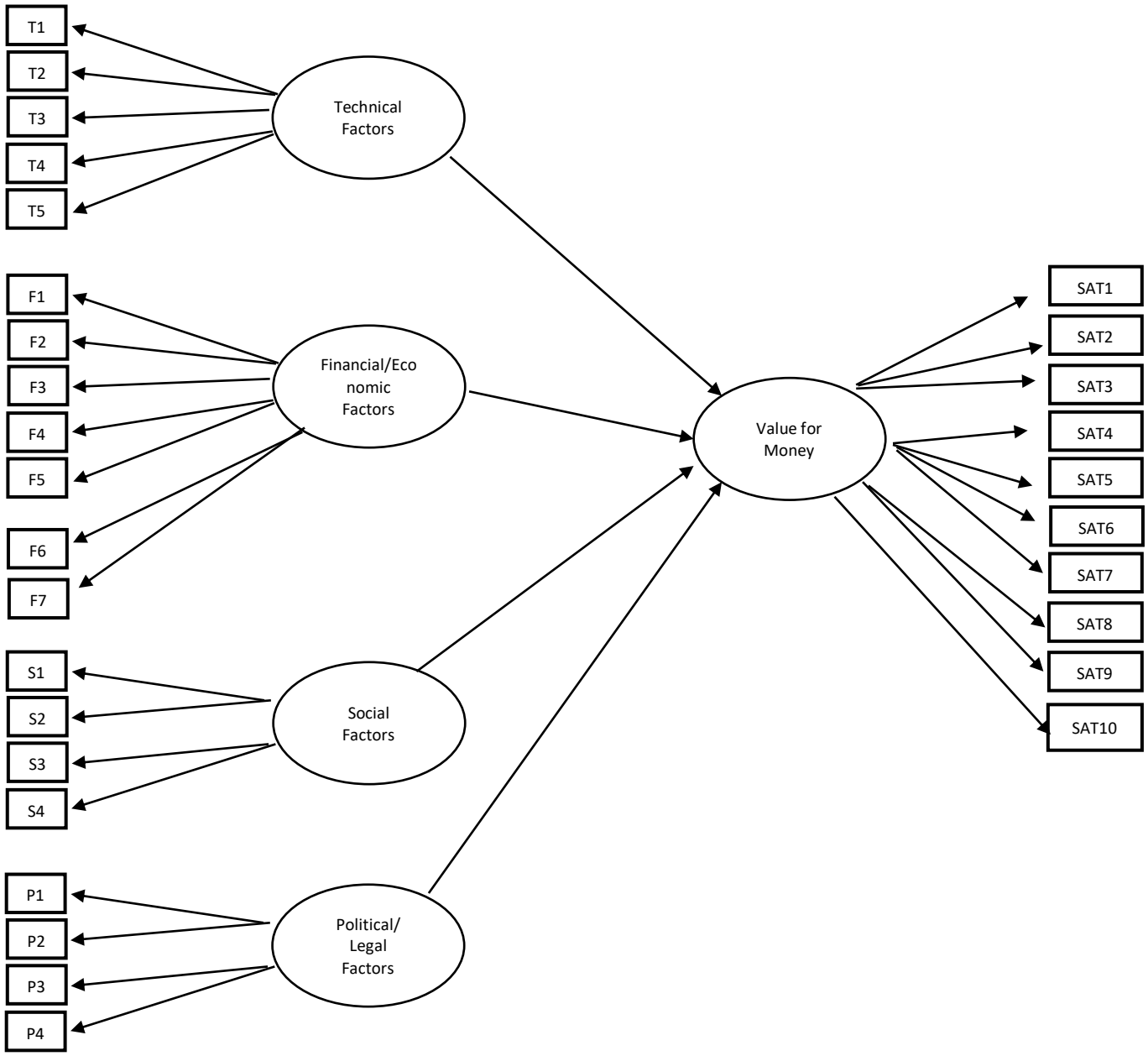
The SEM approach is used in this study to examine the relationships between the various evaluation factors for PPP and TP projects, and the level of stakeholder satisfaction. It is considered an effective method for establishing the structural relationships among the latent variables, and for testing the hypothetical model (Ng *et al*. 2010). Two main types of variables

are used in a SEM, namely the measured and latent variables. Measured variables are observable, while latent variables are hypothetical or theoretical constructs, and are inferred from the measured variables (Ng *et al*. 2010). A SEM therefore consists of the measurement and structural models, which are assessed sequentially. The measurement model firstly assesses the relationships between the latent and observed variables, and then the structural model is examined to identify the relationships among latent variables. There are three main stages in SEM modelling – specification of the theoretical model, assessment of the measurement model, and assessment of the structural model. There may be a fourth phase of modifications depending on the outcome of the three stages.

4.3.1 Specification of the theoretical model

The first step is specifying the hypothesis. In a SEM, this is typically done through path diagrams. Path diagrams are important components of a SEM framework. They enable the set of relationships to be hypothesized, help clarify the theoretical perceptions about the relationships among variables and can then be translated into the equations required for the analysis (Ullman and Bentler, 2013). The conceptual VfM model for this study is presented in Figure 7.

Figure 7: Conceptual VfM SEM model



The figure presents the path diagram hypothesizing the value for money drivers for PPP and TP projects. There are certain established conventions for path diagrams in a SEM. Measured variables are represented by squares or rectangles. Factors (latent variables) are represented by circles or ovals. Relationships between variables are indicated by lines, a lack of a line connecting variables implies that there is no direct relationship that has been hypothesized. Lines either have one or two arrows. A line with one arrow represents a hypothesized direct relationship between two variables, and the variables with the arrow pointing to it is the

dependent variable. A line with a two headed arrow indicates an unanalyzed relationship, meaning a covariance between the two variables with no implied direction of effect (Ullman and Bentler, 2013). Two headed arrows connect the factors to each other and to themselves, given that a variable's variance can be thought of as a covariance of the variable with itself (Mueller and Hancock, 2007). In this case, the diagram shows that the technical, financial, political and social variables drive or create value for money. And in turn their respective constructs predict these measured variables. The implication is that the technical variable creates the factor T1 – adequate project scope and complexity. Given that it is impossible to measure the construct directly, the underlying factors are measured as indicators of the construct (driver).

The SEM diagram above enables the setting out of the hypothesis to be tested in this chapter as follows:

H1: All drivers collectively positively influence value for money
H2: Technical drivers positively influence value for money
H3: Financial drivers positively influence value for money
H4: Political drivers positively influence value for money
H5: Social drivers positively influence value for money

These hypotheses are tested for both PPP and TP procurement options. The construct predicts the measured variables. This means that the technical, financial/economic, social and political factors are predicted/influenced by the respective underlying measured variables/factors, and then the measured variables collectively influence VfM. Therefore, the test is to determine whether this hypothetical structure of the measured variables is indeed relevant to VfM for either PPP or TP.

Measurement model

Once the SEM has been theoretically specified through the path diagram, the second step is to determine the measurement portion of the model. The measurement part of the model deals with the relationship between the measured indicators and the underlying driving factors, termed constructs. Here, the main determination is which of the constructs influence the latent variables. This is tested for both PPP and TP models. Assuming the structural model between

the latent variables in the next phase proves significant, the real explanatory power of this SEM model is unpacking which of the constructs influence value for money. This is the critical finding of the analysis as it will hopefully assist policy makers to understand the real drivers of VfM, for both PPP and TP projects. Comparing the drivers of VfM for PPP and TP projects will be an important finding to understand where there are common drivers, but also where different drivers are observed. Confirmatory factor analysis (CFA) is typically utilized to examine the relationships among the various constructs within the conceptual model (Byrne, 2016).

For the measurement model, the first challenge is to determine whether the model is 'identified'. A model is firstly specified then the parameters are estimated using sample data and then the parameters are used to produce the estimated population covariance matrix. Only models that are identified can be estimated. While the first step is to specify a model based on the hypothesis to be tested, only models that are identified can then be estimated. To establish the identifiability of the measurement portion of the model, the number of factors and measured variables (indicators) loading on each factor are considered. If there is only one factor, the model may be identified if the factor has at least three indicators with nonzero loading and the errors are uncorrelated with each other (Ullman and Bentler, 2013). If there are two or more factors, and if each factor has three or more indicators, the model may be identified if errors associated with the indicators are not correlated, each indicator loads only on one factor and the factors are allowed to covary (Ullman and Bentler, 2013).

There are five general goodness of fit indices used to determine the suitability of the measurement model. These include the Goodness of Fit Index (GFI), Normed Fit Index (NFI), Standardized Root Mean Square Residual (SRMR), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA). (Ullman and Bentler, 2013; Hair, 2018). Each of these tests has recommended thresholds that must be met to test the overall goodness of fit of the measurement model.

Table 8: SEM Model fit indices

Statistic	Recommended value
Chi-squared/d.f	<3.0
Root Mean Square (RMR)	<0.08
Goodness of fit (GFI)	>0.90
Comparative fit index (CFI)	>0.90
Adjusted goodness of fit index (AGFI)	>0.80
Tucker-Lewis index	>0.90

Source: Ullman and Bentler, 2013

It must be noted that the goodness of fit indices are affected to varying degrees by variations with respect to sample size and number of indicators. Where the goodness of fit indicates reveal that the measurement model is deemed not to fit adequately, there are number of measures by which the model may be improved. Byrne (2016) and Hair *et al*. (2018) propose the following means of improving the measurement model:

- The standardised residual covariance should fall within 2.58
- Factor loading (Standardised regression weight) should ideally be greater than 0.5, preferably above 0.7
- Modification indices (MI) indicating high covariance and substantial regression weights should be deleted to refine the model

Applying these measures, a revised measurement model is obtained, typically with a number of the latent variables/constructs dropped. The goodness of fit indicators are then tested again to confirm that the improved measurement model now meets the required thresholds. The constructs that remain are therefore deemed to be the ones that truly influence the latent variable. This is the important finding of the measurement model, to determine which constructs need to be dropped and which remain as the true drivers of the latent variables.

With the successful refinement of the measurement model, the next step is to assess whether the psychometric properties of the measurement model are adequate, through 'validity' and 'reliability' tests. Examining the validity and reliability of the measurement model represents an important step before proceeding to test the hypotheses in the structural model (Hair *et al*.

2018). Although validity and reliability are separate tests, they are interconnected. A measure can exhibit high reliability (consistency) but lack validity (accuracy), or it may have high validity (accuracy) while lacking reliability (consistency), as discussed by Gallagher *et al*. (2019).

Two well recognised tests for the reliability of the measurement model are Cronbach's alpha and Composite Reliability (CR). Cronbach's alpha is a commonly used measure of internal consistency. It quantifies the extent to which the items in a scale or constructs are interrelated or measure the same underlying construct. Cronbach's alpha ranges from 0 to 1, where higher values indicate better internal consistency. The required minimum cut-off value of the Cronbach's alpha and composite reliability are, respectively, 0.7 although 0.6 is permissible (Malhothra *et al*. 2017).

Validity refers to the extent to which a set of measured variables accurately represents the theoretical latent construct they are intended to measure (Hair *et al*., 2018). To assess the validity, researchers often consider "convergent validity" which evaluates the degree to which the specific constructs converge or share a substantial proportion of variance among them. Convergent validity is tested using the Average Variance Extracted (AVE) (Hair *et al*. 2018). To infer convergent validity, the AVE should be greater than 0.5.

Once reliability and validity are established, a third test, the divergent validity, which examines the extent to which a construct is distinct and not excessively related to other similar constructs, is carried out. In essence, convergent validity measures the degree of correlation between constructs that should theoretically be related, while divergent validity measures the extent of differentiation between constructs that should theoretically be distinct from each other (Hair *et al*. 2018).

Once the improved measurement model meets all the above tests of reliability, validity and divergent validity, it confirms that there is an appropriate level of internal consistency for all the constructs included in the improved measurement model. The measurement model can therefore be concluded to be reliable and the assessment can proceed to the structural model.

Structural model

The third step in the SEM is to examine the structural portion of the model, looking only at the relationships among the latent variables. Testing the relationships between the exogenous and endogenous latent variables occurs during the structural model stage when reliability, convergent validity, and discriminant validity have been established. Differentiating between dependent and independent variables is necessary during the structural model stage of structural equation modelling (SEM).

The same criteria used to test the goodness of fit of the measurement model are applied for the structural model. Once the goodness of fit of the model is established, the analysis proceeds to examine the hypothesized relationships within the model. This is the main test of the structural model, to identify whether the different hypotheses are significant or not, based on the p-values. The Beta values indicate the direction and strength of the relationships, while the p-values (sig.) estimate the significance of the predictive effects (Pallant, 2010). The significance of the relationship is supported if the p-value is below 0.05. Where a path relationship that underscore a hypothesis is proved to not be significant (based on the p-value), this indicates that the hypothesis does not hold and must be rejected. This will indicate, in this study, that the latent variable set out in that hypothesis does not materially affect VfM.

4.3.2 SEM Estimation techniques

The two most prevalent SEM estimation techniques are the covariance-based SEM (CB-SEM) and the variance-based SEM (PLS-SEM). Hair *et al.* (2017) notes that understanding the differences between the two methods is an important factor when deciding which would be more appropriate for a particular research study. CB-SEM is primarily used for confirmation of established theory (i.e., explanation). In contrast, PLS is a prediction-oriented approach to SEM, primarily used for exploratory research, but also appropriate for confirmatory research (Sarstedt *et al*. 2014).

Using a maximum likelihood (ML) function, CB-SEM attempts to minimize the difference between the sample covariance and those predicted by the theoretical model. Therefore, the parameter estimation process aims to reproduce the covariance matrix of the observed measures (Chin & Newsted, 1999). The use of the CB-SEM involves constraints in the form of parametric assumptions, sample size, model complexity, identification and factor

indeterminacy. To use this approach, it is assumed that the observed variables are suitable for a specific multivariate distribution (normality) and that observations are independent of each other (Chin and Newsted, 1999). Small samples that are not asymptotic in characteristics can lead to poor parameter estimates (Chin and Newsted 1999; Chou and Bentler, 1995; Hu and Bentler, 1995).

CB-SEM requires indicators to be reflective. This means the indicators are influenced or affected by the underlying latent variable. An alternative conceptualization is where the indicators are formative. This means the indicators are viewed as causing rather than being caused by the latent variable (Chin and Newsted, 1999). According to Bollen and lennox (1991) formative indicators do not conform to the classical test theory or factor analysis models that treat indicators as effects of a construct.

The CB-SEM estimates converge to the pre-specified parameter value as the sample size increases (i.e., the estimates have a low relative bias and are consistent). PLS-SEM estimates are not consistent and show higher variability in coverage (i.e., an increase of statistical power when the sample size increases); this variability declines with more indicators per measurement models and higher outer loadings.

The alternate approach is the PLS-SEM, which is a causal modelling approach aimed at maximizing the explained variance of the dependent latent constructs (Hair *et al*. 2011). PLS-SEM is similar to using multiple regression analysis. The primary objective is to maximize explained variance in the dependent constructs but additionally to evaluate the data quality on the basis of measurement model characteristics (Hair *et al*. 2011). PLS-SEM estimates loadings of the indicator variables for the exogenous constructs based on their prediction of the endogenous constructs, not their shared variance among indicator variables on the same construct (Hair *et al*. 2011). For small sample sizes, PLS-SEM has the highest statistical power (Lu *et al*. 2011). When measurement or model properties restrict the use of CB-SEM or when the emphasis is more on exploration than confirmation, PLS-SEM is seen as a suitable alternative to CB-SEM. If the sample size is large (e.g., more than 250 observations), CB- SEM has higher parameter accuracy and consistency than PLS-SEM. When the sample size is small, in comparison with CB-SEM, PLS- SEM has always larger or equal statistical power (Reinartz *et al*. 2009).

According to Hair *et al*. (2011), the philosophical distinction between CB-SEM and PLS-SEM is straightforward. If the research objective is theory testing and confirmation, then the appropriate method is CB-SEM. In contrast, if the research objective is prediction and theory development, then the appropriate method is PLS-SEM. In causal modelling situations where prior theory is strong and further testing and confirmation are the goals, CB-SEM is the more appropriate statistical methodology. Global goodness-of-fit criteria that also emphasize theory testing rather than theory building can be used to assess CB-SEM results (Anderson and Gerbing 1988).

This study is essentially testing the view that PPPs typically result in greater VfM than TP. While this is not a formal theory it is a widely held view, as discussed extensively in the literature review. Thus, the study tests whether this view holds empirically. In essence, the approach is mainly testing/confirmation but also importantly some theory development. On the face of it, the CB-SEM may appear to be the more appropriate model. However, as will be shown in the next chapter, the study has a relatively small sample size, and also seeks to develop the theory regarding PPPs, so a PLS-SEM can also be considered. Previous studies (Ng *et al*. 2011; Liu *et al*. 2019; Hang, 2017), which all looked at VfM drivers in PPPs, used the CB-SEM approach. We elect to present both approaches in this study. This will add to the rigor of the study, but also apart from providing insights on VfM, it adds a further dimension to the study by comparing the two estimation techniques in the context of VfM, to see how comparable the results are.

4.4 Data for SEM analysis

In estimating a SEM model, an important consideration is the sample size. Covariances are less stable when estimated from small samples. Parameter estimates and chi-square tests of fit are also sensitive to sample size (Ullman and Bentler, 2013). The SEM is ideally a large sample technique. However, Ullman and Bentler (2013) note that test statistics have been developed that allow for estimation of small models with as few as 60 respondents. Ng *et al*. (2010) note that there has been no consensus on what is regarded as a reasonable sample size for a SEM analysis. Ng *et al.* (2010) note that as a general guideline, a sample size of less than 100 should be considered as small, between 100 and 200 as medium and greater than 200 as large.

To collect the data required to conduct the SEM model, a questionnaire protocol was designed based on the evaluation factors and satisfaction factors as set out above. The survey was identical for PPPs and TP, thus respondents effectively completed two identical surveys, one for PPP and the other for TP. The questionnaire asked respondents to rate each project success factor and value for money driver on a Likert scale from one to seven, indicating the extent to which they agree with the statement as being relevant as a value for money driver or a satisfaction factor for PPP/TP, as follows:

- 7 – Strongly agree
- 6 – Agree
- 5 – Somewhat agree
- 4 – Neither agree nor disagree
- 3 – Somewhat disagree
- 2 – Disagree
- 1 – Strongly Disagree

A stratified sampling approach was used to classify respondents into three broad groups – public sector, private sector and general public/community groups. This was done to ensure that the survey results were representative across the three groups. The private sector respondents include infrastructure industry practitioners such as developers, consultants and investors experienced with PPP and TP transactions. The public sector respondents targeted government departments relevant for infrastructure development, government PPP units, as well as development finance institutions. The validity of the survey depends on obtaining responses across these three groups as they each play some role in the effectiveness of a project, and also have a perspective on the 'value' aspect of value for money, particularly for the users of the infrastructure i.e. general public/community groups. To ensure that respondents, particularly general public/community respondents, understood the purpose and rationale for the study, an introduction on the concept and research objectives was included in the survey (see annexure 1).

To begin, the questionnaire posed three descriptive questions – the region in which the respondent operates, the field of operations and their years of infrastructure experience. Given that the purpose of the survey was to unpack quite a complex issue, it was important that majority of respondents had experience or operated in Africa and are generally knowledgeable about the infrastructure sector. However, it was also important to have some respondents from the general public, representing users of infrastructure services, to get a view of the general (nonexpert) perspective of PPP and TP projects.

700 questionnaires were issued out over an 8-month period. A total of 131 responses were received, indicating a response rate of 18.7%. This yields a medium sample size, which is a sufficient to proceed with the analysis (Ng *et al*., 2010). Table 9 shows the breakdown of the responses by the different groups, and the respective response rates.

Table 9: Profile of respondents and response rates

Respondent category	Number of questionnaires issued (estimate)	Number of responses	Response rate	Percentage in the sample
Private sector	250	65	32.5%	49.6%
Government	150	27	18%	20.6%
Development agency	200	22	11%	16.8%
Academic/research institution	50	13	26%	9.9%
General public	50	4	8%	3.1%
Total	**700**	**131**	**18.7**	**100%**

The private sector had the highest response rate at 32.5%, and therefore also had the largest share of the sample at 40.6%. The government response rate was 18% with a 20.6% share of the public. One can argue that the government rate can be combined with the development agencies which had a share of 16.8%, thus the broader public sector's share was 37.4%. the general public had the smallest share at 3.1%. These rates are similar to the study by Ng. et al (2010) who had an overall response rate of 23% (800 questionnaires issued with 180 responses), with a private sector response rate of 40% and share of 44%, and government response rate of 24% and share of 27%.

Although Respondents were targeted across regions, most responses were primarily from Africa, as shown in Table 10. It is still useful that almost 10% of the responses were from outside the Africa region, ensuring some perspectives from other regions were incorporated in the analysis.

Table 10: Regional distribution of respondents

Region	Percentage of responses
Africa	91.6%
Europe	3.8%
Asia	3.1%
North America	1.5%

Respondents were also asked to indicate their relevant years of experience in the infrastructure sector and/or finance experience. As shown in the figure below, almost half of respondents, 42.8% had greater than 10 years of experience in infrastructure/finance. 24.4% had between 5 – 10 years and about 29% had less than 5 years of experience. Just 3.8%, likely aligned to the public sector respondents had no experience in infrastructure/finance. This is an important validation that the respondents represent the right level of experience and understanding required to complete the survey.

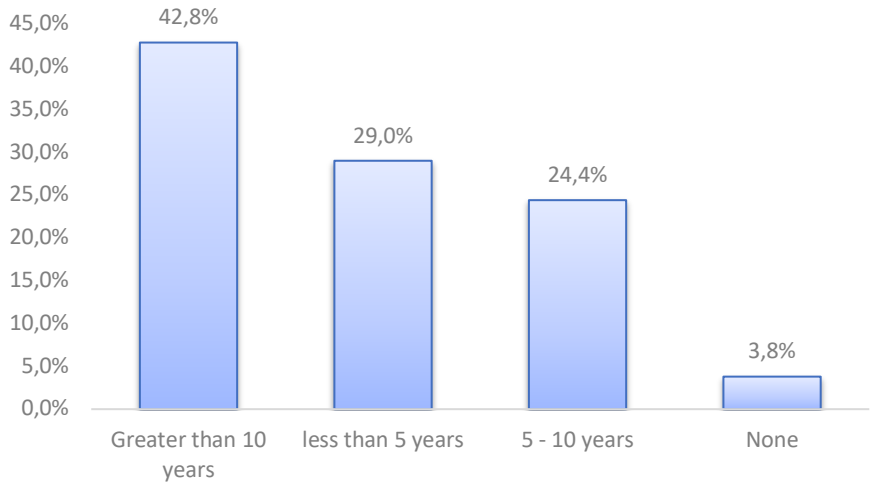


Figure 8: Experience of survey respondents

4.5 SEM Results – PPP

Building on the methodology set out above, this section now presents the results of the PPP SEM analysis, following the survey results. The section is split into three parts – firstly, the descriptive analysis of the survey results for PPP is presented. This gives an initial snapshot of the responses to the survey questions. The next two parts present the SEM analysis, first for the CB-SEM approach, and then the PLS SEM.

4.5.1 Descriptive Analysis

The first analysis of the results reflects the relative importance attributed to the evaluation factors and satisfaction measured based solely on the rankings provided by the respondents. This is captured by the mean ratings and standard deviations of each factor and measure. Where a mean factor is above the midpoint of the 7-point Likert scale (i.e., 4 or above), this implies that the factor is deemed to be relevant to the success of a PPP project (prior to a detailed statistical assessment). The mean and standard deviations are shown in Table 11.

Table 11: PPP Value for money drivers - means and standard deviations

Constructs	Items	Mean	Std. Deviation	Overall Mean	Overall Std. Deviation	Skewness	Kurtosis
Technical Factors	T1	5,72	1,270	5,72	1,088	-0,548	-0,973
	T2	5,67	1,278			-0,532	-0,971
	T3	5,82	1,262			-0,678	-0,795
	T4	5,60	1,249			-0,219	-1,513
	T5	5,81	1,289			-0,672	-0,894
Financial/Economic Factors	F1	5,13	1,443	5,37	1,120	-0,389	-0,629
	F2	5,05	1,408			-0,286	-0,526
	F3	5,55	1,370			-0,640	-0,545
	F4	5,48	1,283			-0,412	-0,787
	F5	5,44	1,436			-0,505	-0,847
	F6	5,56	1,300			-0,449	-0,970
	F7	5,42	1,440			-0,619	-0,483
Social Factors	S1	5,54	1,246	5,48	1,175	-0,309	-1,030
	S2	5,44	1,294			-0,342	-0,893
	S3	5,47	1,313			-0,402	-0,809
	S4	5,47	1,348			-0,503	-0,737
Political/ Legal Factors	P1	5,64	1,300	5,68	1,172	-0,525	-0,802
	P2	5,68	1,288			-0,605	-0,669
	P3	5,82	1,291			-0,762	-0,522
	P4	5,59	1,243			-0,436	-0,946
Stakeholder satisfaction	SAT1	5,62	1,259	5,44	1,145	-0,460	-1,049
	SAT2	5,56	1,306			-0,455	-0,925
	SAT3	5,36	1,403			-0,566	-0,363
	SAT4	5,33	1,349			-0,374	-0,787
	SAT5	5,31	1,369			-0,426	-0,687
	SAT6	5,30	1,304			-0,170	-1,214
	SAT7	5,38	1,389			-0,401	-0,839
	SAT8	5,48	1,289			-0,395	-0,885

	SAT9	5,54	1,295			-0,282	-1,274
	SAT10	5,47	1,289			-0,251	-1,243

In general, all the VfM drivers scored 5 (somewhat agree) or higher, indicating a general agreement of their importance and relevance. At an overall factor level, the technical factors had the highest average, at 5.72. Interestingly, the political/legal factors came in second at 5.68, higher than the financial/economic factors at 5.38. This is notable given that the basis of PPPs has often been the financial rationale, and less so the political factors, though the legal regime is also a critical determining factor. As may be somewhat expected the social factors ranked lowest at 5.48. All satisfaction factors also scored between 5 and 6, confirming a broad alignment of their relevance. The final descriptive test is the skewness and kurtosis assessment, which helps to test whether the data is normally distributed, a relevant factor for SEM. The skewness and kurtosis confirm that the data is indeed normally distributed.

The descriptive analysis has provided some insight into the responses of the survey respondents. It provides a snapshot of the overall view on the VfM drivers, but also paints an initial picture of which specific drivers are rated higher by respondents, and similarly for satisfaction factors. However, the analysis must proceed to a more structured measuring approach, based on the SEM estimation approach. The CB-SEM is presented next.

4.5.2 Covariance Based Approach

The measurement model is assessed through the confirmatory factor analysis (CFA), examining the relationship between the observed and latent variables or constructs. Using the AMOS software, an initial measurement model is specified and assessed through the confirmatory factor analysis (CFA), examining the relationship between the observed and latent variables or constructs. The initial CB-SEM measurement model for PPP is shown in Figure 9.

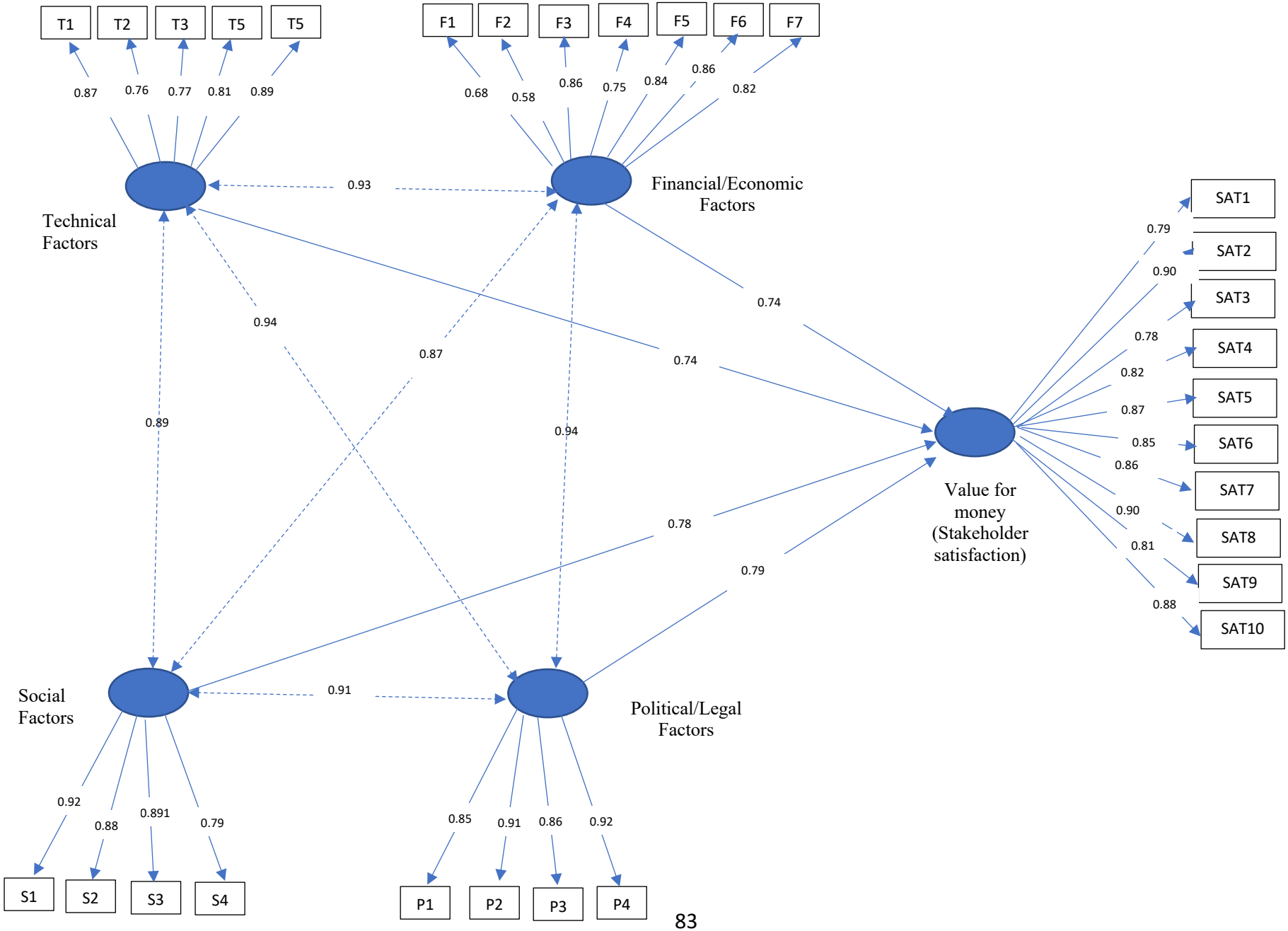


Figure 9: PPP – CB-SEM initial measurement model

The base model indicators are Chi-square – 1304.016, d.f. – 395 and a probability of 0.000. However, as noted in the methodology, it is necessary to check that the initial measurement model fits well. This implies checking the relevant specific fit indicators, as set out in Table 12.

Table 12: PPP CB-SEM - Initial goodness of fit estimation

Fit Indicator	**Threshold adapted from Hair *et al.* (2014)**	**measurement model**
CMIN/DF (Chi-square/degree of freedom)	Less than 3 (good) Between [3-5] (acceptable)	3.301
RMSEA (Root Mean Square Error of Approximation)	Less than .05 (good) Between [.06-.1] (acceptable)	0.133
CFI (Comparative Fit Index)	Above .90	0.807
TLI (Tucker Lewis Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.787
GFI (Goodness-Of-Fit-Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.614
SRMR (Standardized Root Mean Square Residual)	Less than .08 (acceptable) Less than 0.05 (good)	0.057

The table indicates that the initial measurement model does not appear to fit well with the data, as several of the goodness of fit indicators do not meet the required thresholds. The SEM model was re-estimated a few times to improve the model fit by removing evaluation factors having a lower correlation to the latent factors. Figure 10 presents the output of the improved SEM model. To confirm the validity of the improved model, the goodness of fit indicators for this model are presented in Table 13.

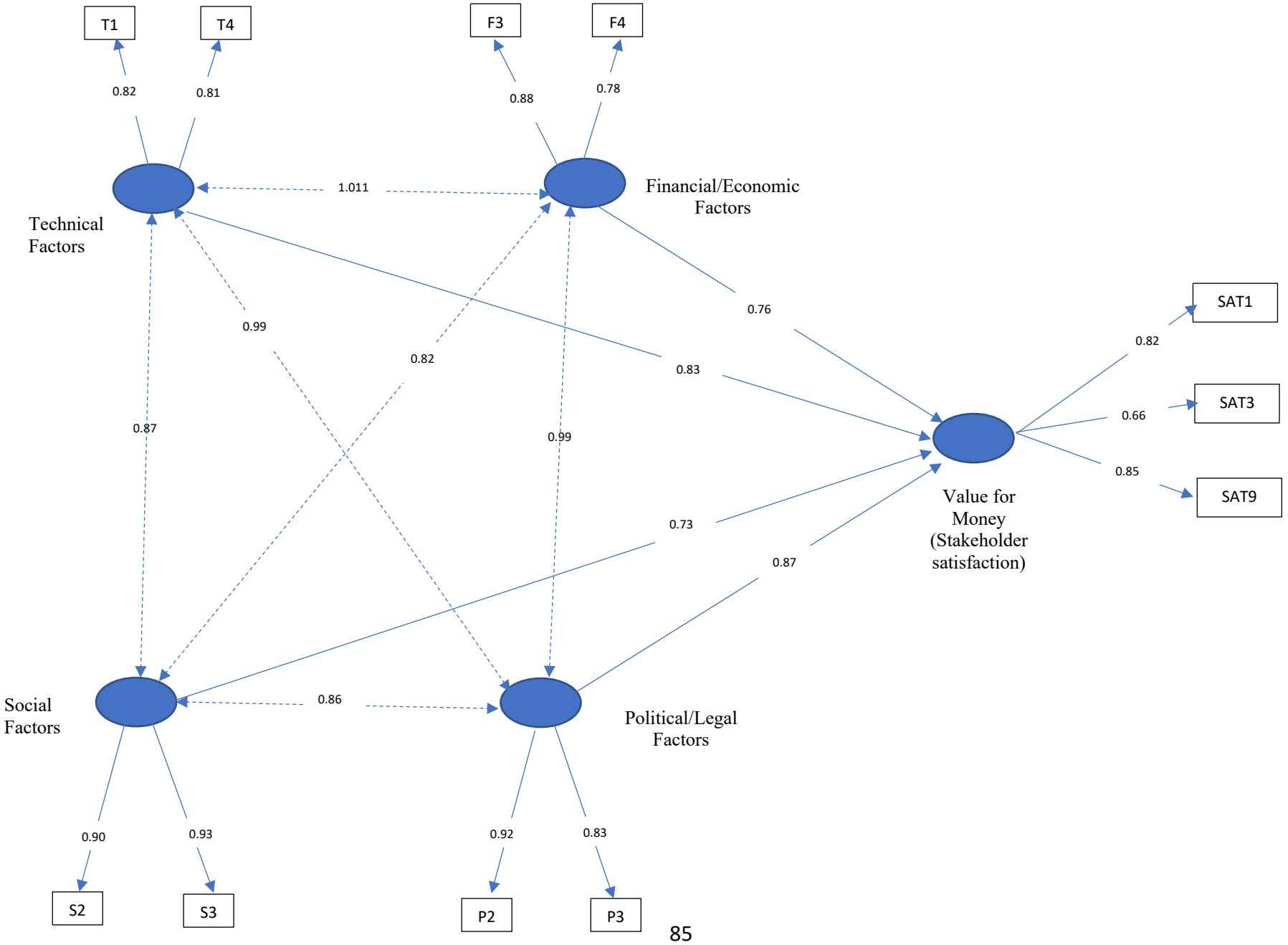


Figure 10: PPP CB-SEM - Final SEM model

Table 13: CB-SEM TP model - Initial goodness of fit estimation

Fit Indicator	Threshold adapted from Hair et al. (2014)	Measurement model
CMIN/DF (Chi-square/degree of freedom)	Less than 3 (good) Between [3-5] (acceptable)	1.779
RMSEA (Root Mean Square Error of Approximation)	Less than .05 (good) Between [.06-.1] (acceptable)	0.077
CFI (Comparative Fit Index)	Above .90	0.978
TLI (Tucker Lewis Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.964
GFI (Goodness-Of-Fit-Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.923
SRMR (Standardized Root Mean Square Residual)	Less than .08 (acceptable) Less than 0.05 (good)	0.031

It is now necessary to examine which factors remain in the revised model, as these are the ones that essentially are relevant determining factors for VfM in PPP as well as the satisfaction factors that remain. The table below indicators which factors were excluded (shown with strikethrough) and which factors remain.

Table 14: PPP CB-SEM: Factors of improved measurement model

Evaluation factor/variable
Technical factors
T1 – Efficient project scope and complexity
~~T2 - Skills and expertise of the private sector~~
~~T3 - Government contract management experience~~
T4 - Output based specifications
~~T5 - Project governance structures~~
Financial and economic factors
~~F1 - Development of local capital market~~
~~F2 - Access to international capital for transactions~~
F3 - Efficient risk allocation
F4 - Stable macroeconomic conditions
~~F5 - Clear revenue/tariff model~~

~~F6 - Long-term demand for the products/services~~
~~F7 - Affordability of tariffs/fees~~
Social factors
~~S1 - Community support for the project~~
S2 - Local participation in the project
S3 - Job opportunities created by project
~~S4 - Environmental impact considerations~~
Political and legal factors
~~P1 - Stability of political environment~~
P2 - Supportive legal framework
P3 - Efficient procurement process
~~P4 - Clear process for legal recourse~~

Similarly for the stakeholder satisfaction factors, the table below indicators the factors that remain in the improved measurement model.

Table 15: PPP CB-SEM: Stakeholders' satisfaction factors of improved measurement model

SAT1 - The output meets the required standards of users
~~SAT 2 - The service delivery is prompt, stable and reliable~~
SAT 3 - The project results in cost savings to the procuring entity
~~SAT 4 - There is time saving in the construction of the facilities~~
~~SAT 5 - The procurement process is inclusive and involves significant local providers~~
~~SAT 6 - There are innovative solutions in the project that meet various stakeholder demands~~
~~SAT 7 - There is well-functioning channel of communication amongst all stakeholders~~
~~SAT 8 - The project sufficiently considers social factors~~
SAT 9 - The project aligns with the development mandate of the Government at the national and local levels
~~SAT 10 - The project sufficiently considers environmental factors in its design~~

The next step is to check the reliability and convergent validity of the improved measurement model. This is done by assessing the p-value and through Cronbach's alpha, composite reliability (CR) and the average variance extracted (AVEs).

Table 16: PPP CB-SEM - Outputs of Cronbach's Alpha, CR and AVE

Constructs	Items	Factor loadings	P-value	Cronbach's Alpha	Composite Reliability (CR)	Average variance extracted (AVE)
Technical Factors	T1	0.824	0,000	0.801	0.801	0.668
	T4	0.810	0,000			
Financial/Economic Factors	F3	0.877	0,000	0.813	0.819	0.690
	F4	0.782	0,000			
Social Factors	S2	0.901	0,000	0.911	0.911	0.837
	S3	0.928	0,000			
Political/ Legal Factors	P2	0.915	0,000	0.866	0.868	0.767
	P3	0.834	0,000			
Stakeholder satisfaction	SAT1	0.816	0,000	0.832	0.795	0.610
	SAT3	0.664	0,000			
	SAT9	0.850	0,000			

Reliability

Table 16 reports the results of the reliability test, assessed with Cronbach's Alpha and Composite Reliability, with a required cut-off value for Cronbach's Alpha and Composite Reliability (CR) of 0.7. The results in the table above show that Cronbach's Alpha ranges from 0.801 to 0.911; while for Composite reliability they also range from 0.801 to 0.911. This confirms an overall acceptable internal consistency of all five (5) latent variables considered in the model. Therefore, based on these results, all constructs involved in are considered reliable.

Convergent validity

Convergent validity is the extent to which a set of items only measures one latent variable in the same direction. The results support the notion of convergent validity because all the factor loadings are above or equal to 0.5. In addition, the Average Variance Extracted (AVEs) estimates are all above 0.5.

Structural model assessment

The assessment of the CB-SEM model can now proceed to the analysis of the structural model. The structural model now tests the hypotheses abouts the relationship between the latent variables and value for money (defined by stakeholder satisfaction). The table below establishes the results of the structural model tests on the various hypothesis. The Beta values

indicate the direction and strength of the relationships, while the p-values estimate the significance of the relationships. Significance is supported if the p-value is below 0.05.

Table 17 shows that all drivers when considered collectively as one group, have a positive and significant effect on VfM. The technical, financial and social drivers also have a positive significant effect on VfM. On the other hand, the political drivers emerge as non-significant. The implications of these findings are discussed in more detail in at the end of this chapter and in Chapter 6.

Table 17: PPP CB-SEM - structural model

Hypothesis	Beta value	P-value	Implication
H1: All drivers collectively positively influence value for money	0.777	0.000	All drivers collectively have a positive significant effect on value for money
H2: Technical drivers positively influence value for money	0.195	0.003	Technical drivers have a positive significant effect on value for money
H3: Financial drivers positively influence value for money	0.256	0.000	Financial drivers have a positive significant effect on value for money
H4: Political drivers positively influence value for money	0.092	0.282	Political drivers have a non-significant effect on value for money
H5: Social drivers positively influence value for money	0.192	0.084	Social drivers have a positive effect on value for money

To confirm the validity of the structural model, the goodness of fit indices are again presented for the structural model. All the fit indicators are within the expected threshold, except the GFI which is on the border of the acceptable range.

Table 18: CB-SEM Structural Model - Fit indicators

Fit Indicator	Threshold adapted from Hair et al. (2014: 579-580)	Final measurement model	Notes for the model
CMIN/DF (Chi-square/degree of freedom)	Less than 3 (good) Between [3-5] (acceptable) Above 5 (bad)	2.806	Chi-square = 117.857 Degrees of freedom = 42 Probability level = 0.000
RMSEA (Root Mean Square Error of Approximation)	Less than .05 (good) Between [.06-.1] (acceptable) Above .1 (bad)	0.118	
CFI (Comparative Fit Index)	Less than .90 (bad) Above .90 (good)	0.935	
TLI (Tucker Lewis Index)	Less than .80 (bad) Between [.80-.90] (acceptable) Above .90 (good)	0.915	
GFI (Goodness-Of-Fit-Index)	Less than .80 (bad) Between [.80-.90] (acceptable) Above .90 (good)	0.857	
SRMR (Standardized Root Mean Square Residual)	Above .08 (bad) Less than .08 (acceptable) Less than 0.05 (good) Equals 0 (perfect)	0.042	

4.5.3 PLS-SEM Method

The CB-SEM model confirmed the main hypothesis – that value for money should be seen as a significant factor for stakeholder satisfaction, and secondly it highlighted the specific factors within each of the four value-for-money drivers that appear most relevant for PPPs. We now turn to the PLS-SEM method to conduct a similar analysis, mainly as a confirmatory approach of the CB-SEM, but also to identify any differences in the outcomes.

Measurement model

The measurement model is assessed through the confirmatory factor analysis (CFA), examining the relationship between the observed and latent variables or constructs. The figure below presents the initial measurement model.

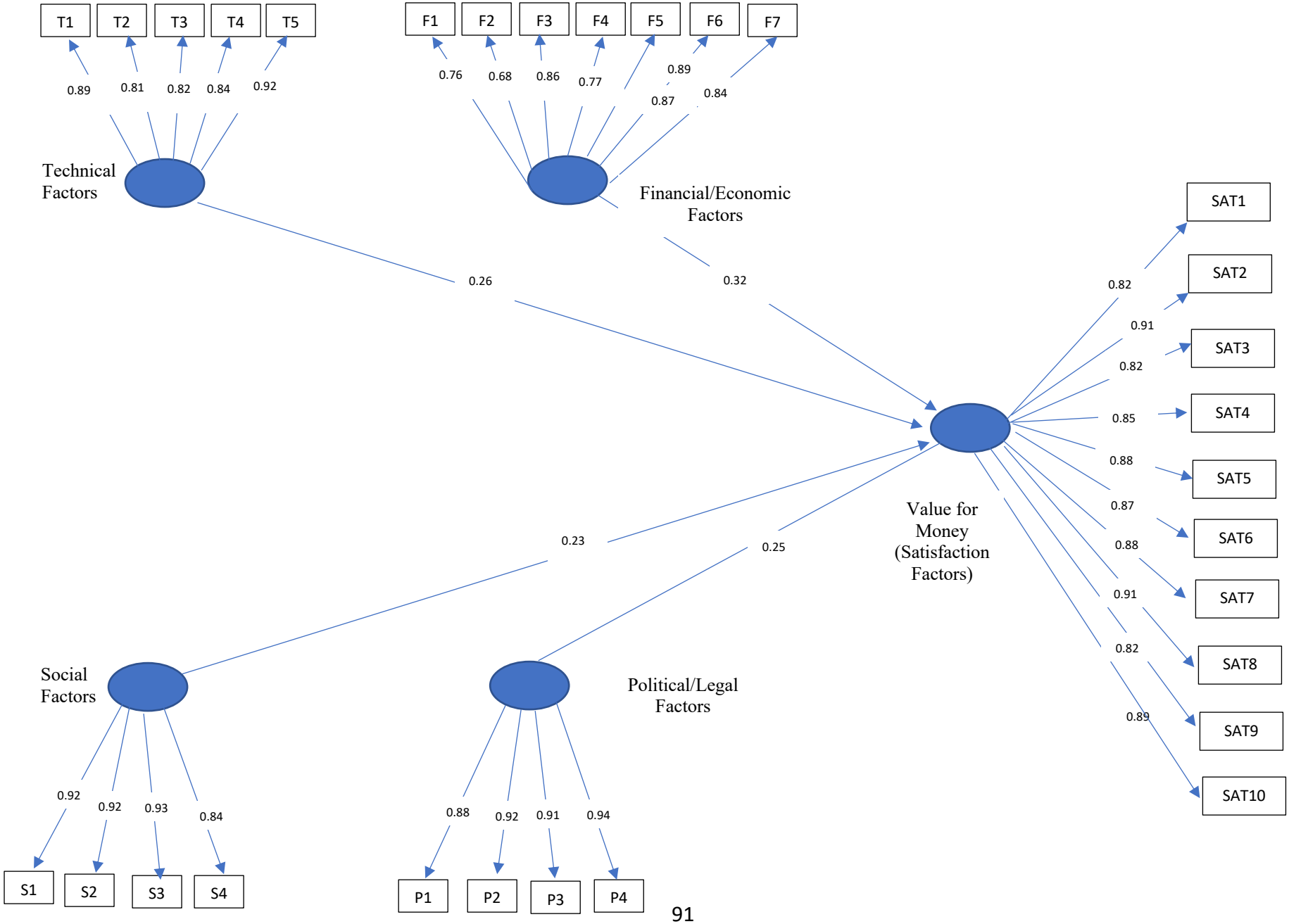


Figure 11: PPP: PLS - Initial Measurement model

All the constructs in the PLS-SEM model are well above the threshold of 0.7, implying that all constructs are relevant and should not be dropped. Only one, F2 (access to international capital) is at 0.68, which is marginally below 0.7 and drawing from theory, does not imply that it must be immediately deleted. This is quite an interesting finding as it supposes that each of the value for money factors, as well as the stakeholder satisfaction factors identified at the theoretical stage are in fact relevant.

This result contrasts with the CB-SEM where the model had to be improved by dropping certain factors to improve the goodness of fit indices. The result may not be uncommon for PLS-SEM models, as confirmed by Hair *et al*. (2017) who found that PLS-SEM typically retains almost every factor, whereas the CB-SEM method often requires a few items to be dropped to improve the goodness of fit indices.

The next step is to check the reliability and convergent validity of the improved measurement model. This is done by assessing the p-value and through Cronbach's alpha, composite reliability (CR) and the average variance extracted (AVEs).

Table 19: PPP: PLS Reliability and Convergent Validity test

Constructs	Items	Factor loadings	Cronbach's Alpha	Composite Reliability (CR)	Average variance extracted (AVE)
Technical Factors	T1	0.890	0.910	0.913	0.736
	T2	0.813			
	T3	0.824			
	T4	0.838			
	T5	0.920			
Financial/Economic Factors	F1	0.756	0.912	0.920	0.659
	F2	0.675			
	F3	0.859			
	F4	0.777			
	F5	0.887			
	F6	0.866			
	F7	0.841			
Social Factors	S1	0.924	0.926	0.927	0.819
	S2	0.920			
	S3	0.931			
	S4	0.841			
Political/ Legal Factors	P1	0.899	0.935	0.936	0.838
	P2	0.921			
	P3	0.905			

	P4	0.935			
Stakeholder satisfaction	SAT1	0.817	0.962	0.965	0.747
	SAT2	0.907			
	SAT3	0.815			
	SAT4	0.853			
	SAT5	0.880			
	SAT6	0.869			
	SAT7	0.877			
	SAT8	0.905			
	SAT9	0.823			
	SAT10	0.902			

Reliability

The results in the table above show that Cronbach's Alpha ranges from 0.910 to 0.962; while for Composite reliability they also range from 0.659 to 0.838. This confirms an overall acceptable internal consistency of all five (5) latent variables considered in the model. Therefore, based on these results, all constructs involved in are considered reliable.

Convergent validity

Convergent validity is the extent to which a set of items only measures one latent variable in the same direction. The results support the notion of convergent validity because all the factor loadings are above or equal to 0.5. In addition, the Average Variance Extracted (AVEs) estimates are all above 0.5.

Structural model assessment

The structural model examined the structural model path coefficients (β) and Coefficient of determination (R^2), specifically of the relationship between value for money and stakeholder satisfaction. As with the CB-SEM the value for money factors are constructs that explain value for money, while the structural model tests the significance of the overarching relationship between value for money and stakeholder satisfaction. Similar to the CB-SEM, the PLS model confirms the significance of value for money in explaining stakeholder satisfaction.

Table 20: PPP PLS-SEM model - value for money structural model

Hypothesis	Beta value	P-value	Implication
H1: All drivers collectively positively influence value for money	0.774	0.000	All drivers collectively have a positive significant effect on value for money
H2: Technical drivers positively influence value for money	0.263	0.000	Technical drivers have a positive significant effect on value for money
H3: Financial drivers positively influence value for money	0.321	0.000	Financial drivers have a positive significant effect on value for money
H4: Political drivers positively influence value for money	0.245	0.000	Political drivers have a positive significant effect on value for money
H5: Social drivers positively influence value for money	0.228	0.000	Social drivers have a positive significant effect on value for money

All hypotheses were found to be significant and have a positive impact on VfM. According to the PLS-SEM therefore, the full theoretical model is adequate and every variable and underlying factor is relevant in influencing VfM. This differs from the CB-SEM where the political and social drivers were not found to be significant.

4.6 SEM Results – TP

Building on the methodology set out above, this section now presents the results of the TP SEM analysis, following the survey results. The section is split into three parts – firstly the descriptive analysis of the survey results for TP is presented. This gives an initial snapshot of the responses to the survey questions. Following this, the next two sections present the econometric SEM analysis, first for the CB-SEM approach, and then the PLS SEM.

4.6.1 Descriptive Analysis

The first analysis of the results reflects the relative importance attributed to the evaluation factors and satisfaction measured based solely on the rankings provided by the respondents. This is captured by the mean ratings and standard deviations of each factor and measure. Where a mean factor is above the midpoint of the 7-point Likert scale (i.e., 4 or above), this implies

that the factor is deemed to be relevant to the success of a PPP project. The mean and standard deviations are reported in Table 21.

Table 21: TP Value for money drivers - means and standard deviations

Constructs	Items	Mean	Std. Deviation	Overall Mean	Overall Std. Deviation	Skewness	Kurtosis
Technical Factors	T1	6,06	1,199	6,04	1,059	-1,269	1,121
	T2	6,18	1,174			-1,483	1,853
	T3	5,99	1,166			-1,128	1,116
	T4	5,91	1,233			-1,139	0,993
	T5	6,07	1,145			-1,322	1,743
Financial/Economic Factors	F1	5,47	1,232	5,78	1,040	-0,625	0,284
	F2	5,38	1,354			-0,669	-0,209
	F3	6,02	1,233			-1,312	1,392
	F4	5,67	1,276			-0,946	0,559
	F5	6,02	1,312			-1,290	0,988
	F6	6,04	1,257			-1,288	1,162
	F7	5,84	1,271			-1,044	0,549
Social Factors	S1	5,67	1,292	5,65	1,095	-0,860	0,318
	S2	5,52	1,309			-0,690	-0,026
	S3	5,62	1,203			-0,676	0,157
	S4	5,77	1,228			-0,835	0,187
Political/ Legal Factors	P1	5,96	1,239	5,95	1,144	-1,077	0,578
	P2	6,01	1,257			-1,415	2,031
	P3	5,92	1,307			-1,161	0,791
	P4	5,90	1,230			-1,137	1,011
Value for money drivers (Stakeholder satisfaction)	SAT1	5,78	1,336	5,64	1,139	-0,928	0,082
	SAT2	5,86	1,288			-0,859	-0,254
	SAT3	5,58	1,437			-0,685	-0,531
	SAT4	5,53	1,286			-0,463	-0,688
	SAT5	5,41	1,350			-0,490	-0,416
	SAT6	5,63	1,268			-0,553	-0,515
	SAT7	5,71	1,298			-0,704	-0,446
	SAT8	5,58	1,272			-0,647	-0,274
	SAT9	5,64	1,302			-0,579	-0,621
	SAT10	5,67	1,315			-0,662	-0,414

In general, all the VfM drivers scored 5 (somewhat agree) or higher, indicating a general agreement of their importance and relevance. At an overall factor level, the technical factors had the highest average, at 6.04. Interestingly, the political/legal factors came in second at 5.95,

higher than the financial/economic factors at 5.78. This is notable given that the basis of PPPs has often been the financial rationale, and less so the political factors, though the legal regime is also a critical determining factor. This could be attributed to the importance that political factors, such as consumer participation, and accountability play in TP projects. Public buy-in for infrastructure projects, particularly those fully undertaken by the public sector is important to achieving VfM in these projects. As may be somewhat expected, the social factors ranked lowest at 5.65, given the existing prominence of the narrow shareholder view where social factors are not considered as vital at project specific factors. All satisfaction factors also scored between 5 and 6, confirming a broad alignment of their relevance. The final descriptive test is the skewness and kurtosis assessment, which helps to test whether the data is normally distributed, a relevant factor for SEM. The skewness and kurtosis results confirm that the data is indeed normally distributed.

Similar to the analysis for PPPs, the descriptive analysis for TPs has provided some insight into the responses of the survey respondents. It provides a snapshot of the overall view on the VfM drivers, but also paints an initial picture of which specific drivers are rated higher by respondents, and similarly for satisfaction factors. The analysis now presents the results of the two SEM estimation techniques – CB-SEM and PLS -SEM.

4.6.2 Covariance Based Method

The results presented below for the CB-SEM follow the methodology set out above. Given that the theoretical model has already been laid out in figure 1, the analysis here proceeds to present the results of the main SEM estimations – the measurement model and structural model.

Measurement model

The initial CB-SEM measurement model for TP is shown in the figure below.

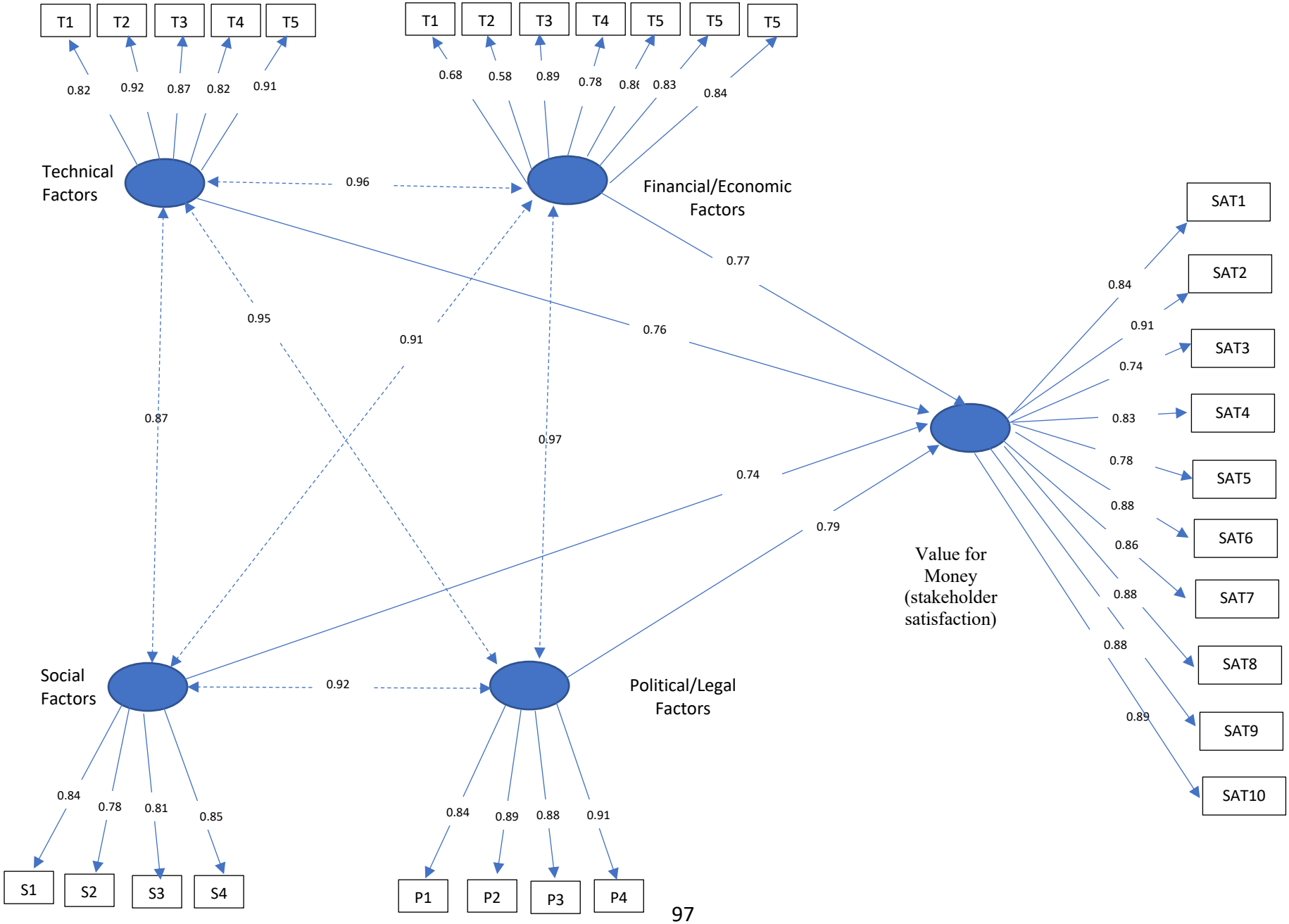


Figure 12: TP CB-SEM - Initial Measurement model

The base model indicates are Chi-square – 924.717, d.f. – 395 and a probability level of 0.000. However, as noted in the methodology, it is necessary to check that the initial SEM model fits well. This implies checking some of the specific fit indicators, as set out in Table 20 below.

Table 22: TP CB-SEM - Initial goodness of fit

Fit Indicator	**Threshold adapted from Hair *et al.* (2014)**	**measurement model**
CMIN/DF (Chi-square/degree of freedom)	Less than 3 (good) Between [3-5] (acceptable)	2.341
RMSEA (Root Mean Square Error of Approximation)	Less than .05 (good) Between [.06-.1] (acceptable)	0.101
CFI (Comparative Fit Index)	Above .90	0.882
TLI (Tucker Lewis Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.870
GFI (Goodness-Of-Fit-Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.706
SRMR (Standardized Root Mean Square Residual)	Less than .08 (acceptable) Less than 0.05 (good)	0.040

The table indicates that the SEM does not appear to fit well with the data, as a number of the goodness of fit indicators do not meet the required thresholds. Only the CMIN/DF and SRMR fall well within the required threshold, while the TLI measure is at an acceptable level. The RMSEA, CFI and GFI all do not meet the threshold requirements. This indicates that the initial SEM measurement model is not an adequate fit and requires a modification.

To improve the model fit, the SEM model was re-estimated several times by following the improvement steps set out in the methodology above. Given that no factor loadings were below the 0.7 threshold, the standard errors criterion was then considered. All factors whose standard errors were below the threshold of 2.58 were excluded. The resulting improved measurement model is shown in Figure 13.

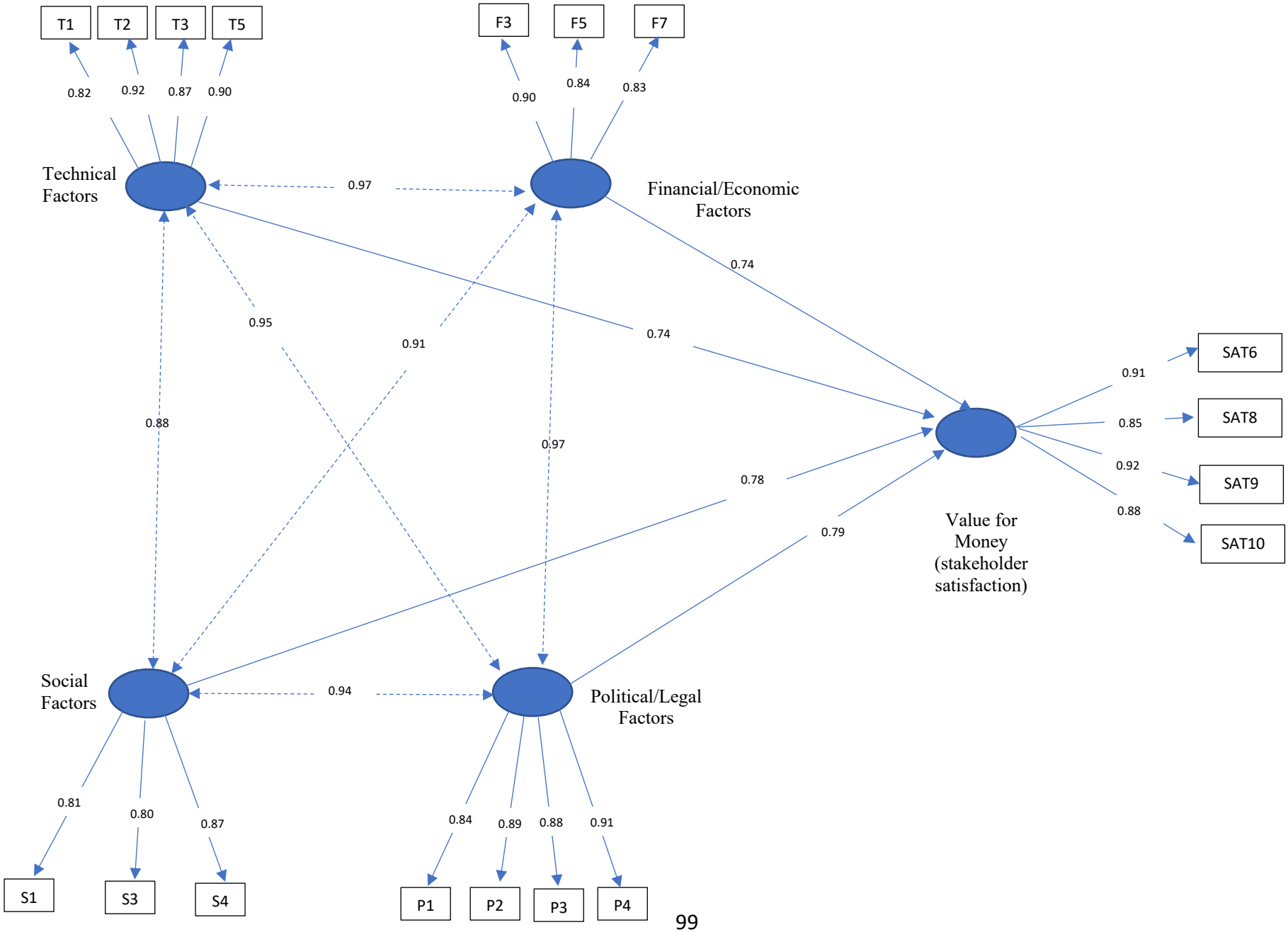


Figure 13: TP CB-SEM – Final model

To confirm the validity of the improved model, the goodness of fit indicators for this model are presented below.

Table 23: TP CB-SEM - Initial goodness of fit estimation

Fit Indicator	**Threshold adapted from Hair *et al.* (2014)**	**measurement model**
CMIN/DF (Chi-square/degree of freedom)	Less than 3 (good) Between [3-5] (acceptable)	2.022
RMSEA (Root Mean Square Error of Approximation)	Less than .05 (good) Between [.06-.1] (acceptable)	0.088
CFI (Comparative Fit Index)	Above .90	0.951
TLI (Tucker Lewis Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.940
GFI (Goodness-Of-Fit-Index)	Between [.80-.90] (acceptable) Above .90 (good)	0.832
SRMR (Standardized Root Mean Square Residual)	Less than .08 (acceptable) Less than 0.05 (good)	0.031

The table indicates that the SEM now fits well with the data, as all of the goodness of fit indicators meet the required thresholds. We may therefore adopt the improved measurement model. It is now necessary to examine which factors remain in the revised model, as these are the ones that essentially are relevant determining factors for TP as well as the satisfaction factors that remain. The table below indicators which factors were excluded (shown by the red strikethrough) and which factors remain.

Table 24: TP CB-SEM: Factors of improved measurement model

Evaluation factor/variable
Technical factors
T1 – Efficient project scope and complexity
T2 - Skills and expertise of the private sector
T3 - Government contract management experience
~~T4 - Output based specifications~~
T5 - Project governance structures
Financial and economic factors
~~F1 - Development of local capital market~~

~~F2 - Access to international capital for transactions~~
F3 - Efficient risk allocation
~~F4 - Stable macroeconomic conditions~~
F5 - Clear revenue/tariff model
~~F6 - Long-term demand for the products/services~~
F7 - Affordability of tariffs/fees
Social factors
S1 - Community support for the project
~~S2 - Local participation in the project~~
S3 - Job opportunities created by project
S4 - Environmental impact considerations
Political and legal factors
P1 - Stability of political environment
P2 - Supportive legal framework
P3 - Efficient procurement process
P4 - Clear process for legal recourse

Similarly for the stakeholder satisfaction factors, the table below indicators the factors that remain in the improved measurement model.

Table 25: TP SCB-SEM: Stakeholders' satisfaction determinants of improved measurement model

~~SAT1 - The output meets the required standards of users~~
~~SAT 2 - The service delivery is prompt, stable and reliable~~
~~SAT 3 - The project results in cost savings to the procuring entity~~
~~SAT 4 - There is time saving in the construction of the facilities~~
~~SAT 5 - The procurement process is inclusive and involves significant local providers~~
SAT 6 - There are innovative solutions in the project that meet various stakeholder demands
~~SAT 7 - There is well-functioning channel of communication amongst all stakeholders~~
SAT 8 - The project sufficiently considers social factors
SAT 9 - The project aligns with the development mandate of the Government at the national and local levels
SAT 10 - The project sufficiently considers environmental factors in its design

The next step is to check the reliability and convergent validity of the improved measurement model. This is done by assessing the p-value and through Cronbach's alpha, composite reliability (CR) and the average variance extracted (AVEs).

Table 26:TP CB-SEM - Cronbach's Alpha, CR and AVE

Constructs	Items	Factor loadings	P-value	Cronbach's Alpha	Composite Reliability (CR)	Average variance extracted (AVE)
Technical Factors	T1	0.822	0,000	0.933	0.932	0.776
	T2	0.924	0,000			
	T3	0.872	0,000			
	T5	0.903	0,000			
Financial/Economic Factors	F3	0.901	0,000	0.898	0.892	0.736
	F5	0.839	0,000			
	F7	0.832	0,000			
Social Factors	S1	0.810	0,000	0.868	0.866	0.683
	S3	0.801	0,000			
	S4	0.867	0,000			
Political/ Legal Factors	P1	0.835	0,000	0.930	0.931	0.771
	P2	0.885	0,000			
	P3	0.882	0,000			
	P4	0.910	0,000			
Stakeholder satisfaction	SAT6	0.845	0,000	0.939	0.940	0.795
	SAT8	0.924	0,000			
	SAT9	0.881	0,000			
	SAT10	0.914	0,000			

Reliability

As noted in Section 3, reliability evaluates the extent to which the measurement of a phenomenon provides stable and consistent results. The reliability in SEM studies is assessed with Cronbach's Alpha and Composite Reliability, with a required cut-off value for Cronbach's Alpha and Composite Reliability (CR) of 0.7. The results in the table above show that Cronbach's Alpha ranges from 0.868 to 0.939; while for Composite reliability they also range from 0.866 to 0.940. This confirms an overall acceptable internal consistency of all five (5) latent variables considered in the model. Therefore, based on these results, all constructs involved in are considered reliable.

Convergent validity

Convergent validity is the extent to which a set of items only measures one latent variable in the same direction. The results support the convergent validity because all the factor loadings are above or equal to 0.5. In addition, the Average Variance Extracted (AVEs) estimates are all above 0.5.

Structural model assessment

The assessment of the CB-SEM model can now proceed to the analysis of the structural model, testing all five hypotheses. Similar to the PPP CB-SEM, the table shows that all drivers when considered collectively as one group, have a positive and significant effect on VfM. However, in contrast, for the TP CB-SEM, the technical and financial drivers are not found to be significant, thus having no material effect on VfM. On the other hand, the political and social drivers emerge as significant and having a positive effect on VfM. The implications of these findings are discussed in more detail in section 7.

Table 27: TP CB-SEM model - structural model

Hypothesis	Beta value	P-value	Implication
H1: All drivers collectively positively influence value for money	0.777	0.000	All drivers collectively have a positive significant effect on value for money
H2: Technical drivers positively influence value for money	0.154	0.476	Technical drivers have a non-significant effect on value for money
H3: Financial drivers positively influence value for money	0.024	0.908	Financial drivers have a non-significant effect on value for money
H4: Political drivers positively influence value for money	0.563	0.025	Political drivers have a positive significant effect on value for money
H5: Social drivers positively influence value for money	0.325	0.038	Social drivers have a positive significant effect on value for money

To confirm this relationship, the fit indices are again presented for the structural model. All the fit indicators are within the expected threshold.

Table 28: TP CB-SEM Structural Model - Fit indicators

Fit Indicator	Threshold adapted from Hair et al. (2014: 579-580)	Final measurement model	Notes for the model
CMIN/DF (Chi-square/degree of freedom)	Less than 3 (good) Between [3-5] (acceptable) Above 5 (bad)	2.284	Chi-square = 306.096 Degrees of freedom = 134 Probability level = 0.000
RMSEA (Root Mean Square Error of Approximation)	Less than .05 (good) Between [.06-.1] (acceptable) Above .1 (bad)	0.099	
CFI (Comparative Fit Index)	Less than .90 (bad) Above .90 (good)	0.934	
TLI (Tucker Lewis Index)	Less than .80 (bad) Between [.80-.90] (acceptable) Above .90 (good)	0.925	
GFI (Goodness-Of-Fit-Index)	Less than .80 (bad) Between [.80-.90] (acceptable) Above .90 (good)	0.800	
SRMR (Standardized Root Mean Square Residual)	Above .08 (bad) Less than .08 (acceptable) Less than 0.05 (good) Equals 0 (perfect)	0.037	

4.6.3 PLS-SEM Method

The CB-SEM model confirmed two main hypothesis – that value for money should be seen as a significant factor for stakeholder satisfaction, and secondly it highlighted the specific factors within each of the four value-for-money drivers that appear most relevant for PPPs. We now turn to the PLS-SEM method to conduct a similar analysis, mainly as a confirmatory approach of the CB-SEM, but also to identify any differences in the outcomes.

Measurement model

The measurement model is assessed through the confirmatory factor analysis (CFA), examining the relationship between the observed and latent variables or constructs. The figure below presents the initial measurement model.

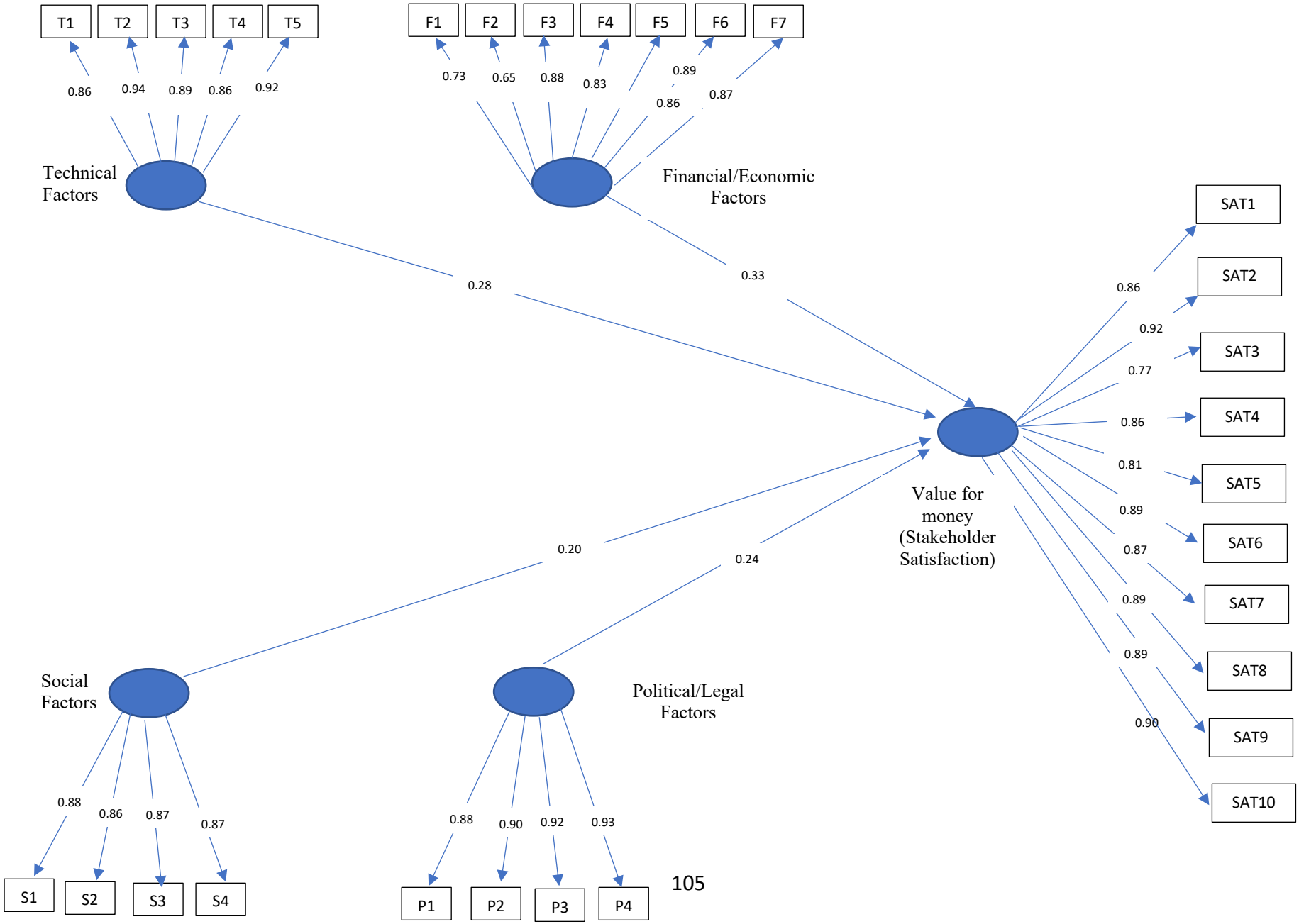


Figure 14: TP - Initial PLS-SEM output

All the constructs in the PLS-SEM model are well above the threshold of 0.7, implying that all constructs are relevant and should be retained. Only one, F2 (access to international capital), is at 0.65, which is marginally below 0.7 and drawing from theory, does not imply that it must be immediately deleted. This is quite an interesting finding as it supposes that each of the value for money factors, as well as the stakeholder satisfaction factors identified at the theoretical stage are in fact relevant. As with the PPP model, the PLS-SEM model for TP contrasts with the CB-SEM where the model had to be improved by dropping certain factors to improve the goodness of fit indices.

The next step is to check the reliability and validity of the improved measurement model. This is done by assessing the p-value and through Cronbach's alpha, composite reliability (CR) and the average variance extracted (AVEs).

Reliability

The results in the table below show that Cronbach's Alpha ranges from 0.894 to 0.963; while for Composite reliability they also range from 0.896 to 0.966. This confirms an overall acceptable internal consistency of all five (5) latent variables considered in the model. Therefore, based on these results, all constructs involved are considered reliable.

Convergent validity

Convergent validity is the extent to which a set of items only measures one latent variable in the same direction. The results support the convergent validity because all the factor loadings are above or equal to 0.5. In addition, the Average Variance Extracted (AVEs) estimates are all above 0.5.

Table 29: TP PLS-SEM: Reliability and Convergent Validity

Constructs	Items	Factor loadings	Cronbach's Alpha	Composite Reliability (CR)	Average variance extracted (AVE)
Technical Factors	T1	0.890	0.938	0.940	0.802
	T2	0.813			
	T3	0.824			
	T4	0.838			
	T5	0.920			
Financial/Economic Factors	F1	0.756	0.916	0.926	0.671
	F2	0.675			
	F3	0.859			
	F4	0.777			
	F5	0.887			
	F6	0.866			
	F7	0.841			
Social Factors	S1	0.879	0.894	0.896	0.758
	S2	0.857			
	S3	0.874			
	S4	0.872			
Political/ Legal Factors	P1	0.881	0.930	0.931	0.826
	P2	0.902			
	P3	0.921			
	P4	0.932			
Stakeholder satisfaction	SAT1	0.860	0.963	0.966	0.754
	SAT2	0.917			
	SAT3	0.773			
	SAT4	0.858			
	SAT5	0.808			
	SAT6	0.895			
	SAT7	0.873			
	SAT8	0.893			
	SAT9	0.891			
	SAT10	0.890			

The next assessment is the evidence of discriminant validity.

Structural model assessment

The structural model examined the structural model path coefficients (β) and p-values specifically for the different hypothesis. All hypotheses were found to be significant and have a positive impact on VfM. The PLS-SEM therefore confirms that the theoretical model is fully adequate and each variable and underlying factor is relevant in influencing VfM. This differs from the CB-SEM where the political and social drivers were not found to be significant.

Table 30: TP PLS-SEM model - structural model

Hypothesis	Beta value	P-value	Implication
H1: All drivers collectively positively influence value for money	0.760	0.000	All drivers collectively have a positive significant effect on value for money
H2: Technical drivers positively influence value for money	0.281	0.000	Technical drivers have a positive significant effect on value for money
H3: Financial drivers positively influence value for money	0.334	0.000	Financial drivers have a positive significant effect on value for money
H4: Political drivers positively influence value for money	0.237	0.000	Political drivers have a positive significant effect on value for money
H5: Social drivers positively influence value for money	0.204	0.000	Social drivers have a positive significant effect on value for money

4.7 Discussion of findings

The two previous sections provided the results of the SEM for PPP and TP respectively. This section now unpacks the results and outlines the implications thereof in terms of the relative importance of the VfM and underlying factors to VfM. The SEM models confirm the relative importance of the evaluation variables and factors to VfM in PPP and TP projects and helps provide a comprehensive framework for the assessment of the procurement options for infrastructure projects. Prior to unpacking the implications of the results, the analysis first compares the two evaluation techniques used.

Covariance approach vs PLS SEM findings

Generally, both the CB-SEM and PLS-SEM approaches confirmed that the four evaluation latent drivers and the underlying indicators/factors collectively do influence VfM. However, the main difference in the two approaches was that the PLS-SEM model indicates that all drivers and factors were significant in influencing VfM, while the CB-SEM found that for both the drivers and factors, some were significant while others were not. The findings of the PLS-SEM do not lend to a novel interpretation as all drivers and factors were found to be significant for both PPP and TP. Therefore, if one was to draw inferences based on the PLS-SEM primarily, it would imply that the theoretical model is fully adequate and identical for PPP and

TP, and essentially all drivers and factors equally affect VfM, and secondly there is no difference between the two procurement approaches regarding how VfM is perceived.

Hair *et al*. 2011 note that certain scholars view the PLS-SEM as less rigorous and therefore less suitable for examining relationships between latent variables. They also note that because the PLS-SEM has greater statistical power even with small sample sizes it does imply that often when using the PLS-SEM, a specific relationship is more likely to be statistically significant when it is present in the population (Hair *et al*. 2011). In conducting a comparison between the CB-SEM and the PLS-SEM method on the same dataset, Hair *et al*. 2011 found that the PLS-SEM enabled the retention of many more indicator items. This is consistent with the findings in this study for the PLS-SEM where all the hypothesis tested were found to be statistically significant, and all drivers and satisfaction factors found to be relevant.

In additional, PLS-SEM parameter estimates are not optimal regarding bias and consistency, a property frequently referred to as PLS-SEM bias (Hair *et al*. 2011). However, it is argued that this bias is often of minor relevance for practical applications because estimates will be asymptotically correct under consistency in large samples and large numbers of indicators per latent variable (Hair *et al*. 2011; Joreskong and Wold, 1982). A further drawback with the PLS-SEM for theory testing and confirmation is that there is no adequate global measure of the goodness of fit for the model.

The above constraints withstanding, structural equation models with good measurement properties generally achieve comparable results with either approach, especially when the CB-SEM's model specifications have been correctly set up (Reinartz *et al*. 2009). This is indeed the case with this study, that both models generally provided useful results, however the PLS-SEM does indeed appear less rigorous in determining the relationships between the latent variables, and in determining which of the underlying drivers actually influence a particular latent variable. For this reason, the subsequent analysis below where the specific relationships between the latent variables as well as with the drivers is of interest, the CB-SEM model appears more useful and it is these results that form the basis of the analysis going forward.

Assessment of structural model

The structural models for both PPP and TP projects reveal which variables are seen to be statistically important in predicting VfM. The differences arise in the identification of which

variables emerge significant for PPP/TP and which do not. The results posit quite interesting findings, which generally align with the theoretical or generalised view on which variables are considered particularly important when assessing VfM in either procurement option.

For PPP, it is important to note firstly that when all the variables were combined together into one, they collectively have a strong positive effect on VfM. This provides a first overall view that the variables as a whole are relevant to the broader stakeholder concept of VfM. On the specific variables, the technical and financial variables are seen to positively influence VfM, while the social and political variables are not significant.

The structural model assessment of TP also indicates that all variables are significant when assessed collectively as influencing VfM. This again confirms that as a group, technical, financial, social and political variables all have some interplay in affecting VfM. Assessing the variables separately however, the political and social variables have a positive significant influence on VfM, while the technical and financial variables are not seen to be significant.

Assessment of factors of latent variables

With the structural model establishing positive significant relationships between certain variables and VfM for PPP and TP projects, the final element of the analysis is to unpack which specific factors are important indicators for the variables that emerged as significant.

PPP indicators

Given that the final SEM shows that the technical and financial variables are significant in driving VfM for PPPs, the underlying drivers of these variables that emerged as relevant are of importance to note. The technical variables were indicated by the 'project scope and complexity' as well as the 'output-based specifications' factors. This indicates that the technical strengths of the private consortium and their ability to provide complex and innovative solutions is critical to the success of PPP projects. The financial drivers of VfM in PPPs is firstly 'efficient risk allocation'. This is an expected but important outcome, as the justification for PPPs has often been about the transfer of risk from the public to the private sector. The SEM confirms that ensuring that the risk allocation and transfer is efficient is an important bedrock of achieving VfM in PPPs. Interestingly, 'stable macroeconomic conditions' also emerged as an important VfM indicator for PPPs.

This underscores the role of the government in ensuring stable conditions that enable private sector investment to flourish. On the other hand, the factors related to tariffs were eliminated in the final SEM. This may imply that while the tariff structures and affordability of rates/tariffs are important, these are often considered upfront and secured in long-term contracts for PPPs, thus are value determined upfront. Further, in the African context, many PPPs are based on availability payments where the government is the sole off-taker (e.g. hospitals, airports, national roads), thus the end user is shielded from a direct exposure to the tariffs. It is in such instances that the macroeconomic conditions become even more important as they underpin the governments' ability to meet its obligations to the private party under the PPP arrangement.

The final important consideration for PPPs is to identify which success factors underpin VfM. The SEM model indicates that three VfM success factors are that 'the output meets the required standards of users'; 'the project results in cost savings to the procuring entity'; and 'the project aligns with the development mandate of the Government at the national and local levels'. The first two VfM success factors are closely aligned with the technical and financial drivers of VfM, indicating synergy between the drivers of VfM and how VfM is observed in PPPs. For the outputs to meet the required standards of users, it is reliant on efficient technical solutions for the project. Similarly for cost savings to be realised by the procuring entity, the project's financial VfM drivers need to be evident. A final VfM satisfaction factor is that 'the project aligns with the development mandate of the government'. This reveals that for PPP projects to be seen to generate VfM, particularly in the broader stakeholder view of VfM, the project must have alignment with the country's priorities, and ideally should be seen to contribute to the broader economic and social development of the local area and ideally national priorities where relevant.

TP indicators

For the TP SEM model, the social and political variables emerged as significant, while the technical and financial/economic variables were not. As noted above, this is the opposite to the findings for the PPP SEM model. The significant indicators of the political variables were the 'stability of the political environment'; 'supportive legal framework'; 'efficient procurement process'; and 'clear process for legal recourse'. This indicates that government projects are driven primarily by the underlying political environment, and the right legal framework. Where there is an unstable political environment (e.g. frequent political party changes/disruptions), long term infrastructure projects are unlikely to be delivered effectively, thus hampering their

VfM. The finding on the procurement process is an expected finding given that national and local governments are typically governed by a set of procurement rules which stipulate how infrastructure projects will be contracted. The legal framework and legal recourse are also important drivers especially as TP infrastructure projects are often based on an underlying engineering and operations contract to a third party, thus these legal agreements materially impact the extent to which VfM is realised. On the social side, the VfM indicators that emerged as relevant are 'community support for the project'; 'job opportunities created by the project'; and 'environmental impact considerations'.

The SEM model also identified which success factors are most relevant for VfM in TP projects. These are the factors by which VfM in TP (based on the stakeholder theory) are most evident. Four TP VfM satisfaction factors emerged – 'innovative solutions in the project that meet various stakeholder demands'; 'the project sufficiently considers social factors'; 'the projects aligns with the development mandate of the government at the national and local levels'; and finally 'the project sufficiently considers social factors'.

The one satisfaction factor that was common with PPPs is that the project must align with the development mandate of the government at national and local levels. This is an important finding as it indicates that regardless of whether a PPP or TP procurement option is employed, VfM is measured by the extent to which there is alignment wit the national and local priorities. This intuitively is a correct means by which VfM should be observed as all infrastructure projects must firstly be based on an economic and/or social impetus.

In conclusion, the SEM model has assisted in identifying which factors are particularly important when considering VfM for PPP and TP projects. While broadly once can conclude that collectively the technical financial, social as well as political/legal factors as a whole are relevant to VfM, important nuances emerge when assessing the variables separately. The results of the SEM modelling will hopefully help to provide a more comprehensive understanding of which factors drive VfM for either PPP or TP projects, informing policy decisions about which of the two procurement options is more suitable under certain conditions.

5 PPP AND TP VfM ASSESSMENT

5.1 Introduction

One of the primary objectives of this study is to identify whether the argument that PPPs deliver greater VfM than TP projects holds, specifically in the African context. This assessment is critical as it examines the foundation on which many ex-ante VfM assessments are conducted to justify the selection of PPPs as a preferred procurement option over TP. An ex-post VfM assessment will help to build an evidence base of which procurement option, TP, or PPP, has actually achieved greater VfM. Ideally, such an analysis compares the benefits and costs, both financial and non-financial that would be generated from each procurement option in providing a similar public asset or service (Park *et al*., 2018).

The literature review established that most previous studies on VfM have been focused on European markets. Much fewer analytical studies have explored actual (not theoretical) VfM in infrastructure projects in Africa. This highlights the importance of this chapter, and the overall study, to remedy this gap by conducting an ex-post VfM examination of PPP and TP projects in Africa. To do this, the chapter employs a panel regression econometric assessment of a pool of PPP and TP projects across Africa.

The underlying logic of the econometric panel regression approach is that VfM is not purely a function of costs and benefits, but that there are certain important factors that drive VFM, and therefore the strength of these variables on a VfM outcome needs to be explored. Importantly, certain variables may have a greater influence on TP projects relative to PPP projects. Therefore, the analysis determines not just which procurement option yields VfM, which is rather rudimentary, but more interestingly, aims to unpack which factors have a greater weighting for TP and PPP projects, under certain conditions. Understanding which factors influence VfM for each procurement option then becomes critical when determining which procurement option to pursue. In summary, while the econometric approach does aim to provide a result in terms of which approach offers greater VfM, it goes further by highlighting the determining factors of a VM outcome. This, I argue, is of more value to policymakers and practitioners when making forward looking decisions about a particular procurement option.

In conducting this analysis, the chapter approaches VfM from two perspectives – the narrow shareholder view, as well as the broader stakeholder approach. This is important because the line of inquiry is not just whether VfM has been achieved, but how VfM is perceived – as a function of purely financial metrics, or as a broader concept incorporating more holistic elements that affect a wide range of stakeholders.

The chapter firstly briefly sets out the panel regression model framework. It then presents the data and model specification before outlining the results. The final section provides an assessment of the econometric results, to complete the chapter. Firstly though, the chapter must begin with a discussion of how VfM will be observed i.e. the indicators to be used in observing VfM.

5.2 Developing VfM indicators

Historically, the most common approach to determining value for money has been a quantitative assessment of the costs of the project, in relation to a quantitative determination of financial return. The use of absolute cost and time quantitative measures as indicators of VfM only is deemed as an insufficient means to measure the complexity associated with infrastructure projects, particularly PPP projects (Lui *et al*., 2014). More recent discussions have highlighted the importance of a broader value for money framework and indicators from which VfM can be assessed. This has particularly been in studies such as (Liu *et al*., 2014; Henjewele *et al*., 2011; and Yong, 2010).

Lui *et al*. (2014) content that true VfM assessment focus on overall outcomes achieved, covering a wide range of issues within quantitative and qualitative contexts, such as whole life costs, service quality, social benefits, sustainability and maintainability of the service. An effective value for money assessment must therefore incorporate both a quantitative and qualitative set of indicators. Yong (2010) confirms this view and states that the key values in PPP performance indicators should not be entirely a function of costs, but broader issues incorporating project completion time and quality.

Many studies have looked at performance indicators for construction projects, essentially as a basis to measuring VfM. As reflected in Table 31 below, most studies have focused on the cost and quality dimensions of VfM, linked to the shareholder approach. A few studies have

incorporated broader stakeholder satisfaction elements around user expectations, health and safety and the environment.

Table 31: Summary of studies on VfM performance indicators

Authors	Measurement indicators
Kumaraswamy and Thorpe (1996)	Cost, project duration, quality, health and safety, quality of workmanship, functionality
Songer and Molenaar (1997)	Cost, project duration, quality, client and project manager satisfaction, user expectations and satisfaction, quality of workmanship, dispute minimization
Lim and Mohammed (1999)	Cost, project duration, quality, client and project manager satisfaction, quality, health and safety, functionality
Love and Holt (2000)	Product, service performance, corporate ability, individual ability, productivity
Cox *et al*. (2003)	Time, cost, quality, safety and productivity
Sohail and Baldwin (2004)	Time, cost, quality, stakeholders' roles and responsibility, partnership and social-economic factors
Luu et al. (2008)	Time, cost, quality, safety, customer satisfaction, project team performance, change and material management
Haponava and Al-Jibouri (2010)	Time, cost, quality, safety, value and objective, stakeholders' requirements and communication
Hwang *et al*. (2010)	Schedule (time), cost
Lai and Lam (2010)	Time, profit, environment, quality, safety, effectiveness of process, level of dispute, innovation
Idrus et al. (2011)	Quality of products, construction cost, construction time, health and safety, project management, technology, environment

Source: Lui et al. (2014)

The above list provides a useful reference point from which to start generating a set of indicators to measure VfM in PPP and TP projects. Given the complexity in measuring a VfM metric for projects based on primary data collection, the approach recently has been to assess VfM based on a set of standardized indicators.

In considering the selection of measurement indicators for this study, an important issue is whether the broader or narrower version of value for money is being considered. Where the narrow shareholder view is adopted, the indicators used are mainly monetary – project revenues and costs (as is evidenced in the table above). This is a very limited view only based on certain project specific data points, not incorporating broader factors that have a bearing on VfM. The AfDB (2016), in a review of infrastructure evaluation approaches and the approaches to VfM, noted that drawing aggregate conclusions simply from project level data points could be worrisome. They note that '*such aggregate VfM would be flawed because project-level efficiency analysis does not capture all the relevant considerations*' (AfDB, 2016).

More recent approaches have moved away from relying solely on indicators drawn from the narrow definition of value for money and are rather electing to consider the overall performance of projects when identifying VfM measurement indicators. Moving beyond assessing just financial indicators allows the researcher to delve more broadly when collating information, and then attempt to bring together the different elements into a concise conclusion. This however does create the potential for ambiguity in the outcomes. Specifically, it becomes more difficult to categorically state whether greater value for money has been achieved in one project versus the other where varied indicators are used. To remedy this, the approach has been to use internationally accepted standards, which have been developed by institutions such as DfID, the OECD, and the World Bank.

One set of indicators that has increasingly become common is the DAC evaluation criteria. The Organisation for Economic Co-operation and Development (OECD)'s Development Assistance Committee (DAC) developed six criteria for evaluating development projects and programs. The criteria are relevance, coherence, effectiveness, efficiency, impact and sustainability; and these serve as a normative framework used to determine the worth (value) of an intervention (policy, strategy, programme, project or activity) (OECD, 2023). Table 32 provides a brief description of the criteria.

Table 32: OECD DAC Evaluation Criteria

Criteria	Definition
Relevance	Is the intervention doing the right things? *The extent to which the intervention objectives and design respond to beneficiaries, global, country, and partner/institution needs, policies, and priorities, and continue to do so if circumstances change.*
Coherence	How well does the intervention fit? *The compatibility of the intervention with other interventions in a country, sector or institution.*
Effectiveness	Is the intervention achieving its objectives? *The extent to which the intervention achieved, or is expected to achieve, its objectives, and its results, including any differential results across groups.*
Efficiency	How well are the resources being used? *The extent to which the intervention delivers, or is likely to deliver, results in an economic and timely way.*
Impact	What difference does the intervention make? *The extent to which the intervention has generated social, environmental and economic effects that are longer term or broader in scope than those already captured under the effectiveness criterion.*
Sustainability	Will the benefits last? *The extent to which the net benefits of the intervention continue or are likely to continue.*

Source: OECD, 2023

The above criteria have recently been adopted to measure VfM for infrastructure projects, both in Africa and internationally. The efficiency indicator is the closest to the narrow view of VfM – the shareholder approach. If one were to look at this approach only, then this would be the indicator of interest. For a broader VfM assessment, all the indicators can be applied, and often an overall aggregate VfM indicator is derived, based on an average of the indicators.

5.3 Panel regression methodology

The empirical link between macroeconomic variables and infrastructure financing options – PPP or TP, is analysed in this chapter through a panel regression analysis. A panel dataset is a cross-sectional time-series dataset which provides repeated measurements of a certain number of variables over a set period on observed units, such as individuals, households, firms, cities, and countries (Eom *et al.*, 2007). The number of observations in the samples are often the same across all periods (balanced panels), while in some cases, particularly in random surveys, the number of observations in the samples from one period are not identical to those from another (unbalanced panels). In general, an unbalanced panel dataset results from missing observations for certain variables for a certain number of periods of time (Eom *et al.*, 2007).

Panel data is particularly useful for exploring causal relationships. Gujarati and Porter (2009) argue that panel data enhances empirical analysis in ways that could not be achieved if only time series or cross-sectional analysis were conducted. Some advantages of panel data are that by combining time series and cross-sectional observations, panel data provides more informative outcomes, less collinearity among variables, and can better study more complicated phenomenon and behavioural models (Gujarati and Porter, 2009). Panel data also controls for heterogeneity present in country data, while time series and cross-sectional approaches do not take this heterogeneity into account and so increase the likelihood of generating biased estimates (Baltagi, 2005). Further, because panel data is a combination of time series and cross-sectional data, it permits more degrees of freedom, less collinearity, and more variability and efficiency (Hsiao, 2003).

The general regression equation model of panel data is depicted as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{it,1} + \beta_1 X_{it,2} + \beta_1 X_{it,k} + v_{it}, \qquad (6.1)$$

i = 1….,T k =1….,k

where

i is the unit of observation

t is the period of time

k indicates the *k*th explanatory variable

B_0 is the intercept

B_k is the coefficient of each explanatory variable
V_{it} is the error term

The error term above $v_{it,}$, can be split into two elements, a cross-section unit-specific error, a_i, and an idiosyncratic error u_{it}. The error term a_i does not change over time while u_{it} varies over the cross-sectional units and time (Eom *et al*, 2007). Eom *et al* (2007) provide a justification for splitting the error term, in that by separating the error terms into two parts, if it was possible to eliminate some part of them using panel data, the concerns of omitted variable bias caused by unmeasured unit-specific factors would be significantly reduced. The basic panel data regression equation therefore becomes:

$$Y_{it} = a_i + \beta_1 X_{it,1} + \beta_1 X_{it,2} + \beta_1 X_{it,k} + u_{it} \quad (6.2)$$

This is known as the error component model. The time-constant but unit-specific error a_i depicts the unobserved factors in the regression, which are extremely hard to measure. There are four general estimation techniques/models for panel data, as follows:

- Pooled OLS model
- Fixed effects model (FEM)
- Random effects model (REM)
- Correlated random effects model (CRE)

The estimation methods of these models above are classified by how they treat the error term a_i. The pooled OLS model does not distinguish it from other types of errors, whereas the fixed effects model regards it as coefficients to be estimated, and the random effects model treats it as random variables (Eom *et al*, 2007). Each of these estimate methods are discussed in a bit more detail below.

Pooled OLS model

The pooled OLS approach is the simplest and most basic method to estimate panel data. In this model the approach is to pool the data and apply OLS, ignoring the cross-section and time series elements of the data (Gujarati and Porter, 2009). The key assumption here is that the

composite error term is not correlated with the explanatory variable (Eom *et al*, 2007). The pooled OLS equation is set out below, as follows:

$$Y = \beta_0 + \beta_1\chi_1 + \beta_2\chi_2 + \ldots + \beta_k\chi_k + a_i + v \quad (6.3)$$

The subscripts *i* and *t* are no longer relevant due to the above assumption where the time and cross-sectional elements are deemed to not be relevant. It is assumed here that the explanatory variables are non-stochastic, implying that they are not correlated with the error term. It is also assumed here that the error term is independently and identically distributed with a zero mean and constant variance (Gujarati and Porter, 2009). The model is only applicable where the cross-sectional units under examination are homogenous, which is rarely the case (Asteriou & Hall, 2007).

The main drawback of the pooled OLS approach is that it disregards the key features of panel data - time and cross-sectional dimensions. Xu and Lee (2007) therefore argue that the assumption of pooled OLS is problematic since it is not possible to measure all time-constant and unit-specific effects and include them in the model. Therefore, when using OLS for panel data, the assumption is usually violated. Further, Gujarati and Porter (2009) state that the pooled OLS approach 'camouflages' the heterogeneity that exists, given that it is assumed to be subsumed in the disturbance term. They argue that in such an instance the estimated coefficients may be biased as well as inconsistent. Applying this to the context of this study, the primary shortcoming of the pooled OLS model is that it does not differentiate between countries and so ignores the heterogeneity existing in the different country cross-sectional units (Hill *et al*. 2012).

To account for autocorrelation and heteroskedasticity in panel regressions, studies have typically used generalized least squares methods. Mengistu (2013) however argues that this has drawbacks as it 'imposes an assumed distribution' on the error terms which is not testable, and in the event of misspecification, may lead to incorrect standard errors and biased coefficients.

Fixed effects model (FEM)

The fixed effects model is applied when there is a need to control for omitted variables that are constant over the period and vary across the units (Eom *et al*, 2007). The term 'fixed effects' is because, although the intercept may differ across subjects (the countries in this case), each entity's intercept does not vary over time, meaning the intercepts are time-invariant (Gujarati and Porter, 2009). When estimating an equation, e.g., equation (2) above, using the fixed effects model, it is assumed that the unobserved heterogeneity (a_i) is correlated with the explanatory variable (χ_{itk}). Another important assumption is that the idiosyncratic error (u_{it}) is independent of the explanatory variable (χ_{itk}) (Eom *et al*, 2007; Baltagi, 2001; Wooldridge, 2006).

The fixed effects model is therefore:

$$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 X_{2it} + \cdots + \beta_k X_{kit} + \varepsilon_{it} \quad (6.4)$$

The fixed effects model is applied where the researcher is only concerned with the impact of variables that vary over time. When using fixed effects, the assumption is that a factor within the variable may impact or bias the predictor or outcome variables, and this needs to be controlled for. The fixed effects model removes the effect of the time-invariant characteristics so that the net effect of the predictors on the outcome variable can be adequately assessed (Torres-Reyna, 2007).

A further key assumption of the fixed effects model is that the time-invariant elements are unique to each individual entity and should not be correlated with other individual characteristics. Thus, each entity's error term and the constant, which captures individual characteristics, should not be correlated with each other. Where the error terms are correlated, then the fixed effects approach is no longer appropriate (Torres-Reyna, 2007). Importantly, Torres-Reyna (2007) note that fixed effects does not work well with data for which within-cluster variation is minimal or for slow changing variables over time. This is an important consideration for this study's panel regression, as there is unlikely to be large changes in the explanatory variables over time, given the nature of macro-economic variables, which typically have steady incremental changes over time (thus slow changing over time), rather than significant fluctuations over a short period, except in a period of macro-economic shocks/volatility.

Random effects model

The rationale underlying the random effects model is that the variation across entities is assumed to be random and uncorrelated with the predictor or independent variables included in the model. This is the key difference between the random effects model and the fixed effects model. The crucial distinction between the fixed effects model and random effects model is whether the unobserved individual effect embodies elements that are correlated with the regressors in the model, not whether these effects are stochastic or not (Green, 2008). Torres-Reyna (2007) state that if there is a belief that the differences across entities have some influence on the dependent variable, then a random effect model is more appropriate to consider.

The random effects model is specified as follows:

$$Y_{it} = \beta_{0t} + \beta_1 X_{1it} + \beta_2 X_{2it} + \varepsilon_{it} \quad (6.5)$$

Where:

$$\beta_{0t} = \beta_0 + \beta_2 z_t + u_t \quad (6.6)$$

These equations are macro and micro components of the model and are estimated together as one equation by substituting the micro part into the macro part as follows:

$$Y_{it} = \beta_{0t} + \beta_1 X_{1it} + + \beta_2 z_t + (u_t + \varepsilon_{it}) \quad (6.7)$$

Where Y_{it} is the dependent variable, β_0 is the intercept term in the fixed part of the model, X_{1it} is a series of time-variant covariates with coefficient β_1, and z_t is a series of time-invariant covariates with coefficient β_2. The random part of the model consists of u_t, the disturbance term of the time-invariant variables also known as the random effect and ε_{it} is the regression disturbance term (Bell and Jones, 2015).

The random effects model regards the unobserved heterogeneity as random variables rather than fixed ones (Baltagi, 2001; Xu and Lee, 2007). Baltagi (2001) notes that therefore the random effects model is more appropriate when the cross-sectional units are randomly selected from a large population. If a variance structure among the groups is known, the random effects

model can be estimated by the generalized least squares, but if the variance structure is unknown, the feasible generalized least squares method is more appropriate to estimate the variance structure (Xu and Lee, 2007). The individual characteristics that may or may not influence the predictor variables needs to be specified, this may however lead to omitted variables bias in the model.

Correlated Random Effects Model (CRE)

An alternate approach is termed the correlated random effects model. This addresses the issue that arises from the assumption that the random intercept is uncorrelated with the regressors, which is seen as restrictive (Antonakis *et al*., 2019). The CRE model relaxes the above assumption by adding cluster means to the model. The approach originates from the work of Mundlak (1978) and become termed the correlated random effects model by Wooldridge (2010, 2013).

The CRE equation is specified below:

$$Y_{ij} = \gamma_0 + \gamma_1 + \gamma_{2(contextual)}\bar{X}_j + u_j + e_{ij} \quad (6.8)$$

To specify a CRE model, the cluster mean of X_{ij} regressor is included in the model. γ_1 provides the within effect, with γ_2 producing either the between or contextual effect.

The within effect tells how characteristics or actions of an individual affect individual level outcomes. The contextual effect however tells how characteristics or actions of other individuals in the same context affect individual level outcomes. In the context of this study, a contextual effect would examine whether the macro-economic characteristics/conditions of one country, affect the amount of infrastructure investment received by another country. However, this may not always hold as investment decisions are country specific. Although investors who are considering an investment may look at two similar country destinations, the investment decision is made on an assessment of each country and its underlying context.

Comparing the three models

It is important to clearly clarify the difference between the fixed effects and random effects models. For the fixed effects, each cross-sectional unit has its own fixed intercept value, in all *N* such values for *N* cross-sectional units. For the random effects, the common intercept represents the mean value of all cross-sectional intercepts, and the error component represents the random deviation of individual intercept from this mean variable (Gujarati and Porter, 2009).

A vital assumption in both the fixed effects and random effects models is that the random part of the model is uncorrelated with the regressors (Antonakis *et al*. 2019). The REM introduces an additional element, that in addition to the e_{ij} term, a u_j term is introduced too. Thus, compared to the FE model, the RE model has an additional assumption that $cov(x_{ij},u_j)=0$, which is referred to as the *random effects assumption* (Antonakis *et al*. 2019).

The correlated random effects model essentially unifies the fixed effects and random effects models. As an advantage over both models, this modelling approach provides the estimates for both within and between or contextual effects simultaneously (Antonakis *et al*. 2019). More specifically, the correlated random effects model is an advantage over the fixed effects model, as the correlated random effects allows for modelling effects of variables that are constant within cluster i.e., between or contextual effects (Antonakis *et al*. 2019). Antonakis *et al*. (2019) note that the correlated random effects model makes it easier to transition between the fixed effects and random effects, and tests if unobserved level 2 effects are correlated with the explanatory variables, and if so, with which explanatory variables specifically. However, importantly, due to the fact that the level 1 estimates from a correlated random effects model are identical to the fixed effects estimates, the correlated random effects model is less efficient than the random effects model, where the random effects assumption holds.

Figure 15 below, adopted from (Antonakis *et al*. 2019) provides a useful decision tree to help identify which model is most effective, based on a consideration of the within, between and contextual effects. A fixed effects model is appropriate where there are within effects only, and the random effects assumption does not hold. Where between and contextual effects hold, the decision then becomes between a random effects model and the correlated random effects. Where the random effects assumption holds, then the random effects model is appropriate.

However, where contextual effects are considered, then the correlated random effects can also be considered, by applying cluster means to the model.

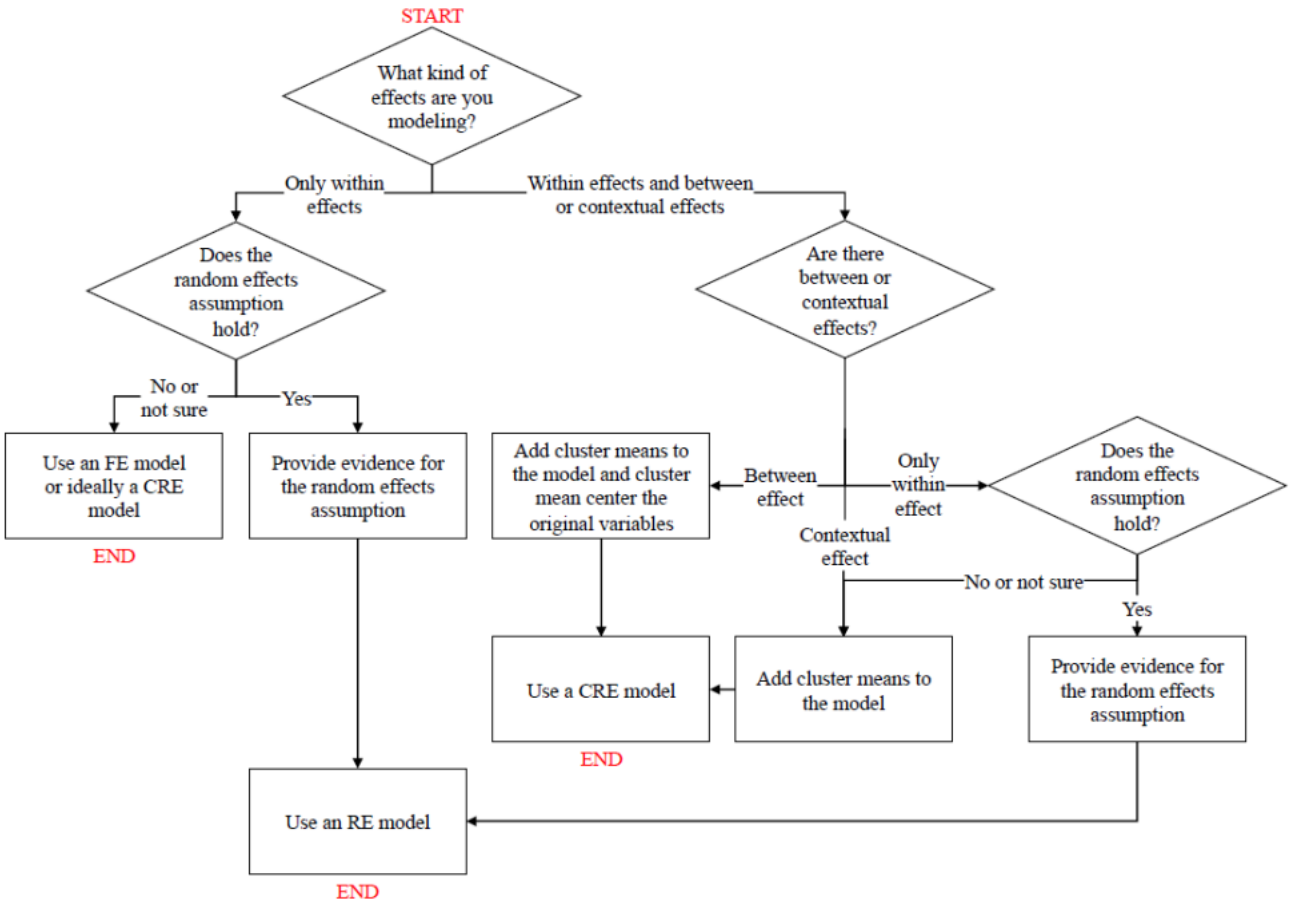


Figure 15: Decision tree for estimation models

Source: Antonakis *et al*. 2019

Tests for panel regression techniques

The first step in a panel regression is to determine which of the above regression techniques is most appropriate. The tests typically employed are the Hausman test and the Likelihood ratio test. These tests are important to ensure that the correct model is applied. Particularly, the random effects model should only be used of the random effects assumption is empirically assessed through the above tests. The tests can be run sequentially, firstly testing between fixed effects model and the random effects model, and if the random effects model emerges as the preferred method, then further testing between random effects model and the correlated random effects model to see if the correlated random effects model should be applied.

Hausman test

The purpose of the Hausman test is to decide between a fixed or random effects model. The null hypothesis is that the preferred model is a random effects model. It tests whether the unique errors (u_i) are correlated with the regressors, the null hypothesis is that they are not. The notation for the test is shown below.

H_0: Select RE (p>= 0.10)
H_1: Select FE (p =<0.10)

Likelihood ratio test

This test is used for comparing nested models. It therefore cannot be used to compare the fixed effects model and the random effects model. However, it can be applied to a comparison between the random effects model and the correlated random effects. This is achieved by comparing the maximum likelihood estimates of an RE model against the correlated random effects model. A statistically significant χ^2 value indicates that the model with cluster means the correlated random effects fits the data better than does the random effects model, thus rejecting the random effects assumption.

5.4 Data and model specification

5.4.1 Data

Projects' selection

The most comprehensive source of data and project information on both PPP and TP projects collated in one database is held by the African Development Bank (AfDB). The AfDB keeps records of over 2000 infrastructure projects which it has played a significant part in financing. The projects are delineated by certain categories – country, year, sector, and by the designation 'Sovereign' and 'Non-Sovereign'. Sovereign projects are those which are undertaken by African governments with some AfDB financing support but with no private sector participation (except possibly in a subcontracting role). Such projects are therefore akin to TP projects as defined in this study. Non-sovereign projects are those with significant private sector funding participation, in addition to funding provided by the AfDB. These are essentially PPP-type projects.

While comprehensive, the AfDB database does not include every single large infrastructure project undertaken in Africa – it only accounts for projects where the AfDB has played a role; despite this, it remains the most complete source of actual (not estimated) data on infrastructure projects on the continent, especially as it captures both TP and PPP projects. An alternate database, the World Bank's PPI database, only captures PPP type projects with no TP projects; further, it is mainly made up of estimates and contract values.

Table 33 shows a breakdown of the projects captured on the AfDB database, by sector and procurement type. 96% of the projects are Sovereign, showing the dominance of government led transactions historically. One important factor to note is what is defined as a 'project'. Projects on this database include a broad spectrum, spanning actual infrastructure investments, but also funding of feasibility studies, as well as sector support initiatives that the AfDB has supported. Hence the large number of projects, particularly on the Sovereign side does not necessary equate to investments where an infrastructure asset is being financed. Unfortunately, the database does not easily distinguish between these categories, so one must examine project specific details to unpack the nature of the financing or support provided.

Table 33: AfDB portfolio of infrastructure projects

Sector	Non-Sovereign	Sovereign	Total
Social	3	671	674
Transport	22	637	663
Water supply & sanitation	1	477	478
Power/Energy	50	375	425
Urban Development		6	6
Total	**76**	**2166**	**2242**

Source: AfDB, 2024

Most important, for the projects which have been completed, the AfDB conducts a project completion evaluation. One of the indicators measured in the project completion reports is VfM. The project completion reports have a section for project completion rating, based on the VfM criteria – relevance, effectiveness, efficiency, sustainability and an overall VfM rating. The completion reports therefore provide a useful indicator for VfM at a project level, and the sub-components thereof. To our knowledge no other such database exists in Africa where VfM indicators are measured for a large enough set of infrastructure projects. This study therefore

draws on these reports to extract the VfM indicators to use as the dependent variable for the study.

The main limitation with the data however is that the VfM assessment is conducted at the end of projects which the AfDB has supported. Therefore, only projects classified as 'completed' by the AfDB would qualify for inclusion in this study as VfM assessments are only conducted at this stage. This restriction reduces the population of projects from which an assessment can be conducted. Another limiting factor is that completion reports have not been published for all projects listed as completed. In many instances, the data portal has missing fields and final completion reports have not been loaded. All such projects were therefore excluded as no VfM scores could be obtained.

The next restriction placed was on the sectors selected. Most research on PPPs, as shown in the literature review, have preferred to be centred in one sector but have projects across countries. This approach is logical because the differences in projects across sectors is more varied than across countries, especially within a specific region (Blanc-Brude *et al*. 2006; Atmo *et al*. 2017; Oshea *et al*. 2019). It will impose a significant level of complexity if the database includes projects across a wide range of sectors such as transport, energy, water, ICT, healthcare etc. This is because the technical structure of these projects differs significantly and they also have different dependencies, which may impact the outcomes if many sectors are examined together. At most two sectors of roughly similar characteristics may be selected – e.g. economic infrastructure sectors (transport and power) may be clustered and social infrastructure sectors (water, housing) may also be clustered together.

The social sector has the largest number of projects in the AfDB's database. This is to be expected as this sector spans infrastructure such as schools, hospitals, housing etc. Thus, it is quite a broad category, and further many of what are termed projects here are smaller scale programmes and policy initiatives, not large infrastructure investments that are the object of this study. Secondly, there are only three non-sovereign social projects, limiting the potential for consideration for this assessment. A similar dynamic is observed for the water/sanitation sector. For these reasons the social sector is not ideal to be included in the regression.

The transport and power sectors are the two with the highest number of actual infrastructure investments. Within transport, the projects are further categorized into road, rail, and port

projects. A practical consideration is also applied, in choosing sectors where the most completed projects are, to enable a larger sample of projects for the regression. The transport and power sectors we therefore selected for inclusion in the study as these have the highest number of completed projects in the AfDB, particularly the road sector.

Given the above factors, the following selection criteria was applied in selecting projects for this study:

- Only actual 'projects' where there was an investment in a physical infrastructure asset
- Projects that have been tagged as completed
- Projects where there is financing of an infrastructure asset (therefore excluding financing of feasibility studies, policies and programmes)
- Projects in the transport or power sectors only
- Projects where a project completion report has been published or VfM data is available

The final criterion was the most challenging given that project completion reports have not been published for quite a few of the projects on the AfDB's database that have been tagged as 'completed'. This limits the sample of projects that could be included in the analysis.

The final sample for the analysis is made up of 58 projects, across 22 countries. Of these, 12 were PPP projects and the remainder, 46 were TP projects. The database is skewed towards TP projects, as is to be expected, given that TP projects make up a much larger percentage of the overall number of projects undertaken with the AfDB's involvement. This is also likely reflective of the general pattern of infrastructure projects in Africa, as these are mostly dominated by public sector projects, with PPPs only becoming a mode of financing more recently.

The projects span the period 2002 – 2017. The time span was not determined upfront but is a result of the availability of data. It was not feasible to get any projects from a more recent period as these would not have reached the completion stage where VfM has been measured. Kenya has the most projects with 9, followed by Cameroon, Ethiopia and Morocco with 5 each. Ghana has 4 projects, and then Egypt and Senegal follow with 3 projects. Burundi, Chad, Cote d'Ivoire, Malawi, Rwanda, Tanzania, and Uganda all have 2 projects. The remaining countries have just one project, as shown in Figure 16.

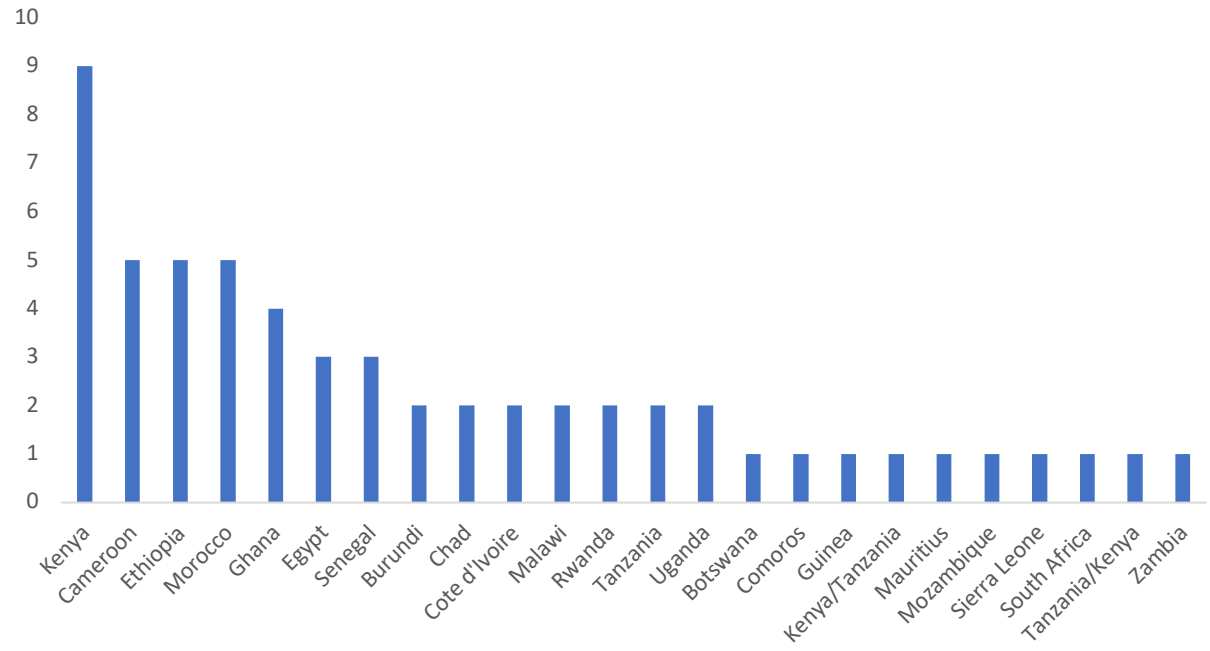


Figure 16: Projects selected per country for panel regression

Source: AfDB Data Portal, 2024

One may argue that it is important to have a relatively common spread of projects per country. In an ideal setting this would be desirable, however the limitations noted above in the project selection imply that this is the best fit of projects available. There is a risk that country specific dynamics will not be accurately accounted for given that some countries have just one or two projects. However, the counter argument is that infrastructure projects are generally quite similar and given that all of these are developing countries within Africa, they are likely to face similar non-project factors. Further, the country constraint is balanced by the fact that all the projects were undertaken by one main funder, the AfDB, thus they can still be seen as a common set of projects that underwent a similar financing process. The country dynamics are still tested in the regression, with specific variables which are discussed in the section on explanatory variables.

Table 34 presents the distribution of the projects by procurement type and sector. There is an almost event split between the power sector (30 projects) and the road sector (28). 79% of the projects are traditionally procured, and 21% are PPPs. This is to be expected given the general historical dominance of traditional projects across Africa.

Table 34: Projects selected by procurement type and sector

	PPP	TP	Total
Power	9	21	30
Road	3	25	28
Total	**12**	**46**	**58**

Dependent variables

The dependent variable to be tested is VfM as captured from the project completion reports. In considering the selection of the measurement indicator to be used for VfM, an important issue is whether the broader or narrower version of value for money is being considered. As stated in the literature review, studies from a few decades ago focused very much on the narrow version of VfM and in many instances only looked at two indicators – construction time and cost overruns. More recent approaches have moved away from this narrow definition of value for money, and rather considered the overall performance of projects over their lifetime.

The project completion reports provide not just an overall VfM score, but the underlying components that make up VfM (as set out in section 1 of this chapter). This enables a more comprehensive analysis to be conducted of VfM at three levels – overall VfM, VfM based on the narrow definition (i.e. efficiency and effectiveness) and broader elements of VfM (relevance and sustainability).

Therefore 5 dependent variables are considered separately. The standardised definitions of these variables were provided earlier as per the OECD standards. Given that this study will draw specifically on these indicators as adopted by the AfDB for the dependent variables, the AfDB's definitions (albeit almost identical) for these criteria is specified below in Table 35 for clarity on what the variables represent in this context.

Table 35: VfM definitions as per AfDB evaluation criteria

Dependent variable	Dimensions as per AfDB
Overall VfM rating	Average of the sub-elements
Relevance	Consistency of project with (i) Country's overall development strategy and the AfDB assistance strategy for that country (ii) AfDB's statutory requirements, comparative advantage and policy priorities
Efficiency	Extent to which the project benefits, actual or expected, at the time of evaluation, are commensurate with inputs, looking at cost and implementation time.
Effectiveness	Extent to which the project achieved development objectives articulated at approval and specified in categories such as policy goals, physical, financial, institutional, social and environmental, recognising any changes introduced since approval
Sustainability	Likelihood that project results, actual or expected at the time of evaluation will be maintained over the intended useful project life

Source: AfDB, 2001

The AfDB's completion reports rates each of the above criteria (except aggregate VfM) on a 4-point scale as follows:

- 4 - Highly satisfactory – project achieved or expected to achieve, or exceeded criteria
- 3 – Satisfactory – project achieved or expected to achieve major relevant elements of criteria
- 2 – Unsatisfactory – project failed to achieve most of the relevant elements of criteria
- 1 – Highly unsatisfactory – project failed to achieve any of its relevant objectives

The aggregate VfM score is an average of the four subcategories. Annexure 2 provides the specific indicators and scoring template used for each of the four criteria. The report published does not however provide the scorings for each indicator, just at the aggregate level per criteria (see annexure 3). Although the scoring criteria is quite clear, it is noted that the ratings are made by the evaluator based on his/her own assessment and judgement, and on the significance that they attach to each component of the evaluation criteria (AfDB, 2001). This introduces some subjectivity into the project ratings, especially where different projects are rated by different evaluators. Further, the AfDB does conduct a final review of the evaluation, with a view to obtaining consistency across different evaluations.

Explanatory variables

Three groups of explanatory variables are used – project specific variables, country macroeconomic variables (initial conditions), and thirdly institutional variables.

To explore the factors that may influence VfM, a combination of project specific and country macroeconomic variables as well as institutional variables are examined. Project specific factors may be expected to be the most obvious determinant of VfM. However, given the nature of infrastructure projects (large, long horizon, often with a reliance on users to pay tariffs), the macroeconomic conditions of a country, as well as the prevailing institutional structures may have an impact on the performance of a project. The AfDB (2016), in a review of infrastructure evaluation approaches and the approaches to VfM, noted that drawing aggregate conclusions simply from project level data points could be worrisome. They note that 'such *aggregate VfM would be flawed because project-level efficiency analysis does not capture all the relevant considerations*' (AfDB, 2016). It is therefore necessary to consider the macroeconomic and institutional factors as well as project specific factors.

Project specific factors:

It is well established that the nature of a project's performance will be the primary determinant of whether VfM is achieved. Therefore, the starting point of examining the variables that influence VfM are the variables linked to each project. Four project variables are included in the panel regression – procurement type, construction cost, sector, and scale.

- *Procurement type (PPP)* - The primary analysis concerns whether PPPs have a positive effect on VfM or not. A PPP dummy variable is included as an explanatory variable to indicate whether a project is a PPP or not. The alternative is whether the project is a TP project. The AfDB's categorization of 'non-sovereign' (i.e. PPP) or 'sovereign' (i.e. TP) was used as the determining criteria for the dummy variable.

- *Construction cost (Cost)* – A project's cost has been one of the most common determinants of VfM, but more so whether there are cost overruns rather than just the cost of the project. There is a theory that projects with a high cost often have lower value for money (Blanc-Brude *et al*. 2006). Therefore, the panel regression tests whether indeed a negative relation exists between VfM and construction costs. The construction cost data was obtained from

the data provided by AfDB on each project, calculated as the capital cost to construct the project.

- *Sector (Sec)* - The 'Sec' variable refers to the project's sector. In an ideal setting where a large number of projects can be sourced within a sector, the regression will be conducted separately for each sector, similar to the approach of Blanc-Brude *et al*. (2006) where only the road sector was considered. For this study, where a relatively small sample size of projects is available, two sectors are chosen – the road and power sectors. A sector dummy variable is used to indicate whether a project is a road project or not, with the alternate classification implying that the project is a power project.

- *Scale (Scl)* - An important consideration has been about the impact of the size of a project on VfM. It will be interesting to observe whether there is a pattern between the scale of a project (whether large or small) and VfM. Scale is defined separately from project construction cost. Most simple analysis use a cost threshold as a reference point for the scale (size) of a project. This is avoided for two reasons – the construction cost of the project has been included as a separate explanatory variable, and secondly, for many projects, there were additional infrastructure assets included in the project (e.g. often a large road included tolling infrastructure, bridges etc.). Therefore, just using a cost line item may result in inaccurate comparisons. A better measure is to use a technical specification of a project as the unit of measure for scale. in this instance the length of road in km and the size of the power plant in megawatts (MW) are adopted. For roads, a distinction was drawn at 100km, therefore a road with total length (considering all lanes etc.) less than 100km was considered a small road, and one with a total length above 100km is delineated as a large road. A similar benchmark was used in Blanc-Brude *et al*., (2006). For the power projects, a project above 100MW is considered a large project, and one below 100MW is considered a small project. While perhaps a bit simplistic, this distinction does enable a categorization of the projects by scale.

Country initial macroeconomic factors:

Although VfM is observed at a project level, the performance of infrastructure projects is potentially dependent on the prevailing macroeconomic conditions of the country in which the project is located. This is built on the theory of initial conditions (Johnson and Takeyama, 2001; Melo *et al*. 2001). It has been suggested that the transition path of a country is reliant on both

its initial economic conditions and the economic policies it chooses to implement (Melo *et al*., 2001). While this approach has been mostly applied to macroeconomic assessments, these could also impact at a microeconomic level – on industries, commercial entities and infrastructure projects. The rationale here is that the performance of an infrastructure project may be impacted by the prevailing macroeconomic conditions of the country, thus the inclusion of these factors as initial conditions.

To effectively consider the initial conditions likely to be most relevant to infrastructure projects, five variables are included in the panel regression – GDP per capita, GDP growth, population density, a financial institutions index and finally the existing infrastructure endowment index. These are described further below.

- *GDP per capita* (*GDPcap*) – GDP per capita provides a measure of the economic size of an economy. The GDP of a country is well established as an important determining factor of the extent of private sector investment (Mengistu, 2013). The hypothesis being tested here is that stronger countries (in economic terms) are better able to deliver and maintain infrastructure projects effectively and efficiently, thus having a positive impact on VfM.

- *GDP growth (GDPgr)* - GDP growth reflects the trajectory of the country in term of economic expansion. The economic trajectory a country has been on, either growing or declining is an important determinant of the ability to develop critical new infrastructure, but also of the general ability of users to pay for infrastructure services (Yurdakul *et al.* 2021). This can therefore be an important underlying factor in how infrastructure projects perform. A sustained positive GDP growth gives an indication that a country is on a positive stable trajectory and that investments into infrastructure are likely to reap the anticipated benefits. This view may be more likely for PPP projects where there is significant private sector involvement and often a reliance on tariffs. Interestingly previous studies (Yurdakul *et al*. 2021; Mengistu, 2013) have had varying findings on the importance of GDP in PPP investment.

- *Financial development index (FD)* - The advancement of a country's financial system is also expected to have an important impact on the extent to which investment will be attracted. Mofokeng *et al*. (2023) note that given the significant infrastructure financing needs, accessing capital through well development financial markets is critical to successful

infrastructure development. This may be more pronounced for private sector investment and less so for government's expenditure, except in the instances where a government raises capital on the financial market (typically through bond issuances) to help finance its infrastructure program.

- Financial development can be considered as 'a combination of depth (size and liquidity of markets), access (ability of individuals to access financial services) and efficiency (ability of institutions to provide financial services at low cost and with sustainable revenues, and the level of activity of capital markets) (IMF, 2015). The implication of this diverse combination of concepts is that multiple indicators would be required to comprehensively measure financial development in an economy. To overcome what may be viewed as the 'shortcomings' of single indicators as proxies for financial development, a new comprehensive index, termed the Financial Development (FD) index, capturing both financial institutions (FI) and financial markets (FM) has been constructed by the IMF.

- Financial Institutions here include banks, insurance companies, mutual funds, pension funds and other type of nonbank financial institutions. This broader remit of financial institutions is useful for this study, as many of these institutions are now actively investing in long term infrastructure projects, thus a narrow view of banks as the only institutions investing in infrastructure would be inadequate. Financial markets include mainly stock and bond markets (IMF, 2015). For the two sub-indexes, a list of indicators was chosen to measure these denoting depth (D), access (A) and efficiency (E) respectively.

- Each indicator is normalized between 0 and 1, therefore the highest value of a given variable across time and countries is 1 and all other values are measured relative to the maximum values. The indicators are then aggregated into the six sub-indices, based on a weighted average approach drawn from a principal component analysis methodology (IMF, 2015).

Table 36: Variables used in construction of FD Index

	Financial Institutions	Financial Markets
Depth	• Private sector credit (% of GDP) • Pension fund assets (% of GDP) • Mutual fund assets (% of GDP) • Insurance premiums, life and non-life (% of GDP)	• Stock market capitalisation to GDP • Stocks traded to GDP • International debt securities government (% of GDP) • Total debt securities of financial corporations (% of GDP)

		• Total debt securities of non-financial corporations (% of GDP)
Access	• Branches (commercial banks) per 100,000 adults • ATMs per 100,000 adults	• Percent of market capitalisation outside of top 10 largest companies • Total number of issuers of debt (domestic and external, nonfinancial corporations and financial corporations)
Efficiency	• Net interest margin • Lending deposits spread • Non-interest income to total income • Overhead costs to total assets • Return on assets • Return on equity	• Stock market turnover ratio (stocks traded/capitalisation)

Source: IMF, 2015

Applying this database to this study, The broad Financial Development Index (FD) is applied in the panel regression estimation.

- *Population density – (Popden)*- Population has been used in some studies (Yurdakul *et al*. 2021; Mengistu, 2013, Hammani, 2006) given the rationale that private sector investments, particularly those that rely on user-fees/tariffs, are assumed to be more sustainable in large populations. Thus, countries with larger populations may, in theory, be better placed to attract PPP investment. However, this assumption may not hold in instances where the primary off-taker is the government, particularly in the African context where most of the infrastructure needs are for social infrastructure services where a toll/tariff may not apply. Also, given that large government infrastructure services are more often provided for dense rather than sparsely distributed populations, population density is a more important measure to consider. Prieto *et al*., (2015) argued that there are economies of scale to be derived from infrastructure investments in larger urban areas with high population density. Countries with large population densities are therefore expected to have greater infrastructure investment needs. This assertion was confirmed in the study by (Yurdakul *et al*. 2021).

- *Existing infrastructure endowment (IDI)* – The level of investment in an economy has also been seen as an important determiner of how infrastructure projects perform. Yurdakul et al., (2021) include total investments as a percentage of GDP as an indicator in their assessment. The rationale here was that the higher the existing stock of

investment, the greater the likelihood of more PPP projects. I argue that for infrastructure projects, a more relevant measure is the level of existing infrastructure endowment. This posits that countries with a stronger level of infrastructure development, are more likely to execute future projects better. This is both due to having a good base of infrastructure on which to develop further, but also the ability to draw on previous experience in implementing infrastructure projects.

- The Africa Infrastructure Development Index (AIDI) was developed by the African Development Bank (AfDB), to monitor the status and progress of infrastructure development across the continent. The database aims to benchmark the relative performance of African countries' infrastructure sectors. The database ranks infrastructure development across African countries on a scale of 0 to 100, with 100 representing the highest possible score. The first edition of the index was published in 2011. The most recent publication covers 2000 to 2020.

- The data was collected as part of the AfDB's Africa Infrastructure Knowledge Program, and is based on four main components – transport, electricity, information and communication technologies (ICT) and water/sanitation, to develop composite indices for each component (Ncube, 2013). The composite index is calculated as a weighted average of indicators for each component that comprise more than one indicator. The weights are based on the inverse of the standard deviation of each normalized component.

- Since the components of the AIDI are originally measured in different units, the observations are "standardized" or "normalized" to permit averaging, with the average regarded as a composite index. The composite index is calculated as a weighted average of indicators for each component that comprise more than one indicator.

Institutional/governance factors:

As noted repeatedly throughout this study, one of the main objectives is to broaden the set of variables typically examined as influencing PPP and TP investments. The main contribution of this study, beyond the comparative analysis of factors affecting PPP and TP projects, comes in furthering the analysis to examine the possible impact of 'institutional' factors on VfM. These factors are important to consider as it is theoretically accepted that they have an impact, perhaps

somewhat nuanced, on investment flows into infrastructure projects. The empirical assessment of this impact, on a large scale, across countries in Africa has however been lacking. Yurdakul *et al.* (2021), who although do not include these factors, concede that the effect of institutional/governance related factors on PPP activities is important to consider, and measure empirically. It is therefore important for this study to include these variables in the panel regression.

Data are from the Worldwide Governance Indicators (WGI), a research dataset that measures and reports several governance parameters. Governance here is considered under three broad parameters – (a) the process by which governments are selected, monitored and replaced; (b) the capacity of the government to effectively formulate and implement sound policies; and (c) the respect of citizens and the state for institutions that govern economic and social interactions among them (Kaufmann *et al*. 2010). Three categories of governance for each of these areas are defined, as follows:

(a) the process by which governments are selected, monitored and replaced

- Voice and Accountability – capturing perceptions of the extent to which a country's citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.
- Political Stability and Absence of Violence/Terrorism – capturing perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism.

(b) the capacity of the government to effectively formulate and implement sound policies

- Government effectiveness – capturing perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation and the credibility of the government's contribution to such policies
- Regulatory Quality – capturing perception of the ability of the government to formulate an implement sound policies and regulations that permit and promote private sector development

(b) the respect of citizens and the state for institutions that govern economic and social interactions among them

- Rule of Law – capturing perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.
- Control of corruption – capturing perceptions of the extent to which public power is exercised for private gain, including petty and grand forms of corruption, as well as 'capture' of the state by elites and private interests.

The indicators are built up from perceptions-based data sources, from 31 different sources. These summarize the views on the quality of governance provided by a large number of enterprises, citizen and expert survey respondents in industrial and developing countries. The data are gathered from survey institutes, think tanks, non-governmental organizations, international organizations, and public sector bodies (Kaufmann *et al*., 2010). The indicators are measured on a scale from -2.5 to 2.5, and in percentile rank ranging from 0 to 100. The indicators can therefore be used to make comparisons of countries over time, as well as compare the scores of different countries.

One thing to note with the WGI is the linkages between the indicators. In fact, Kaufman *et al* (2010) note that the six indicators of governance should not be seen as being totally independent of each other. They concede that it is not surprising that the six measures of governance are strongly positively correlated, given the inter-relationships with such measures of institutional and governance variables. This implies the possibility of multicollinearity in the indicators, which must be considered when conducting the regression analysis.

Given that the focus of this study is on the impact of these factors on PPP investment decisions, the first category of the WGI, which deals with the formation of governments, is less relevant. For the purposes of this study, four of these composite indicators are deemed most relevant:

- Regulatory Quality
- Control of Corruption
- Voice and Accountability

Given the interdependencies of the WGI and therefore the likelihood of high correlation between the variables, the variables are firstly used interchangeably, rather than being modelled at the same time.

5.4.2 General model to be estimated

The VfM indicator is fed into an econometric model as the dependent variable to facilitate an examination of the cause-and-effect relationships underlying a VfM outcome. The underlying logic of the econometric approach is that VfM is not purely a function of costs and benefits, but that there are certain important factors that drive VfM, and the strength of these variables on a VfM outcome needs to be observed. While the econometric approach yields a result in terms of whether PPP offers greater VfM, it does so by further highlighting the other determining factors of a VfM outcome. This, I argue, is of more value to policymakers and practitioners when making forward looking decisions about a particular procurement option.

The following general equation is estimated:

$$VFM_{ij} = \beta_0 + B_1 PPP_{it} + B_2 Cst_{it} + B_3 SEC_{it} + B_4 Scl_{it} + \beta_5 GDPcap_{jt} + B_6 GDPgro_{jt} + B_7 Pop_{jt} + B_8 IDI_{jt} + B_9 Reg_{jt} + B_{10} Corr_{jt} + B_{11} Vce_{jt} + u_i \quad (6.8)$$

Where *i* denotes the project, *j* the country and *t* denotes the year, respectively

- VFM_{ij} is the value for money of a project
- PPP_{ij} is a PPP dummy of a project defined as follows:
  - $PPP_i = 1\ if\ project\ is\ PPP$
  - $PPP_i = 0\ if\ project\ is\ TP$
- Cst_{ij} is the log of the construction cost of project
- SEC_{ij} is a sector dummy of project defined as follows:
  - $SEC_i = 1\ if\ project\ is\ a\ road$
  - $SEC_i = 0\ if\ project\ is\ a\ power\ project$
- Scl_{ij} is the scale of the project of project defined as follows:
  - $Scl_i = 1\ if\ the\ project\ size\ is\ greater\ than\ 100MW\ (energy) or 100km\ (transport)$
  - $Scl_i = 0\ if\ the\ project\ size\ is\ smaller\ than\ 100MW\ (energy) or 100km\ (transport)$
- $GDPcap_j$ is the GDP per capita

- $GDPgro_j$ is the GDP per capita
- $Popd_j$ is the population density
- IDI_j is the infrastructure development index
- Reg_j is the regulatory quality index
- $Corr_j$ is the control of corruption index
- $Voice_j$ is the voice and accountability

5.5 Results of VfM assessment

Drawing on the general panel regression model of equation (6) above, a number of panel regression models were run, as follows:

A. Project variables only

$$VFM_{ij} = \beta_0 + B_1 PPP_{it} + B_2 Cst_{it} + B_3 SEC_{it} + u_i \quad (6.9)$$

B. Project variables and initial conditions only

$$VFM_{ij} = \beta_0 + B_1 PPP_{it} + B_2 Cst_{it} + B_3 SEC_{it} + B_4 Scl_{it} + \beta_5 GDPcap_{jt} + B_6 GDPgro_{jt} + B_7 Popd_{jt} + B_8 IDI_{jt} + u_i \quad (6.10)$$

C. Project variables, initial conditions and institutional factors (excluding Voice index)

$$VFM_{ij} = \beta_0 + B_1 PPP_{it} + B_2 Cst_{it} + B_3 SEC_{it} + B_4 Scl_{it} + \beta_5 GDPcap_{jt} + B_6 GDPgro_{jt} + B_7 Popd_{jt} + B_8 IDI_{jt} + B_9 Reg_{jt} + B_{10} Corr_{jt} + u_i \quad (6.11)$$

D. Project variables, initial conditions and institutional factors (excluding corruption index)

$$VFM_{ij} = \beta_0 + B_1 PPP_{it} + B_2 Cst_{it} + B_3 SEC_{it} + B_4 Scl_{it} + \beta_5 GDPcap_{jt} + B_6 GDPgro_{jt} + B_7 Popd_{jt} + B_8 IDI_{jt} + B_9 Reg_{jt} + B_{10} Vce_{jt} + u_i \quad (6.11)$$

Apart from VfM, each of the above models was run for each of the other four dependent variables – relevance, effectiveness, efficiency and sustainability. Thus, a total of 20 model tests were run. Prior to the running of the regression models, it was important to conduct a number of tests on the models.

5.5.1 Panel model tests

One potential issue with large panel datasets is that of multicollinearity among the explanatory variables. Collinearity is a linear association between two explanatory variables. Multi-collinearity occurs where two or more explanatory variables in a multiple regression are related to each other and likewise related to the dependent variable (Akinwade *et al*., 2015) Collinearity can increase estimates of parameter variance, produce models in which no variable is statistically significant although R^2 is large, or produce parameter estimates of the incorrect sign and of implausible magnitude (O'Brien, 2007).

To initially check for potential multicollinearity among the independent variables, bivariate correlation metrics are calculated for pairs of the independent variable's pre-estimation. A coefficient greater than 0.5 indicates high correlation between the variables and indicates potential multicollinearity.

Table 37 shows the correlation matrix, presenting the bivariate correlation coefficients for the explanatory variables and highlighting the instances of high correlation.

Table 37: Correlation matrix

	PPP	*Lcost*	*Sec*	*Scale*	*GDPpercap*	*GDPgro*	*PopDen*	*FI*	*IDI*	*Regqual*	*Corr*	*Voice*
PPP	1.000	0.277	-0.238	0.256	0.072	-0.222	-0.204	0.217	0.132	-0.001	-0.159	0.031
LCost	0.277	1.000	-0.336	0.595	0.232	-0.262	-0.263	0.454	0.535	0.417	-0.012	0.129
Sec	-0.237	-0.336	1.000	-0.239	-0.226	0.188	-0.019	-0.406	-0.458	-0.373	-0.046	0.055
Scale	0.256	0.595	-0.239	1.000	-0.028	-0.169	-0.328	0.282	0.206	0.001	-0.187	-0.181
Gdppercap	0.072	0.232	-0.226	-0.028	1.000	-0.415	0.476	0.651	0.670	0.499	0.557	0.221
Gdpgro	-0.222	-0.263	0.188	-0.169	-0.386	1.000	0.080	-0.416	-0.311	-0.293	-0.194	-0.216
Popden	-0.204	-0.263	-0.019	-0.328	0.476	0.0080	1.000	0.013	0.114	0.226	0.557	0.221
FI	0.217	0.454	-0.405	0.282	0.651	-0.416	0.013	1.000	0.715	0.561	0.251	0.343
IDI	0.132	0.535	-0.458	0.205	0.670	-0.311	0.114	0.715	1.000	0.595	0.257	0.116
Regqual	-0.001	0.417	-0.373	0.001	0.499	-0.293	0.226	0.561	0.561	1.000	0.423	0.591
Corr	-0.159	-0.012	-0.046	-0.187	0.557	-0.194	0.557	0.251	0.257	0.423	1.000	0.292
Voice	0.031	0.129	0.055	-0.181	0.221	-0.216	0.04	0.343	0.116	0.591	0.292	1.000

The only correlation between the project specific variables is between cost and scale. This is to be expected given how the variables are constructed; the scale variable, although defined as a function of size, has some association to the cost. This is because typically larger projects also tend to have higher absolute costs. The infrastructure development index (IDI) has the greatest number of correlations at 4, followed by GDP per cap and regulatory quality. It is reasonable that the IDI will have correlations with variables such as GDP per cap, FI and regulatory quality as theoretically speaking all these factors are generally consistent with the level of infrastructure development in a country. Countries with higher GDP, more developed financial institutions and strong regulations are most likely to have well developed infrastructure sectors. Given these correlations, a synthetic institutional index will be a relevant robustness check. Further in the base models the corruption and voice variables are tested interchangeably.

Following the correlation analysis, the next step in the regression process is to determine which of the panel regression model techniques is most appropriate for this dataset – either fixed effects, random effects or the correlated random effects models. This is done sequentially, firstly the Hausman test is used to compare between the fixed effects and random effects, and then a likelihood ratio test determines whether the correlated random effects is most appropriate for this dataset.

Hausman test

As discussed in the methodology, the null hypothesis for the Hausman test is that the fixed effects and random estimators do not differ substantially. If the null hypothesis is rejected, the implication is that the random effects is not appropriate because the random effects are most likely correlated with one or more of the regressors.

H_0: Random effects model is preferred

H_1: Fixed effects model is preferred

The Hausman test was conducted for all 20 model test runs, with the results shown in Table 38.

Table 38: Hausman test outputs

Dependent variable	Model	Chi-sq statistic	Chi-sq d.f.	Prob
VfM	Model A	6.297174	4	0.178
	Model B	11.988153	9	0.214
	Model C	13.611154	11	0.2553
	Model D	13.368763	11	0.2699
Relevance	Model A	1.979692	4	0.7395
	Model B	16.927825	9	**0.0499**
	Model C	26.163069	11	**0.0061**
	Model D	16.197523	11	0.134
Effectiveness	Model A	5.149535	4	0.8091
	Model B	5.466729	9	0.7919
	Model C	5.899479	11	0.8800
	Model D	7.446834	11	0.7618
Efficiency	Model A	1.510726	4	0.8247
	Model B	5.180368	9	0.8183
	Model C	5.677023	11	0.894
	Model D	6.992356	11	0.7997
Sustainability	Model A	7.181539	4	0.1266
	Model B	9.46801	9	0.3952
	Model C	11.848533	11	0.3751
	Model D	10.190168	11	0.5134

The table shows that in almost all cases, the test fails to reject the null hypothesis that the fixed and random estimators do not differ substantially. It is only in two instances for the relevance dependent variable where the null hypothesis is rejected. Given the overwhelming consistency of the results for 18 out of the 20 permutations, one can conclude that the null hypothesis cannot be rejected and that the random effects model is more appropriate for this dataset than the fixed effects model. The regression analysis therefore proceeds using the random effects model technique.

Unit root test

One of the challenges of panel data is that it can sometimes display the characteristics of non-stationarity which could lead to biased results. Without a stationary dataset, accurate predications and analysis cannot be made. There a unit root test is used to determine the presence of a unit root – a non-stationary time series in a panel dataset. The unit root test helps to confirm that the chosen econometric model – in this case the random effects panel regression model, is the most appropriate to use.

The test provide a p-value. If the null hypothesis is rejected, then the series is deemed stationary and the chose model can provide an accurate estimation and prediction. The unit root test is done to ensure the data is stationary at 'level' or at least at the 1st difference. The table presents the results of the unit root test for this database

Variable	Test at Levels		Test at 1st difference	
	ADF Chi-square	Probability	ADF Chi-square	Probability
Dependent variable				
VfM	10.7887	0.0290**		
Relevance	8.26748	0.0823*		
Effectiveness	5.77549	0.2166	15.34574	0.006213**
Efficiency	5.37136	0.2513	15.73565	0.005345**
Sustainability	9.22087	0.0558*		
Explanatory variables				
PPP	0.44177	0.8018	18.4207	0.0001***
Sector	7.54670	0.0230**		
Scale	4.89555	0.0865*		
GDP per capita	0.35884	0.9857	15.8066	0.0004***
GDP growth	10.3058	0.0356**		
FI	2.67604	0.6134	7.58473	0.0225**
AIDA	4.73294	0.3158	10.0799	0.0065***
Pop density	1.72494	0.7862	6.97730	0.0305**
Regulatory Quality	1.43903	0.8374	5.24662	0.0726*
Sustainability	9.22087	0.0558*		
Corr	5.58899	0.2320	5.21532	0.0737*
Voice	2.58989	0.6286	7.94790	0.0188**

The table above demonstrates that most variables are stationary at levels with a number of them stationary at 1st difference. This indicates that the dataset has a mixed of integration of order one and zero, which is suitable to proceed with the analysis.

5.5.2 Base model results

The results for the base panel regression, based on the random effects model, are presented below, for each of the dependent variables – VfM, efficiency, effectiveness, relevance and sustainability. For each of these dependent variables the four model permutations are presented. The actual regression outputs are shown in annexure 4.

Overall VfM assessment

The first regression outputs are for the overall VfM dependent variable, which is a construct of all four sub-categories – efficiency, effectiveness, relevance and sustainability. The results are shown in
Table ***39***, for the four specifications.

Table 39: Base panel regression model: VfM as the dependent variable

Variables	Model (a): Project variables only		Model (b): Project variables and initial conditions		Model (c): Full model (excluding Voice index)		Model (d): Full model (excluding Corruption index)	
	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
PPP	-0.10999	0.3826	-0.1414	0.2507	-0.1505	0.2333	-0.1407	0.2728
Cst(log)	-0.0033	0.9475	-0.0390	0.4933	-0.0554	0.3725	-0.0567	0.3701
Sec	0.1012	0.3190	0.1782	**0.1008***	0.1957	**0.0791***	0.1719	0.1482
Scl	0.1224	0.3096	0.1210	0.3199	0.1452	0.2647	0.1609	0.2397
GDPcap			-0.0003	0.4615	-0.0005	0.7011	-0.0003	0.4989
GDPgro			0.0044	0.7381	0.0044	0.7417	0.0062	0.486
Popd			0.0003	0.4622	0.0004	0.4176	0.0003	0.5762
FI			1.5815	**0.0299****	1.4712	**0.0491****	1.3789	**0.0838***
IDI			0.0013	0.7446	0.0004	0.9198	0.0017	0.7009
Reg					0.1466	0.3619	0.0482	0.8106
Corr					-0.1293	0.2818		
Voice							0.0554	0.6565
R^2	0.0506		0.183184		0.220104		0.204336	
Adjusted R^2	-0.0220		0.030031		0.033607		0.014068	

*Significance levels: *p<0.01; **p<0.05; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log); Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

The model outputs indicate the PPP is not significant in any of the permutations. Similarly for cost and scale which are not found to be significant. The only project specific variable that is significant is the sector, at the 10% level of significance in model (b) and (c). The financial

institutions index is the only initial conditions variable significant, at the 5% level in models (b), (c)and (d). None of the institutional variables are significant in any of the permutations. The model has a very low R^2 and Adjusted R^2, thus indicating it is not a well fitted model in this current format and needs to be enhanced.

VfM shareholder approach – efficiency and effectiveness dependent variables

The efficiency and effectiveness variables, which looks at how well the project delivers its outputs in an economic and timely fashion, are the variables closest to the dominant shareholder approach to VfM. The results of these analyses are shown in the two subsequent tables.

Table 40: Base panel regression model: Efficiency as the dependent variable

Variables	Model (a): Project variables only		Model (b): Project variables and initial conditions		Model (c): Full model (excluding Voice index)		Model (d): Full model (excluding Corruption index)	
	Coefficient	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**
PPP	-0.2709	0.1469	-0.2939	**0.1085***	-0.2498	0.1870	-0.2722	0.1482
Cst	-0.0149	0.8394	-0.0838	0.3013	-0.1124	0.1940	-0.1183	0.1716
Sec	0.2915	**0.0508****	0.4234	**0.0070*****	0.4473	**0.0054*****	0.4065	**0.0135****
Scl	0.3008	**0.0857***	0.3090	**0.0781***	0.3660	**0.0453****	0.3961	**0.0335****
GDPcap			-0.0005	0.3452	-0.0005	0.4266	-0.0007	0.3965
GDPgro			-0.0003	0.8538	-0.0027	0.8897	-0.0015	0.9384
Popd			0.0006	0.4164	0.0004	0.5987	0.0005	0.5520
FI			1.7112	0.1525	1.3346	0.2962	0.9450	0.4722
IDI			0.0079	0.2279	0.0063	0.3783	0.0088	0.2237
Reg					0.2772	0.3097	0.1151	0.7014
Corr					-0.0101	0.9624		
Voice							0.1796	0.3303
R^2	0.159791		0.272921		0.287854		0.304705	
Adjusted R^2	0.096378		0.136594		0.117558		0.138439	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

The PPP variable is just significant but negative at the margin of the 10% threshold in model (b), but not significant in any of the other models. The sector and scale variables are significant in all model permutations. The cost variable does not emerge as a significant variable, which may be a somewhat surprising outcome given the expected importance of costs to the efficiency component of VfM. None of the initial conditions nor institutional variables are found to be

significant in any of the model permutations. Again, the model's R^2 and Adjusted R^2 are quite low, reflecting the need for model improvement.

Table 41: Base panel regression model: Effectiveness as the dependent variable

Variables	Model (a): Project variables only		Model (b): Project variables and initial conditions		Model (c): Full model (excluding Voice index)		Model (d): Full model (excluding Corruption index)	
	Coefficient	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**
PPP	-0.2814	0.1774	-0.3020	0.1673	-0.2968	0.1976	-0.3358	0.1414
Cst	-0.0501	0.5561	-0.0525	0.6042	-0.0619	0.5828	-0.0719	0.5196
Sec	-0.0642	0.7069	-0.0099	0.9584	-0.0020	0.9919	-0.1049	0.6144
Scl	0.1962	0.3313	0.1774	0.4114	0.1947	0.4101	0.2859	0.2378
GDPcap			-0.0005	0.9076	-0.0005	0.9564	-0.0006	0.9464
GDPgro			0.0010	0.9657	0.0014	0.9519	0.0034	0.8882
Popd			0.0004	0.6574	0.0003	0.7049	0.0005	0.5954
FI			1.8090	0.1476	1.7188	0.2012	1.057	0.4477
IDI			-0.0048	0.4984	-0.0051	0.4897	-0.0006	0.9375
Reg					0.0709	0.8077	-0.2731	0.4450
Corr					-0.0260	0.9046		
Voice							0.3337	0.1346
R^2	0.058305		0.123588		0.125102		0.178574	
Adjusted R^2	-0.012766		-0.040740		-0.084113		-0.017854	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

The main thing to note about the model permutations for the effectiveness dependent variable is the extremely low R^2 and negative Adjusted R^2. This indicates a very poor fitting model and therefore results that are uninterpretable.

VfM stakeholder approach – relevance and sustainability dependent variables

The results for the base panel regression for the broader stakeholder VfM variables – relevance and sustainability, are presented next.

Relevance dependent variable

Table 42: Relevance as the dependent variable - panel regression outputs

Variables	Model (a): Project variables only		Model (b): Project variables and initial conditions		Model (c): Full model (excluding Voice index)		Model (d): Full model (excluding Corruption index)	
	Coefficient	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**
PPP	0.095422	0.4515	0.0975	0.4241	0.0641	0.5446	0.1195	0.3543
Cst	0.0053	0.9156	-0.0095	0.8557	-0.0268	0.5814	-0.0159	0.7786
Sec	-0.0172	0.8634	0.0013	0.9887	0.0070	0.9357	0.0285	0.7867
Scl	0.0063	0.9573	0.0113	0.9192	0.0089	0.9294	0.0120	0.9193
GDPcap			0.0002	0.6752	0.0008	**0.0798***	0.0002	0.6900
GDPgro			0.0126	0.3395	0.0079	0.4790	0.0130	0.3404
Popd			-0.0004	0.4957	-0.0001	0.7041	-0.0005	0.4383
FI			0.0520	0.9548	0.0058	0.9934	0.1843	0.8575
IDI			0.0014	0.7665	-0.0029	0.4650	-0.0003	0.9495
Reg					0.2913	**0.060***	0.1746	0.4228
Corr					-0.4521	**0.0005*****		
Voice							-0.0936	0.4746
R^2	0.016777		0.043385		0.234632		0.057156	
Adjusted R^2	-0.057428		-0.135981		0.051609		-0.1683	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

Similar to the 'effectiveness' variable, the model outputs for the 'relevance' dependant variable have extremely low R^2 and negative Adjusted R^2 except for model(c). This indicates a very poor fitting model and therefore results that are uninterpretable. Looking at model (c) only which is the only model with a positive but very low Adjusted R^2, the GDPper capita variable is significant, while two institutional variables are significant for the first time – regulatory quality and control of corruption.

Sustainability dependent variable

Table 43: Sustainability as the dependent variable - panel regression outputs

Variables	Model (a): Project variables only		Model (b): Project variables and initial conditions		Model (c): Full model (excluding Voice index)		Model (d): Full model (excluding Corruption index)	
	Coefficient	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**	**Coefficient**	**Prob**
PPP	-0.0615	0.7278	-0.0562	0.7556	-0.039966	0.8310	-0.0487	0.8001
Cst	-0.0024	0.9720	-0.0322	0.6858	-0.0299	0.7216	-0.4004	0.6907
Sec	0.1720	0.2226	0.2872	**0.0591***	0.3012	**0.0518***	0.2895	**0.0797***
Scl	0.2593	0.1200	0.2875	**0.0968***	0.2860	**0.1077***	0.2932	0.1177
GDPcap			-0.0001	0.1167	-0.0001	0.2379	-0.0001	0.1356
GDPgro			-0.0068	0.7215	-0.010	0.6029	-0.0068	0.7322
Popd			0.0015	**0.0685***	0.0017	**0.0656***	0.0015	**0.0939***
FI			1.6410	0.1849	1.4899	0.2674	1.5728	0.2621
IDI			0.0065	0.3345	0.0051	0.4924	0.0065	0.3979
Reg					0.1120	0.6913	0.0249	0.9364
Corr					-0.1864	0.4145		
Voice							0.0057	0.9758
R^2	0.071313		0.181494		0.188680		0.180811	
Adjusted R^2	0.001223		0.028024		-0.005332		-0.015082	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

Aligned with the outputs from the other models, the permutations here have extremely low R^2 and negative Adjusted R^2 except for models (a) and (b). Looking therefore only at model(b), the sector, scale and population density variables are significant at the 10% threshold level.

Overall, it is evident that the base models, while providing some interesting results, are not well fitted and need to be enhanced. The model improvements are presented below.

5.5.3 Base model enhancements

To improve the goodness of fit of the models, two approaches were adopted, rooted in the underlying theoretical logic. Firstly, a number of the initial condition variables were lagged, and then secondly an institutional index was created, to combine the three institutional

variables. These enhancements were firstly run independently of each other, to observe their respective impact on the various models' goodness of fit.

Lagging initial conditions

The initial condition variables are included to account for the state of an economy at the time at which an investment decision is being made. Given that VfM is an output further down the line when the project is operational or at least construction is complete, it is valuable to consider these variables in their lagged format. In an ideal setting, all initial condition variables (except gdp growth) could be lagged simultaneously, and the effect observed. However, given the current limitation of a relatively small database, three initial condition variables – gdp per capita and the financial institutions index are lagged. These present the broadest indicators of general development prior to an investment decision and are thus relevant to observe in their lagged format, to explore what impact, if any, this has on the regression outputs. The models were re-run with the lagged initial conditions variables, but not including the institutional variables. The results are shown below.

Table 44: Initial conditions lagged- VfM, Efficiency, and Sustainability

Variables	VfM Dependent variable		Efficiency Dependent variable		Sustainability Dependent variable	
	Coef.	Prob	Coef	Prob	Coef	Prob
PPP	0.0065	0.9368	-0.4132	**0.0585****	0.0431	0.5490
Cst(log)	-0.1674	**0.088***	-0.2948	0.0124	-0.0597	0.2182
Sec	0.2040	**0.0142****	0.5423	**0.0031*****	0.3284	**0.0002*****
Scl	0.1516	0.1222	0.3594	**0.0887***	0.1871	**0.0346****
GDPcap(lag)	-0.0004	**0.0006*****	-0.0005	**0.0038*****	-0.0005	0.3898
GDPgro	-0.0421	**0.0197****	-0.0399	0.2081	0.0204	0.1557
Popd	0.0048	**0.0078*****	0.0068	**0.0274****	-0.0003	0.7619
FI(lag)	1.820	0.1020	2.5785	0.1778	3.1510	**0.0038*****
IDI(lag)	0.0206	**0.0011*****	0.0340	**0.0008*****	0.0061	0.1611
R^2	0.509238		0.848836		0.445927	
Adjusted R^2	0.141167		0.735463		0.030372	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

It is immediately obvious that there are notable improvements in the model outputs for the VfM, efficiency and sustainability variables when the three initial condition variables are

lagged by one year. The R^2 in particular is much improved for all three dependant variables, while the Adjusted R^2 is approved for the VfM and efficiency variables. In addition to the improved goodness of fit indicators, the models also have much improved significance in many of the variables. This therefore confirms that lagging the initial conditions variables enhancing the models for VfM, efficiency and sustainability.

On the other hand, lagging gdp per capita, financial institutions index and the infrastructure endowment has no material impact on the effectiveness and relevance variables. The R^2 is still very low and negative Adjusted R^2 is still negative. This indicates that these models are still not well fitted. This is further confirmed by the lack of significance of all the explanatory variables.

Table 45: Initial conditions lagged – Effectiveness and relevance

Variables	Effectiveness variable		Relevance Dependent variable	
	Coef.	Prob	Coef	Prob
PPP	0.0603	0.7937	0.0691	0.7857
Cst(log)	-0.0775	0.5837	-0.0419	0.7465
Sec	-0.1952	0.3276	-0.1255	0.5130
Scl	-0.0163	0.9473	-0.1838	0.4664
GDPcap(lag)	-0.0004	0.1027	-0.0003	0.1015
GDPgro	-0.0281	0.5059	-0.0582	0.1537
Popd	0.0059	0.1436	0.0046	0.1958
FI(lag)	3.8147	0.1748	1.3770	0.5565
IDI(lag)	0.0082	0.4998	0.0132	0.1945
R^2	0.251867		0.424467	
Adjusted R^2	-0.309233		-0.007183	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

Institutional index

The second model enhancement is to develop an institutional synthetic index with the regulatory quality, control of corruption as well as the voice and accountability variables as the base. This was done through the Principal Component Analysis (PCA) approach. PCA is a

procedure that can be used to remove multicollinearity from a dataset. PCA constructs artificial variables called Principal Components from the regressors such that they are uncorrelated to each other. The main purpose of the PCA is to reduce the number of correlated variables to fewer uncorrelated components while retaining as much of the variation as possible (Jolliffe, 2002). Annexure 3 presents the underlying PCA loadings of the three variables from which the index was then established. The PCA loadings are then used to generated a new synthetic index, termed 'InstIndex'.

The model permutations were then run again using the synthetic index, keeping all other variables same as they were in the base case. This enables a clear observation of the impact of the institutional synthetic index on improving the goodness of fit and model outputs. The results are shown below.

As shown in Table 46 For the VfM, efficiency and sustainability dependent variables, there is some slight improvement in the goodness of fit of the models. However, for effectiveness and sustainability (see Table 47), there is no improvement, with the Adjusted R^2 is still negative.

Table 46: Institutional index - VfM, Efficiency, and Sustainability

Variables	VfM Dependent variable		Efficiency Dependent variable		Sustainability Dependent variable	
	Coef.	Prob	Coef	Prob	Coef	Prob
PPP	-0.1365	0.2801	-0.2594	0.1602	-0.0533	0.7754
Cst(log)	-0.0452	0.4631	-0.1191	0.1649	-0.0272	0.7492
Sec	0.1773	**0.1088***	0.4225	**0.0073*****	0.2886	**0.0628***
Scl	0.1351	0.3098	0.3814	**0.0399****	0.2799	0.1272
GDPcap	-0.0003	0.4655	-0.0008	0.3127	-0.0001	0.1326
GDPgro	0.0051	0.7073	0.0002	0.9883	-0.0076	0.7014
Popd	0.0003	0.5407	0.0003	0.6656	0.0016	**0.0786***
FI	1.5035	**0.0561****	1.1554	0.3579	1.6694	0.2181
IDI	0.0014	0.7303	0.0086	0.1943	0.0065	0.3528
InstIndex	0.0140	0.7661	0.1012	0.1788	-0.0118	0.8815
R^2	0.185299		0.301511		0.180308	
Adjusted R^2	0.011959		0.152896		0.005905	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

Table 47: Institutional index – Effectiveness and relevance

Variables	Effectiveness variable		Relevance Dependent variable	
	Coef.	Prob	Coef	Prob
PPP	-0.2793	0.2136	0.0831	0.5072
Cst(log)	-0.0795	0.4695	0.0041	0.9402
Sec	-0.0139	0.9427	0.0020	0.9836
Scl	0.2415	0.3096	-0.0129	0.9124
GDPcap	-0.0005	0.9036	0.0005	0.6489
GDPgro	0.0040	0.8668	0.0113	0.4030
Popd	0.0002	0.8279	-0.0002	0.6701
FI	1.4611	0.2810	0.3037	0.7596
IDI	-0.0043	0.5470	0.0014	0.7800
InstIndex	0.0602	0.4699	-0.0048	0.3987
R^2	0.135894		0.055401	
Adjusted R^2	-0.047958		-0.145577	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

Best model fit

Drawing from the outputs of the two model enhancements undertaken, a 'best fit' model can now be obtained. This was achieved by combining the model enhancements lagging three initial condition variables (gdp per capita, financial institutions index and the infrastructure endowment) with the institutional synthetic index. The outcomes are presented below, for the VfM, efficiency and sustainability variables. The effectiveness and relevance variables are excluded from further analysis given that they remain uninterpretable even with the model enhancements.

Table 48: Best model fit – VfM, efficiency and sustainability

Variables	VfM Dependent variable		Efficiency Dependent variable		Sustainability Dependent variable	
	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
PPP	-0.0286	0.7451	-0.4063	**0.0723***	0.0815	0.3484
Cst(log)	-0.1893	**0.0020*****	-0.3262	**0.0139****	-0.1310	**0.0150****
Sec	0.1397	**0.0804***	0.4817	**0.0175****	0.3063	**0.0011*****
Scl	0.1299	0.1910	0.4302	**0.0783***	0.2066	**0.0428****
GDPcap(lag)	-0.0003	**0.0063****	-0.0004	**0.0472****	-0.0005	0.8501
GDPgro	-0.0063	0.6891	-0.0254	0.5014	0.0543	**0.0038*****
Popd	0.0026	0.1198	0.0049	0.2147	-0.0018	0.2601
FI(lag)	1.1307	0.2460	1.7110	0.4516	2.0004	**0.0466****
IDI(lag)	0.0185	**0.0003*****	0.0319	**0.0030****	0.0090	**0.0226****
InstIndex	0.0768	0.1732	0.0937	0.4700	0.0967	**0.0847***
r^2	0.682708		0.854481		0.614574	
Adjusted r^2	0.394261		0.722191		0.264186	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

The improved models now have R^2 and Adjusted R^2 that represented models that are reasonably well fit and therefore results that can be interpreted.

For the VfM variables, four explanatory variables are found to be significant. For the project specific variables, cost and sector are significant, though cost has a negative coefficient. Two initial condition variables are also found to be significant. GDP per capita is significant but negative, while the infrastructure endowment index is significant and positive.

The narrow stakeholder VfM theory is represented by the efficiency variable. As is to be expected, all the project specific variables are significant for the efficiency variable. PPP and cost are negative however, while sector and scale have a positive impact on VfM. As with the broader VfM, the same initial condition variables are found to be significant – GDP per capita and the infrastructure endowment index.

The sustainability variable, which now is the sole variable for the broader shareholder theory, also has many of its explanatory variables now significant. Cost, sector and scale are significant project specific variables (again with cost negative). Different initial condition variables from

the VfM and efficiency models are significant. In this case GDP growth and the financial institutions index are significant and positive to sustainability. Interesting, the institutional index is found to be significant for the first time, indicating the importance of institutional factors to sustainability. The infrastructure endowments index is the one initial condition variable that is significant in all models.

The implications of these findings are unpacked in more detail in the discussion section below, but prior to the findings from robustness checks are presented briefly.

5.5.4 Robustness checks

To ensure that the regression results are plausible and robust, a number of checks were undertaken. The value of robustness checks is also that it enables an assessment of whether and how the findings change under certain conditions or assumptions.

Variance inflation factor test

The correlation matrix was conducted prior to the running of the panel regression. To further rule out multicollinearity as a potential driver of our results, a separate multicollinearity test was undertaken post-estimation. This is done through the variance inflation factor (VIF), which indicates how much the estimated variance of the *i*th regression coefficient is increased above what it would be if R^2 equalled zero (O'Brien, 2007). VIF is one of the most conventional multi-collinearity diagnostic techniques (Liao and Valliant, 2012). It provides a reasonable and intuitive indication of the effects of multi-collinearity on the variance of the *i*th regression coefficient (O'Brien, 2007). Akinwade *et al*. (2015) note that it has been established that a VIF of 5 and above for an explanatory variable is not suitable for a regression model as it might render other significant variables redundant. This is confirmed by earlier studies (Hocking and Pendelton, 1983; Craney and Surles, 2002) which suggested that the typical cutoff values (rules of them) for VIFs should be 5 or 10. This study conducts a VIF on the regression model, to see whether any notably large VIF measures will be observed.

The results of the VIF test on the explanatory variables are shown in Table 49 below. The results indicate that none of the explanatory variables have a VIF above 5, with the GDP per

capita variable highest at 4.1817. Therefore, one may conclude that multi-collinearity is not present. There is thus no need to exclude any of the variables from the regression tests.

Table 49: Variance inflation Factor results

Variables	Coefficient Variance	Centered VIF
PPP	0.0169	1.2696
Cst	0.0040	2.6769
Sec	0.0141	1.6130
Scl	0.0188	2.0917
GDPcap	0.0004	4.1817
GDPgro	0.0001	1.4134
Popd	0.0003	2.3541
FI	0.6304	3.5118
IDI	0.0002	3.8482
Reg	0.0422	3.6281
Corr	0.0152	1.9691
Voice	0.0159	2.4505

Correlated random effects model

Another robustness check conducted was to run the 'best fit' model using the correlated random effects model. As noted earlier the correlated random effects model could be applied where there are significant contextual effects to be considered. Given that contextual effects, particularly relating to the initial conditions and institutional variables could be relevant, it is useful to explore this technique as a robustness check.

The results, shown in Table 50, indicate that while the goodness of fit is very high, the correlated random effects model does not present any of the variables as significant. Thus it appears to have a much lower explanatory power than the random effects model. The robustness of the random effects approach as the most appropriate model technique for this dataset is thus confirmed.

Table 50: Correlated random effects model

Variables	VfM Dependent variable		Efficiency Dependent variable		Sustainability Dependent variable	
	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
PPP	0.1361	0.7022	-0.0215	0.9786	-0.3696	0.3910
Cst(log)	0.0617	0.8211	0.2613	0.6976	0.1905	0.5263
Sec	0.3589	0.2575	0.6405	0.3297	0.5769	0.1605
Scl	-0.0580	0.8833	-0.1101	0.9063	-0.1408	0.7228
GDPcap(lag)	-0.0010	0.6789	0.0006	0.9125	0.0038	0.2920
GDPgro	-0.1052	0.2123	-0.1883	0.2744	-0.0871	0.2448
Popd	0.0740	0.2611	0.0672	0.0764	0.0854	0.2226
FI(lag)	-14.8688	0.2483	-22.4537	0.3655	0.9988	0.8935
IDI(lag)	0.0440	0.6496	0.0545	0.8028	-0.3382	0.1288
InstIndex	0.5597	0.6042	1.7361	0.5212	0.3655	0.7132
r^2	0.993881		0.989916		0.995997	
Adjusted r^2	0.871507		0.788227		0.915944	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

Adjusting PPP dummy, and cost variables

As a final robustness check, a number of permutations were conducted to assess the impact of adjusting the PPP dummy variable, and then also assessing the impact of the cost variable on the PPP dummy variable. Since there are more TP projects than PPP projects, a scenario was run where the TP projects takes a value of 1 and the PPP projects 0. Secondly the PPP/TP dummy was multiplied with cost to see how the cost of a project affects the VfM where the project is a PPP or TP. In summary, three permutations were conducted:

- TP dummy takes value of 1 and PPP 0
- Where PPP dummy takes value of 1, multiplied with cost to get a PPP_Cost variable
- Where TP dummy takes value of 1, multiplied with cost to get a TP_Cost variable

The results are shown below, conducted for the VfM variable only.

Table 51: PPP/TP dummy adjustment

Variables	TP dummy - 1		PPP_Cost		TP-Cost	
	Coefficient	Prob	Coefficient	Prob	Coefficient	Prob
PPP/TP	-0.1361	0.8069	-1.41E-09	0.1023	-1.02E-11	0.9833
Cst(log)	0.0586	0.1710	0.0437	0.6074	0.03974	0.6985
Sec	0.2525	0.0551*	0.2604	0.1310	0.2677	00448*
Scl	0.0299	0.5363	0.1591	0.2733	0.1806	0.2537
GDPcap(lag)	-0.0057	0.6255	0.0003	0.9044	-00001	0.9012
GDPgro	-0.0660	0.6117	-0.0235	0.2970	-0.013	0.5528
Popd	0.0557	0.6413	0.0065	0.4448	0.0097	0.2755
FI(lag)	20.5425	0.6154	6.4482	0.2011	3.4405	0.4932
IDI(lag)	-0.0473	0.6823	-0.0262	0.1023	-0.0209	0.2288
InstIndex	0.3503	1.5815	0.1070	0.4670	0.0870	0.5745
r^2	0.634705		0.672073		0.634346	
Adjusted r^2	0.196350		0.278561		0.195561	

*Significance levels: *p<0.01; **p<0.005; ***p<0.001*

PPP – PPP dummy; Cst – Cost(log);Sec – Sector; Scl – Scale; GDPcap – GDP per capita; GDPgro – GDP growth; Popd – Population density; FI – Financial Institutions Index; IDI – Infrastructure development index; Reg – Regulatory quality; Corr – Corruption; Voice – Voice and Accountability

Overall, the robustness checks have not resulted in outcomes that notably deviate from the findings of the current best fit models. One may therefore conclude that the best fit models are set out accurately and can form the basis of interpretations and analysis. The next section presents a discussion of the results, noting the implications of the model outputs.

5.6 Discussion of findings

The focus of this chapter has been primarily to conduct an empirical test of whether VFM is influenced by the procurement type – either PPP or TP, and secondly to identify other project, macroeconomic or institutional factors that may have an influence on VFM. With the prevailing assumption that PPPs offer greater value for money, it is imperative to understand whether this has held true in infrastructure projects across Africa. The estimated model had three components – project specific variables (procurement type, cost, sector and scale); macro-economic initial condition variables (GDP per capita, GDP growth, population density, a financial development index as well as the infrastructure development index); and thirdly institutional variables (regulations quality, corruption and voice/accountability).

There are insightful findings that emerge from the panel regression results, which are discussed below:

PPPs cannot be said to definitely offer greater VfM in African projects

The most important finding of the panel regression estimation is that the PPP variable has not emerged to be significant and positive in most of the model permutations. The PPP variable was only found to be significant for the narrow stakeholder view of VfM (efficiency variable). This implies that in this narrower view where VfM is mainly a construct of a project's performance, the procurement choice does have some bearing on whether VfM is achieved or not. Interestingly the PPP variable, although significant, has a negative coefficient. This implies that in fact PPPs have performed more poorly than TP projects in terms of VfM, for the sample of projects considered.

The PPP dummy variable was not found to be significant in any of the other model permutations. This was both for the overall VfM variable as well as all the broader shareholder view of VfM. This does not imply that PPPs do not offer VfM, just that it cannot be said that they materially offer greater VfM than traditional procurement in the African context. The results appear to indicate that other variables, particularly the other project variables and some of the initial conditions and institutional variables have a greater bearing on whether VfM is achieved in infrastructure projects in Africa, than the procurement choice of PPP or TP.

Based on these findings, it cannot be argued that for the sample of projects observed, there is a difference in the broad VfM driven by whether the project is procured as a PPP or as a government financed project. The difference appears to be more for the narrow definition of VfM focused primarily on project specific outcomes. These findings align with those of the previous chapter, where the drivers of VfM for PPP and TP are broadly similar, except that the PPP drivers are more focused on the technical and financial factors, and less on the social and political.

Project specific variables – cost, sector and scale appear important to VfM

While PPP did not prove significant, the other project specific variables – cost, sector and scale of a project do appear to have a significant relationship with VFM. The cost variable was significant to the overall VfM indicator, as well as the narrower and broad versions of VfM. Interestingly the coefficient of the cost variable is negative. This implies that as the cost

increases, VfM is diminished. This is not unexpected as projects where there is a higher cost, must meet a greater benefit threshold to achieve VfM, which is essentially a relationship of benefit over costs.

For the sector variable, the positive coefficient indicates that road projects have demonstrated greater VfM than power projects. This may be due to certain factors at play. Firstly, there are simply more roads projects in the sample, so perhaps this is reflective in the significance of roads projects as demonstrating greater VfM. Secondly the fact that there are more roads projects in the sample is consistent with the overall profile of projects undertaken by the AfDB, where road projects dominate. This could imply that over time, greater efficiencies have been developed in the delivery of road projects, which translates into a higher VfM outcome. Power projects on the other hand, are more complex, with different technologies and not undertaken as frequently as roads projects. This may explain why power projects are seen to have a lower VfM than road projects.

Thirdly, the size of a project did emerge generally as an important factor. There was a significant positive correlation between the scale of a project and VfM for both the efficiency variable (shareholder theory) as well as for the sustainability variable (stakeholder theory). It was only in the overall VfM variable that the scale variable did not emerge as significant. Overall, this implies that larger projects tend to have greater value for money, than smaller projects. The core determinants of VfM therefore remains at the project level.

Initial conditions are relevant, particularly the existing infrastructure endowment

It was anticipated that a country's initial conditions may have a bearing on how infrastructure projects perform, thus influencing VFM outcomes at a project level. Particularly in the African context where most countries are at a development stage and often have macroeconomic shocks and instability, understanding how initial conditions could impact project outcomes is valuable. The regression outputs generally support this theory, with GDP per capita, GDP growth, the financial institutions index and the existing infrastructure endowment all proving significant in some of the model permutations. The only initial condition variable that was not significant in all the 'best fit' models was population density.

The most consistently significant initial condition variable is the existing infrastructure endowment. This variable was strongly significant and positive for overall VfM, efficiency and

sustainability. This indicates that the existing level of infrastructure development has a positive bearing on future infrastructure projects. The positive coefficient implies that the greater the infrastructure endowment, the greater the likelihood that future infrastructure projects will realise positive VfM.

GDP per capita, an important indicator of economic development of a country, is positive but negative, for the overall VfM and efficiency dependant variables. The implication here is that GDP per capita and VfM have an inverse relationship in this dataset. The countries with a higher GDP per capita have actually seen lower VfM in their projects. This is surprising finding and contradicts the results of other studies such as Hammami, 2006. Yurdakul et al., (2006) also found GDP per capita to be significant but negative. In their analysis, they note that a positive correlation was expected, and argued that the output was therefore 'inconclusive' on the impact of GDP per capita. One may argue, specifically in the context of the countries included in this study, that countries with a comparatively larger GDP per capita (e.g. South Africa) have already good basic infrastructure (roads and power in this stud). Therefore incremental infrastructure would not create as much value as it would for poorer countries, hence the negative significance observed.

GDP growth and the financial institutions index were significant and positive for only the sustainability variable. This indicates that while these two initial conditions may not be as relevant for achieving efficiency in infrastructure projects, they do have a bearing on the sustainability element of VfM. Countries with a growing economy as well as a stable, developing financial market are important factors to sustaining the benefits of infrastructure projects, particularly beyond the lifetime of the investment. Growing countries often expand their road and power networks rapidly, with broader positive economic impact on the whole population, not just directly related to the project. This may explain the positive significant relationship between GDP growth and the broader VfM.

Institutional variables also play a role, but for sustainability

Observing the institutional variables collectively through the institutional index, they are relevant to the sustainability dependent variable but not the overall VfM and efficiency dependant variable. This result confirms the importance of institutional factors to the broader stakeholder theory of VfM, which takes into account the impact of infrastructure projects on a

broader set of actors such as local communities, social and environmental groups etc. rather than the specific investors and sponsors of a project.

The positive relationship implies that where institutional factors such as regulatory quality, control of corruption and accountability are on the rise, VfM in the broader sense also increases. This finding is corroborated by the study of Hammami *et al*., (2006) who found that the 'ability to control corruption and the rule of law are important variables in attracting both private investors and efficient infrastructure service providers'.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

The overarching purpose of this study has been to explore the concept of VfM in infrastructure projects in Africa, with a view to examining whether the theoretical position that PPPs offer greater VfM than TP, holds true in reality. The study also went further to unpack the drivers of VfM and to juxtapose the narrow shareholder view of VfM with the broader stakeholder view. PPPs are a powerful tool to meet Africa's significant infrastructure gap, especially with recent fiscal constraints faced by most governments, in a post Covid world where public finances are under severe pressure and external financial flows to African countries have declined. Innovative sources of funding and procurement structures such as PPPs can therefore play an important role in advancing infrastructure development. However, their value, most be properly understood and the contexts in which they offer greater VfM than traditional infrastructure financing and procurement approaches must be adequately appreciated, to ensure that they are deployed effectively.

Despite this stated importance, there is a lack of empirical studies examining ex-post VfM of PPP and TP projects in Africa. This research represents one of the few studies aimed at filling this gap. To remedy this lack of empirical research, the study employed two quantitative techniques – structural equation modelling to identify the main drivers of VfM for PPP and TP projects respectively, following a questionnaire completed by 131 respondents spanning government, private sector, development practitioners, academics and the general public; and secondly a panel regression to determine whether PPP does indeed provide greater VfM, drawing on a sample of 58 PPP and TP projects in the transport and power sector that have been supported by the AfDB between 2002 and 2017. Importantly, underpinning both empirical exercises was the theoretical positioning of VfM within the shareholder vs stakeholder approach, which influences how VfM is perceived and measured.

This chapter presents the main conclusions arising from the analysis conducted and discusses the implications for both public and private parties. The conclusions drawn in this chapter emerge from the preceding theoretical discussions and empirical assessments. Importantly, the limitations to the study will be discussed and the chapter concludes by noting some areas for future research. The chapter is structured as follows – section 7.2 provides a summary of the

main findings of the study and notes certain implications. Section 7.3 outlines certain policy recommendations while section 7.4 sets out the limitations of the study. Finally, section 7.5 makes recommendations for future research.

6.2 Summary of research outcomes

There are different methods by which the main findings can be summarised, however a thematic approach is found to be most suitable. This is based on the logic of following the study objectives/lines of inquiry set out and discussing the results in this context. To recap, the study had the following objectives:

- To examine how PPPs undertaken in Africa have performed in terms of VfM, when compared with TP
- To unpack the drivers of VfM, for both PPPs and TPs
- To contribute to the discussion on how VfM should be approached, as either primarily financial, or as a broader stakeholder value concept

The research outcomes, in the context of these objectives are captured below. A few additional observations are then noted.

Objective 1 – Have PPPs undertaken in Africa to date provided greater VfM than TP projects?

The popular notion regarding PPPs is that they tend to offer greater VfM than TP projects. This has served as the rationale for the push towards PPPs in Africa, even though they often have higher upfront costs and are a lot more complex to structure. However, the results of the study could not corroborate this view that PPPs provide greater VfM than TP projects. Five indicators of VfM were explored – an aggregate VfM, as well as efficiency, relevance, effectiveness and sustainability indicators of VfM. The efficiency indicator was the one most aligned to the shareholder view of VfM, given the focus on cost. In the regression analysis, the PPP variable emerged as significant to the efficiency dependant variable. However, contrary to the *a priori* position, it was found to have a negative relationship with VfM. This reveals that for the sample of projects studied, PPPs have offered less VfM than government TP projects. For all the other VfM indicators, PPPs did not emerge as a significant factor in determining VfM.

Conceding the small sample of projects assessed notwithstanding, the findings are still valuable to note. This is an important finding as it contradicts the popular notion observed in other markets, particularly in Europe and then adopted in Africa – that on balance, PPPs can be said to offer greater VfM. This has been the predominant basis on which PPP decisions have been made – that greater VfM will be achieved than the public sector alternative approach. The evidence from this sample of projects does not support this assertion.

This is no way argues for a conclusion that PPPs are not a valuable means of procuring the much-needed infrastructure assets in Africa. Rather that the rationale for undertaking a PPP transaction should be more carefully considered holistically, rather than a somewhat rudimentary VfM analysis. A PPP may be more appropriate than TP for a variety of reasons – limited fiscal capacity to execute a project, greater technical experience and expertise in the private sector for a particular technology and many other factors. On the contrary, the complex structure of PPPs could have adverse outcome of lower VfM, especially in less developed markets which are not structured effectively to executive these transactions effectively and take advantage of the efficiencies of PPPs seen in more developed markets.

What this study does reveal is that the analysis conducted at the feasibility stage of a project may not always hold in reality when the project is being executed. It would be intuitive to assess the VfM assessments conducted on the same set of projects included in this study ex-ante, to see what the VfM rationale was, and to identify whether these were achieved in reality. This would be a valuable study, but beyond the scope of this assignment.

Also, most previous approaches which found PPPs to offer greater VFM were not based on an econometric approach as conducted in this study. To our knowledge, this approach has not been used to test for the role of PPPs in VFM, and definitely not conducted for Africa. It would be interesting to observe such similar econometric methods applied both in the European and other developing regions, rather than the more simplistic descriptive comparison of cost and time variables.

Objective 2 - What are the other main drivers of VfM for PPPs and TP respectively?

An emerging finding of the research is that it is not only important to assess whether greater VfM is achieved in PPPs vs TP, but rather, a more insightful line of inquiry is to understand

what factors drive VfM. The objective of all infrastructure projects is to derive some value, so understanding the drivers of this value is useful for policy makers, financiers and regulators. The study identified four main categories of drivers – financial, technical, political/legal and social. Within these categories certain specific factors can be observed.

VfM has typically been assumed to be driven primarily by financial considerations, and secondly the technical outputs of a project. This is underlined by the fact that most of the prevailing VfM assessments are based on cost and project delivery factors.

Structural equation models were developed to test the nature of the drivers of PPP and TP projects respectively. Four variable categories were considered – technical, financial, political and social. The models helped to indicate which category of variables were observed to be more relevant to predicting VfM, for PPP and TP. Firstly, when all variables were lumped together, they collectively have a strong positive effect on VfM for PPPs. This implies that all variables do have some relevance, particularly in an interconnected manner. Looking at them separately, the results of the specific variable categories for VfM in PPPs was unsurprising. The technical and financial variables have a positive influence on VfM while the social and political variables did not emerge as significant variables individually. This may be explained by the existing structural approach to PPPs where the emphasis is on greater price efficiency and technical innovation. Therefore, these categories, and their underlying drivers naturally emerge as the main influencing forces for PPPs.

Interestingly, on the other hand, the political/legal and social factors were more relevant for TPs than the financial and economic factors. One may allude this to the fact that government led projects are usually those that are not commercially viable on their own and are undertaken for social and/or political reasons. This is quite an interesting finding. Even for government projects, one would expect the technical and financial factors to be important to VfM. However, this shows that in the broader stakeholder view of VfM, government projects are judged mainly through a political and social lens, rather than from a technical and financial standpoint. This reveals that policy makers must ensure that government procurement projects have a strong social and political rationale as these will be the strongest factors in determining whether the projects are seen to have delivered value for all stakeholders.

The regression analysis also provided valuable insights on the factors that drive VfM.

Size and experience matters

One interesting observation is that when it comes to VfM, size does matter. The analysis clearly showed that the scale of a project has an influence on whether VfM is achieved. Larger projects tend to have greater VfM outcomes. Projects of a larger scale are likely to have a greater impact and wider reach, therefore it may be easier to observe the benefits of these projects. For projects of a smaller scale, the benefit – cost ratio is likely to be lower, as these projects will not necessarily have a much lower cost than larger scale projects, given the scale and cost are not linearly connected. In fact, many small projects in Africa have quite high costs, not commensurate with the outputs of the project.

Linked to size, the sector variable emerged as important. We argue that it is less a specific finding of roads projects, but rather a feature that there have been many more road projects than PPPs both as TP and PPP projects. Thus, one may argue that as more projects of a similar nature are conducted, lessons are learned and the project results improve, hence resulting in greater VfM scores. It would be insightful to continue to measure this phenomenon as more sectors such as health, education, housing infrastructure generate a significant pool of PPP projects.

Controlling projects costs in important to achieving VfM

The regression analysis further confirmed that the cost of the project is an important determiner of VfM. Importantly costs appear to have an inverse relationship with VfM, as evidenced by the negative regression coefficient. What this reveals is that the greater the cost of a project, the lower the VfM that is achieved. The ability for a project sponsor to design a cost efficient project and then stick within that cost is therefore important to achieve VfM, regardless of whether the project is a PPP or TP.

This is an important finding, given that many infrastructure projects in Africa, particularly government led projects often have significant cost overruns. The study confirms that such increases in costs diminish the project's benefits, thus reducing the VfM that is achieved. It is important to note however that the cost variable here only accounted for construction costs, not operational costs. It would be interesting to observe, in a future study, the impact of full life cycle costs on VfM.

Objective 3 – Should VfM be viewed through a shareholder or stakeholder lens primarily?

A third line of inquiry centred on the analytical approach to VfM – whether a narrow shareholder view (cost, revenue and technical factors) or a stakeholder view (incorporating broader political, social and environmental factors) is a more appropriate lens by which VfM should be observed and examined. This research concludes that firstly from an analytical point of view, VfM should not be considered in the narrow form, that the stakeholder theory approach should be adopted in all discussions of VfM.

The analysis on the drivers of VfM also explored the concept of satisfaction factors – essentially identifying the factors that shareholders and stakeholders measure to identify that VfM has been achieved. Three satisfaction factors emerged as important for PPPs – the output meets the required standard of users; the project results in cost savings to the procuring entity; and thirdly that the project aligns with the development mandate of the Government at national and local levels. This indicates that while VfM for PPPs leans towards the shareholder approach focusing on outputs and costs, there is also an awareness of the development mandate of projects and that the standards of users must be met. This reveals that PPPs, while at their base must consider the technical and financial satisfaction factors, must also be cognisant of the broader social VfM elements.

The SEM model also indicated the satisfaction factors most relevant for VfM in TP projects. Four factors emerged as relevant for TP projects - innovative solutions in the project that meet various stakeholder demands; the project sufficiently considers social factors; the project aligns with the development mandate of the government at the national and local levels; and fourthly the project sufficiently considers social factors. This clearly shows that for TP projects, there is a greater emphasis on broader factors outside of the project's technical and financial components that are seen as VfM satisfaction factor.

The one VfM satisfaction element that was common with both PPPs and TPs is that the project must align with the development mandate of the government at national and local levels. This is a critical finding as it indicates that regardless of whether a PPP or TP procurement option is chosen, VfM must be considered to be achieved by examining whether the project's outcomes are aligned with the national and local priorities. The implication of this is that the

stakeholder approach to VfM must be adopted as the most appropriate lens by which VfM should be considered.

The regression analysis further supported the notion of a broader stakeholder view of VfM, with the initial conditions and institutional index proving relevant, especially to the broader VfM indicator, as well as the sustainability indicator.

Initial conditions matter to broader VfM components

A well accepted notion in economic theory is that the underlying macroeconomic conditions are important factors in the success of projects at a micro level. However, the nature of the most VfM assessment have been biased towards project level metrics, thus these broader factors may be more difficult to observe, particularly in a relatively small sample with few projects per country. However, despite these constraints, this research concluded that the initial conditions do appear to influence the core VfM measures. The existing infrastructure endowment of a country, measured by the AfDB's infrastructure development index proved to be significant to overall VfM, efficiency and sustainability. Therefore whether a narrow or broad view is taken of VfM, the prevailing infrastructure context of a country has a bearing on the performance of future projects.

This can be attributed to two reasons – firstly, large scale infrastructure projects often rely on a base of existing infrastructure assets such as network infrastructure and basic power/water infrastructure to function effectively. While these services, often termed bulk infrastructure, may be out of the specific scope of a project, there is a reliance on these services for the efficient delivery of other projects. Secondly, an important factor is one of experience in delivering large infrastructure projects. Countries with a high infrastructure endowment are likely to have built the internal skills and capacity to execute such projects, therefore future projects will benefit from this expertise and experience, enhancing their VfM.

The level of economic development, represented by GDP per capita and GDP growth are relevant in slightly different ways to VfM. GDP per capita was significant but negatively related to overall VFM and efficiency. This indicates that at a lower level of development there is a somewhat bigger scope for infrastructure projects to have an impact, hence a greater VfM is achieved. This might indicate some efficiency maximisation for VfM where for countries at an already high level of economic development, the additional gains from infrastructure

projects are less profound, and therefore lower VfM is achieved. On the contrary, GDP growth has a positive impact on the sustainability element of VfM. This indicates that as an economy grows, it is better able to sustain and ensure that the infrastructure assets and services they implement last for a long enough time to benefit their population for a significant time. VfM is therefore more likely to be observed and then sustained in growing economies, even if smaller in economic size, rather than just being a function of the size of an economy.

The level of development of the financial markets of a country, emerged as an important factor. However, perhaps somewhat surprisingly, its significance was to the broader measure of VfM – sustainability, and not to the narrow version of VfM. This could be attributed to the fact that project specific investment decisions are made upfront and thus considered to be factored into the investment decision already. However, broader financial development indicators do affect the long term sustainability of projects, mainly in terms of the stability of financial markets and institutions.

Institutional factors have some influence, but more on the sustainability element of VfM

A somewhat surprising finding was that the institutional factors of a country may not be as strongly deterministic of how infrastructure projects perform as may be expected. Recent studies have highlighted the important role that institutional factors play in attracting private sector capital for infrastructure projects. It was in line with this growing school of thought that this study included a selection of institutional factors most relevant to PPPs – regulatory quality, control of corruption and accountability.

However, the study found that the institutional factors are significant to the broader stakeholder view (the sustainability variable), but not significant for overall VfM and efficiency. This indicates that these institutional factors – regulatory quality, control of corruption as well as accountability are important elements to achieving broader VfM principles for all stakeholders and to ensure that the benefits from projects accrue to a wide spectrum of stakeholders.

One may argue that this is a feature of how the VfM dependent variables are constituted. While some elements of institutional factors are captured in the relevance and sustainability variables, these are not explicitly measured, and one may argue not directly measured. This may explain the lack of significance perceived in the results, rather than drawing a conclusion that these are not relevant. It may be that such factors are considered much earlier at a macro level when

private sector sponsors and financiers are assessing an overall market, even before engaging at a specific project level. That being said, as the pool of PPP projects grows, it will be interesting to observe the insights obtained from future research.

6.3 Policy recommendations

The findings of this research have important policy implications for African countries. PPPs will continue to be an important mans of procuring infrastructure in Africa – both economic and social infrastructure. Understanding VfM, both from a theoretical standpoint, but as importantly from an evidence base of past projects will hopefully serve as a useful tool for policymakers. For private sector sponsors and financiers, it is also valuable to note these findings and the recommendations thereof, to assist in better engagements with public sector officials when designing and tendering for infrastructure projects, to ensure effective project structuring and efficient risk transfer.

VfM should be seen as a broad concept

The study has conclusively shown that a narrow view of VfM is limiting. Current VfM studies by most governments in Africa have followed the framework established in developed markets. This involves conducting a comparator between a PPP project and a conceptual government project, but with the metrics primarily driven by quantifiable project benefits such as revenues and comparing these with the project's costs.

Governments should seek to implement a broader VfM measurement framework, that incorporates the political, social, governance and environmental elements right at the start of the project. The implication of this is that when policymakers are considering undertaking a PPP project, extensive consideration should be given to all the elements, and the extent to which these influence VfM. This will help ensure that a more realistic determination is made of whether a PPP project would yield greater VfM than a similar TP project being considered.

Importantly these findings suggest that more robust measures must be put in place when preparing infrastructure projects, where PPP and TPs to ensure that the interests and rights of all stakeholders are protected. This is particularly for consumers and other community organisations who may have limited resources to influence the project selection process but face the greatest risks of the adverse effects of a project.

Selecting the right projects for a PPP is important

Although this study is based on a small sample, it indicates that perhaps the most important factor is which projects are selected for PPPs and which for TPs. Cost and scale appear to be the most important factor in achieving VfM. Governments must therefore keenly scrutinize relatively smaller projects which they are considering for a PPP procurement to ensure that the benefits can be clearly accounted for upfront, to ensure that the appropriate VfM is observed. Where feasible, projects at greater scale may be more desirable for PPPs. On the other hand, relatively smaller projects which are likely to be less complex may be better suited for a TP approach.

Secondly managing the cost of an infrastructure project is a vital means of enhancing the VfM derived from the project, both for the project's direct beneficiaries and sponsors, but also for the broader population. This has been a notorious issue in many African markets, where project costs often end up at much higher levels than anticipated. Government officials responsible for the oversight of infrastructure projects, whether a PPP or TP, need to ensure that the project's construction remains within the expected cost levels as much as possible.

Building an evidence base is critical to policymaking

Current infrastructure procurement decisions are not made based on a strong evidence base of the historical performance of PPP and TP projects. This is particularly the case for government led (TP) projects. While PPPs are a more recent phenomenon, governments have been undertaking infrastructure projects for many projects. Therefore, it would be reasonable to expect that a database of key performance metrics of government infrastructure projects has been collated.

It was disappointing to find that such information does not exist. This research made several enquiries to governments across Africa and in almost all cases actual performance data on projects already undertaken could not be provided. Save for the database from the AfDB, it would have been almost impossible to conduct the VfM assessment in this study. Policymakers should therefore undertake to begin collating key VfM metrics for all infrastructure projects and should require PPP sponsors in their countries to report on these metrics on a regular basis.

6.4 Limitations of the study

The study was characterised by a few limitations. The main of these was the lack of a large database of projects for which VfM data was available or could be constructed. As discussed earlier in Chapter six, from an initial universe of over 2000 projects, the final sample included for the VfM analysis comprised just 58 completed projects. The primary constraint being that VfM is not often measured ex-post, thus the reliance on the AfDB database where VfM could be found in the completed projects. Given the importance of VfM as a decision driver for VfM, it should become standard practice that actual ex-post VfM is measured for active projects and the data made readily available.

One may also argue that the reliance on the AfDB as the single source of projects may somewhat limit the extensiveness of the analysis. It is correct that, particularly for TP projects, there is a larger universe of government led projects in many countries, particularly in the leading economies like South Africa, Kenya, Ghana etc. However, performance measuring on these projects is often not conducted, and usually does not include measures such as VfM in a quantitative format. Hence it has not been possible to include such projects in this analysis. It is important to note that there are several flagship PPP projects, particularly in South Africa that have been excluded due to the lack of VfM data, despite efforts to obtain that data. The researcher was not permitted access to certain transaction documentation that was not in the public domain and would contain performance data on these infrastructure projects to enable a computation of VfM. Such data was deemed confidential due to the proprietary and other competition/regulations concerns.

Finally, a practical limitation is that there just has not been a large pool of PPP projects at an advanced stage in Africa where ex-post VFM can be measured. PPPs are a relatively nascent concept in Africa, with most projects coming on board in the last 10 – 20 years, thus these are now reaching the completion stage. Hopefully a more comprehensive database of such projects, with VFM measures will be readily available soon. It is hoped that future studies will be conducted on a larger sample of completed PPP projects.

For the Structural Equation Model, it was envisaged that a large sample of responses would be obtained, to enable a very robust analysis. While over 700 survey requests were issued, it took almost six months to reach a satisfactory response level of 131. Given the practicalities of time

to complete this study, the researcher could not prolong the period of collecting responses further.

6.5 Areas of future research

Due to data limitations, this study could not include a large group of projects per country. Lack of accurate time series data per country on infrastructure projects. Future research should narrow in on a few countries, selecting a set of more advanced countries in Africa – South Africa, Nigeria, Kenya where PPPs have been undertaken for a while, and compare these with a sample of less advanced countries where PPPs are increasing become active. This will most likely be reliant on primary data collection.

Secondly, it would be intuitive conduct a comparison of ex ante and ex post project performance for a set of projects. Future research could identify a set of projects for which ex ante VfM measures are available and have been implemented for a while, and then measure the same VfM measured ex post. This will be an important line of inquiry to determine whether the VfM measured estimated before a project is observed in reality and secondly whether the correct VfM measures were considered in the first place.

6.6 Conclusion

Overall, this study has made a significant contribution to the important body of academic literature on the role of PPPs as an important procurement measure in Africa. The literature review demonstrated that while there have been a few descriptive studies, to our knowledge there has not been a study of a reasonably large pool of projects, where the actual VfM has been studied and compared empirically between PPPs and TP. By examination the actual performance of a set of PPP and TP projects in Africa, the research has provided novel insights which will hopefully provide a valuable basis for policymakers and also for academics seeking to conduct further similar research studies.

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ANNEXURES

Annexure 1: Structural Equation Modelling Questionnaire

Survey Introduction

Infrastructure financing arrangements can be grouped into a number of procurement approaches. At one end is delivery of infrastructure fully or mostly by the public sector, and at the other end is significant private sector involvement. The phrase "Traditional Procurement (TP)" has been used where the government largely finances an infrastructure asset (through taxes, official development assistance, debt etc.) while, on the other hand, where the private sector finances and/or owns the asset, the phrase "Public Private Partnership (PPP)" is often used. The underlying rationale for any infrastructure procurement option is that it must offer value for money (VFM) to the procuring entity and to the beneficiaries of the infrastructure asset. Therefore, VFM forms the basis for assessing TP or PPP projects. The purpose of this survey, therefore, is to generate data to facilitate a comparative analysis of performance of projects procured under TP and PPP approaches in Africa, within the existing value for money assessment frameworks. This survey has three parts: Part 1 – introductory participant descriptive questions, Part 2 – Critical project delivery factors, and Part 3 – Critical stakeholder satisfaction factors.

Part 1: Introductory descriptive questions

Please select the region in which you operate:
(Africa, Asia, Europe, North America, Oceania, South America)

Please select your field of operations:
(Government, private sector, academic/research institution, international development agency/DFI, community representative)

Please select the relevant years of infrastructure/finance experience:
(Less than 5 years, 5 – 10 years, More than 10 years)

Part 2: Project delivery success factors

There are 23 statements below which relate to critical success factors for PPP or Traditional Procurement projects respectively. Please rate each statement below on a scale of 1 to 7, indicating the extent to which you agree that the statement is critical for the successful execution of a PPP or Traditional Procurement project. The statements are identical for PPP and Traditional procurement projects, please rate each procurement type independently.

PPP/TP success factors

Evaluation factor/variable

Technical factors

6. Project scope and complexity
7. Skills and expertise of the private sector
8. Government contract management experience
9. Output based specifications
10. Project governance structures

Financial and economic factors

11. Development of local capital market
12. Access to international capital for transactions
13. Efficient risk allocation
14. Stable macroeconomic conditions
15. Clear revenue/tariff model
16. Long-term demand for the products/services
17. Affordability of tariffs/fees

Social factors

18. Community support for the project
19. Local participation in the project
20. Job opportunities created by project
21. Environmental impact considerations

Political and legal factors

22. Stability of political environment
23. Supportive legal framework
24. Efficient procurement process
25. Clear process for legal recourse

Part 3: Determinants of stakeholders' satisfaction (broader value for money concept)

While the above factors indicate the likely success of a PPP or TP project, overall project success is captured in the concept of value for money, to all stakeholders. Please rate each statement below on a scale of 1 to 7, indicating the extent to which you agree that the statement is relevant for the concept of value for money for all stakeholders in a PPP or Traditional Procurement project. The statements are identical for PPP and Traditional procurement projects, please rate each statement independently.

Value for money components

	PPP	TP
11. The output meets the required standards of users		
12. The service delivery is prompt, stable and reliable		
13. The project results in cost savings to the procuring entity		
14. There is time saving in the construction of the facilities		
15. The procurement process is inclusive and involves significant local providers		
16. There are innovative solutions in the project that meet various stakeholder demands		
17. There is well-functioning channel of communication amongst all stakeholders		
18. The project sufficiently considers social factors		
19. The project aligns with the development mandate of the Government at the national and local levels		
20. The project sufficiently considers environmental factors in its design		

7-point Likert Scale to use

1 – Strongly disagree
2 – Disagree
3 – Somewhat disagree
4 – Neither agree nor disagree
5 – Somewhat agree
6 – Agree
7 – Strongly Agree

Annexure 2: AfDB VfM Evaluation Template

No.	Component Indicators	Score (1 to 4)	REMARKS
1	**Relevance and quality at entry assessment**		
i)	Consistency with country overall development strategy		
ii)	Consistency with Bank Assistance Strategy		
iii)	Macro-economic Policy		
iv)	Sector Policy		
v)	Public Policy Reform		
vi)	Poverty reduction		
Vii)	Social and Gender equality		
Viii)	Environmental Concerns		
ix)	Human Resources Development		
x)	Institutional Development		
xi)	Private Sector Development		
Xii)	Regional Economic Integration		
Xiii)	Quality at entry (including demandingness, complexity, riskiness, etc.)		
Xiv)	Other (Specify)		

2	**Achievement of objectives & Outcomes ("Efficacy")**		
i)	Policy Goals - Macro Stabilisation - Public investments and expenditures - Monetary Reforms - Debt management - Private Sector Regulation and Incentives - Banking Sector Reforms - Civil Service Reform - Pricing Efficiency - Sector Regulations - Labour Legislation - Procurement Policies - Other (Specify…..)		
ii)	Physical objectives (outputs)		
iii)	Financial Targets - Financial viability - Cost recovery - Restructuring - Other (Specify):		

Iv)	Institutional Development Objectives National Capacity - Economic management - Civil service reform - Governance - Poverty Alleviation - Financial intermediation - Legal System - Support to private sector - Environment & natural resources - Sectoral capacity - Other (Specify): Executing Agency - Planning/policy analysis - Financial Management - Skills upgrading - Personnel Management - Management information System - Agency restructuring - Other (Specify):		
v)	Social Objectives and Targets - Poverty Alleviation - Protection of vulnerable Groups - Reduction in income disparities - Community development & participation - Gender equality - Access & quality of services - Nutrition & Food security - Settlement/Resettlement		

3)	**Efficiency**		
i)	Economic Rate of return Appraisal Estimate .....% Re-estimated at completion (PCR/PPER) .....%		
ii)	Financial Rate of Return Appraisal Estimate .....% Re-estimated at completion (PCR/PPER) .....%		

5	**Sustainability**		
i)	Technical Soundness (including O&M facilitation, availability of recurrent funding, spare parts, workshop facilities etc.)		
ii)	Continued Borrower Commitment (including legal/regulatory framework)		
iii)	Socio-political Support (including beneficiary participation, vulnerable groups protection, political stability)		
iv)	Economic Viability		
v)	Financial Viability		
vi)	Institutional arrangements (organisational and management)		
vii)	Environmental viability		
viii)	Resilience to exogenous Factors		

Annexure 3: Snapshot of AfDB VfM rating in project completion reports

Dimensions and criteria	Rating*
DIMENSION A: RELEVANCE	***4***
Relevance of project development objective (II.A.1)	4
Relevance of project design (II.A.2)	4
DIMENSION B: EFFECTIVENESS	***3***
Development Objective (DO) (II.B.4)	3
DIMENSION C: EFFICIENCY	***3***
Timeliness (II.C.1)	3
Resource use efficiency (II.C.2)	3
Cost-benefit analysis (II.C.3)	3
Implementation Progress (IP) (II.C.4)	3
DIMENSION D: SUSTAINABILITY	***3***
Financial sustainability (II.D.1)	3
Institutional sustainability and strengthening of capacities (II.D.2)	3
Ownership and sustainability of partnerships (II.D.3)	3
Environmental and social sustainability (II.D.4)	3
AVERAGE OF THE DIMENSION RATINGS	**3.25**
OVERALL PROJECT COMPLETION RATING	**3**

Annexure 4: VFM regression outputs

Base model outputs

VFM dependent variable

Dependent Variable: VFM
Method: Panel EGLS (Cross-section random effects)
Date: 11/03/24 Time: 21:25
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.109993	0.124934	-0.880410	0.3826
LCOST	-0.003339	0.050512	-0.066110	0.9475
SECTOR	0.101216	0.100615	1.005979	0.3190
SCALE	0.122402	0.119320	1.025833	0.3096
C	3.186894	0.900221	3.540124	0.0008

Effects Specification	S.D.	Rho
Cross-section random	0.126599	0.1249
Idiosyncratic random	0.335072	0.8751

Weighted Statistics

R-squared	0.050647	Mean dependent var	2.595755
Adjusted R-squared	-0.021002	S.D. dependent var	0.426091
S.E. of regression	0.340876	Sum squared resid	6.158415
F-statistic	0.706876	Durbin-Watson stat	1.139440
Prob(F-statistic)	0.590809		

Unweighted Statistics

R-squared	0.048778	Mean dependent var	3.232931
Sum squared resid	7.008654	Durbin-Watson stat	1.001212

Dependent Variable: VFM
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 08:20
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.141431	0.121630	-1.162797	0.2507
LCOST	-0.039053	0.056571	-0.690339	0.4933
SECTOR	0.178247	0.106544	1.672998	0.1008
SCALE	0.121050	0.120430	1.005149	0.3199
GDP_PER_CAPITA	-3.87E-05	5.21E-05	-0.742341	0.4615
GDP_GROWTH	0.004427	0.013162	0.336364	0.7381
POP_DENSITY	0.000392	0.000529	0.741091	0.4622
FI	1.581590	0.706620	2.238248	0.0299
AIDA	0.001324	0.004040	0.327705	0.7446
C	3.428062	0.998764	3.432304	0.0012

Effects Specification

	S.D.	Rho
Cross-section random	0.051245	0.0224
Idiosyncratic random	0.338527	0.9776

Weighted Statistics

R-squared	0.183184	Mean dependent var	3.086628
Adjusted R-squared	0.030031	S.D. dependent var	0.351511
S.E. of regression	0.349056	Sum squared resid	5.848313
F-statistic	1.196082	Durbin-Watson stat	1.214825
Prob(F-statistic)	0.319388		

Unweighted Statistics

R-squared	0.193416	Mean dependent var	3.232931
Sum squared resid	5.942955	Durbin-Watson stat	1.195479

Dependent Variable: VFM
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 08:32
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.140773	0.126835	-1.109894	0.2728
LCOST	-0.056745	0.062695	-0.905100	0.3701
SECTOR	0.171978	0.116943	1.470611	0.1482
SCALE	0.160940	0.135123	1.191064	0.2397
GDP_PER_CAPITA	-3.62E-05	5.31E-05	-0.681606	0.4989
GDP_GROWTH	0.006252	0.013628	0.458726	0.6486
POP_DENSITY	0.000315	0.000559	0.562951	0.5762
FI	1.378994	0.780275	1.767318	0.0838
AIDA	0.001712	0.004428	0.386542	0.7009
REGQUAL	0.048298	0.200380	0.241031	0.8106
VOICE	0.055435	0.123831	0.447667	0.6565
C	3.814162	1.152264	3.310146	0.0018

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.350508	1.0000

Weighted Statistics

R-squared	0.204336	Mean dependent var	3.232931
Adjusted R-squared	0.014068	S.D. dependent var	0.359533
S.E. of regression	0.356995	Sum squared resid	5.862497
F-statistic	1.073938	Durbin-Watson stat	1.156721
Prob(F-statistic)	0.402256		

Unweighted Statistics

R-squared	0.204336	Mean dependent var	3.232931
Sum squared resid	5.862497	Durbin-Watson stat	1.156721

Efficiency dependent variable

Dependent Variable: EFFIC
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 08:59
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.270997	0.184092	-1.472073	0.1469
LCOST	-0.014987	0.073608	-0.203612	0.8394
SECTOR	0.291588	0.145914	1.998362	0.0508
SCALE	0.300891	0.171816	1.751235	0.0857
C	3.055822	1.312274	2.328647	0.0237

Effects Specification

	S.D.	Rho
Cross-section random	0.287635	0.2832
Idiosyncratic random	0.457616	0.7168

Weighted Statistics

R-squared	0.159791	Mean dependent var	1.954731
Adjusted R-squared	0.096378	S.D. dependent var	0.620389
S.E. of regression	0.451410	Sum squared resid	10.79987
F-statistic	2.519876	Durbin-Watson stat	1.488025
Prob(F-statistic)	0.051897		

Unweighted Statistics

R-squared	0.117212	Mean dependent var	3.021466
Sum squared resid	15.47307	Durbin-Watson stat	1.038610

Dependent Variable: EFFIC
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 09:03
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.293926	0.179725	-1.635426	0.1085
LCOST	-0.083831	0.080230	-1.044891	0.3013
SECTOR	0.423447	0.150195	2.819318	0.0070
SCALE	0.309078	0.171697	1.800134	0.0781
GDP_PER_CAPITA	-7.87E-05	8.26E-05	-0.953339	0.3452
GDP_GROWTH	-0.003551	0.019175	-0.185206	0.8538
POP_DENSITY	0.000674	0.000822	0.819715	0.4164
FI	1.711245	1.176987	1.453920	0.1525
AIDA	0.007993	0.006544	1.221432	0.2279
C	3.740061	1.415231	2.642721	0.0111

Effects Specification

	S.D.	Rho
Cross-section random	0.229159	0.2039
Idiosyncratic random	0.452853	0.7961

Weighted Statistics

R-squared	0.272921	Mean dependent var	2.172672
Adjusted R-squared	0.136594	S.D. dependent var	0.609149
S.E. of regression	0.454891	Sum squared resid	9.932452
F-statistic	2.001957	Durbin-Watson stat	1.663296
Prob(F-statistic)	0.059647		

Unweighted Statistics

R-squared	0.300084	Mean dependent var	3.021466
Sum squared resid	12.26778	Durbin-Watson stat	1.346667

Dependent Variable: EFFIC
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 09:06
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.249834	0.186501	-1.339582	0.1870
LCOST	-0.112432	0.085309	-1.317940	0.1940
SECTOR	0.447322	0.153117	2.921436	0.0054
SCALE	0.366030	0.177915	2.057332	0.0453
GDP_PER_CAPITA	-7.20E-05	8.97E-05	-0.802066	0.4266
GDP_GROWTH	-0.002754	0.019746	-0.139497	0.8897
POP_DENSITY	0.000479	0.000904	0.529994	0.5987
FI	1.334697	1.263097	1.056686	0.2962
AIDA	0.006325	0.007110	0.889535	0.3783
REGQUAL	0.277261	0.269893	1.027300	0.3097
CORR	-0.010197	0.215124	-0.047400	0.9624
C	4.464189	1.583505	2.819181	0.0071

Effects Specification

	S.D.	Rho
Cross-section random	0.259838	0.2499
Idiosyncratic random	0.450199	0.7501

Weighted Statistics

R-squared	0.287854	Mean dependent var	2.042509
Adjusted R-squared	0.117558	S.D. dependent var	0.617097
S.E. of regression	0.451517	Sum squared resid	9.377891
F-statistic	1.690316	Durbin-Watson stat	1.698398
Prob(F-statistic)	0.105900		

Unweighted Statistics

R-squared	0.328835	Mean dependent var	3.021466
Sum squared resid	11.76384	Durbin-Watson stat	1.353928

Dependent Variable: EFFIC
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 09:10
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.272277	0.185162	-1.470477	0.1482
LCOST	-0.118306	0.085192	-1.388703	0.1716
SECTOR	0.406548	0.158255	2.568940	0.0135
SCALE	0.396135	0.180689	2.192354	0.0335
GDP_PER_CAPITA	-7.19E-05	8.40E-05	-0.855824	0.3965
GDP_GROWTH	-0.001505	0.019376	-0.077695	0.9384
POP_DENSITY	0.000517	0.000862	0.599162	0.5520
FI	0.945090	1.303919	0.724808	0.4722
AIDA	0.008881	0.007201	1.233312	0.2237
REGQUAL	0.115199	0.298548	0.385863	0.7014
VOICE	0.179602	0.182536	0.983925	0.3303
C	4.611979	1.578831	2.921134	0.0054

Effects Specification

	S.D.	Rho
Cross-section random	0.242500	0.2240
Idiosyncratic random	0.451311	0.7760

Weighted Statistics

R-squared	0.304705	Mean dependent var	2.114187
Adjusted R-squared	0.138439	S.D. dependent var	0.613151
S.E. of regression	0.450648	Sum squared resid	9.341845
F-statistic	1.832632	Durbin-Watson stat	1.645860
Prob(F-statistic)	0.075566		

Unweighted Statistics

R-squared	0.347559	Mean dependent var	3.021466
Sum squared resid	11.43566	Durbin-Watson stat	1.344512

Effectiveness dependent variable

Dependent Variable: EFFECT
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 09:26
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.281483	0.205933	-1.366864	0.1774
LCOST	-0.050186	0.084707	-0.592460	0.5561
SECTOR	-0.064023	0.169336	-0.378085	0.7069
SCALE	0.196295	0.200185	0.980570	0.3313
C	4.169934	1.511326	2.759123	0.0079

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.598801	1.0000

Weighted Statistics

R-squared	0.058305	Mean dependent var	3.275862
Adjusted R-squared	-0.012766	S.D. dependent var	0.539431
S.E. of regression	0.542864	Sum squared resid	15.61914
F-statistic	0.820376	Durbin-Watson stat	1.223494
Prob(F-statistic)	0.517991		

Unweighted Statistics

R-squared	0.058305	Mean dependent var	3.275862
Sum squared resid	15.61914	Durbin-Watson stat	1.223494

Dependent Variable: EFFECT
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 09:28
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.302032	0.215384	-1.402296	0.1673
LCOST	-0.052556	0.100721	-0.521801	0.6042
SECTOR	-0.009971	0.190166	-0.052431	0.9584
SCALE	0.177404	0.214079	0.828682	0.4114
GDP_PER_CAPITA	-1.07E-05	9.18E-05	-0.116742	0.9076
GDP_GROWTH	0.001011	0.023402	0.043215	0.9657
POP_DENSITY	0.000417	0.000933	0.446243	0.6574
FI	1.809001	1.228995	1.471935	0.1476
AIDA	-0.004823	0.007069	-0.682240	0.4984
C	3.874585	1.779456	2.177398	0.0344

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.608836	1.0000

Weighted Statistics

R-squared	0.123588	Mean dependent var	3.275862
Adjusted R-squared	-0.040740	S.D. dependent var	0.539431
S.E. of regression	0.550310	Sum squared resid	14.53636
F-statistic	0.752081	Durbin-Watson stat	1.331355
Prob(F-statistic)	0.659961		

Unweighted Statistics

R-squared	0.123588	Mean dependent var	3.275862
Sum squared resid	14.53636	Durbin-Watson stat	1.331355

Dependent Variable: EFFECT
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 09:31
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.296866	0.227069	-1.307381	0.1976
LCOST	-0.061980	0.112042	-0.553191	0.5828
SECTOR	-0.002033	0.198537	-0.010240	0.9919
SCALE	0.194720	0.234212	0.831384	0.4101
GDP_PER_CAPITA	-5.42E-06	9.86E-05	-0.054999	0.9564
GDP_GROWTH	0.001485	0.024507	0.060607	0.9519
POP_DENSITY	0.000396	0.001040	0.381132	0.7049
FI	1.718853	1.325587	1.296673	0.2012
AIDA	-0.005167	0.007419	-0.696370	0.4897
REGQUAL	0.070980	0.289991	0.244767	0.8077
CORR	-0.026058	0.216302	-0.120469	0.9046
C	4.067810	2.060793	1.973905	0.0544

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.627499	1.0000

Weighted Statistics

R-squared	0.125102	Mean dependent var	3.275862
Adjusted R-squared	-0.084113	S.D. dependent var	0.539431
S.E. of regression	0.561660	Sum squared resid	14.51124
F-statistic	0.597958	Durbin-Watson stat	1.315866
Prob(F-statistic)	0.820541		

Unweighted Statistics

R-squared	0.125102	Mean dependent var	3.275862
Sum squared resid	14.51124	Durbin-Watson stat	1.315866

Dependent Variable: EFFECT
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 09:36
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.335887	0.224454	-1.496459	0.1414
LCOST	-0.071997	0.110949	-0.648919	0.5196
SECTOR	-0.104962	0.206950	-0.507188	0.6144
SCALE	0.285975	0.239122	1.195938	0.2378
GDP_PER_CAPITA	-6.35E-06	9.40E-05	-0.067543	0.9464
GDP_GROWTH	0.003409	0.024118	0.141350	0.8882
POP_DENSITY	0.000529	0.000990	0.534696	0.5954
FI	1.057561	1.380822	0.765892	0.4477
AIDA	-0.000617	0.007836	-0.078794	0.9375
REGQUAL	-0.273158	0.354604	-0.770320	0.4450
VOICE	0.333781	0.219138	1.523153	0.1346
C	4.303188	2.039116	2.110320	0.0403

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.620280	1.0000

Weighted Statistics

R-squared	0.178574	Mean dependent var	3.275862
Adjusted R-squared	-0.017854	S.D. dependent var	0.539431
S.E. of regression	0.544226	Sum squared resid	13.62435
F-statistic	0.909105	Durbin-Watson stat	1.420944
Prob(F-statistic)	0.539361		

Unweighted Statistics

R-squared	0.178574	Mean dependent var	3.275862
Sum squared resid	13.62435	Durbin-Watson stat	1.420944

Relevance dependent variable

Dependent Variable: REL
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 10:13
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.095422	0.125794	0.758555	0.4515
LCOST	0.005358	0.050306	0.106515	0.9156
SECTOR	-0.017245	0.099735	-0.172908	0.8634
SCALE	0.006325	0.117469	0.053843	0.9573
C	3.512615	0.896831	3.916698	0.0003

Effects Specification

	S.D.	Rho
Cross-section random	0.195026	0.2794
Idiosyncratic random	0.313202	0.7206

Weighted Statistics

R-squared	0.016777	Mean dependent var	2.367398
Adjusted R-squared	-0.057428	S.D. dependent var	0.489003
S.E. of regression	0.308598	Sum squared resid	5.047328
F-statistic	0.226090	Durbin-Watson stat	0.923845
Prob(F-statistic)	0.922621		

Unweighted Statistics

R-squared	0.008381	Mean dependent var	3.663793
Sum squared resid	6.761814	Durbin-Watson stat	0.689600

Dependent Variable: REL
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 10:16
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.097573	0.121026	0.806211	0.4241
LCOST	-0.009528	0.052133	-0.182770	0.8557
SECTOR	0.001392	0.097831	0.014233	0.9887
SCALE	0.011358	0.111422	0.101941	0.9192
GDP_PER_CAPITA	2.66E-05	6.31E-05	0.421540	0.6752
GDP_GROWTH	0.012629	0.013091	0.964721	0.3395
POP_DENSITY	-0.000424	0.000617	-0.686546	0.4957
FI	0.052073	0.913560	0.057000	0.9548
AIDA	0.001484	0.004970	0.298687	0.7665
C	3.647999	0.924376	3.946444	0.0003

Effects Specification	S.D.	Rho
Cross-section random	0.234653	0.4113
Idiosyncratic random	0.280735	0.5887

Weighted Statistics

R-squared	0.043385	Mean dependent var	1.986372
Adjusted R-squared	-0.135981	S.D. dependent var	0.504644
S.E. of regression	0.305789	Sum squared resid	4.488325
F-statistic	0.241880	Durbin-Watson stat	1.125455
Prob(F-statistic)	0.986208		

Unweighted Statistics

R-squared	0.041041	Mean dependent var	3.663793
Sum squared resid	6.539106	Durbin-Watson stat	0.772492

Dependent Variable: REL
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 10:22
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.064184	0.105157	0.610361	0.5446
LCOST	-0.026811	0.048283	-0.555286	0.5814
SECTOR	0.007022	0.086577	0.081105	0.9357
SCALE	0.008976	0.100701	0.089136	0.9294
GDP_PER_CAPITA	8.99E-05	5.02E-05	1.791529	0.0798
GDP_GROWTH	0.007944	0.011130	0.713723	0.4790
POP_DENSITY	-0.000194	0.000507	-0.382114	0.7041
FI	0.005886	0.705472	0.008344	0.9934
AIDA	-0.002925	0.003971	-0.736723	0.4650
REGQUAL	0.291310	0.151050	1.928564	0.0600
CORR	-0.452125	0.120086	-3.765018	0.0005
C	3.888222	0.895566	4.341635	0.0001

Effects Specification

	S.D.	Rho
Cross-section random	0.141314	0.2342
Idiosyncratic random	0.255561	0.7658

Weighted Statistics

R-squared	0.234632	Mean dependent var	2.515379
Adjusted R-squared	0.051609	S.D. dependent var	0.473331
S.E. of regression	0.297236	Sum squared resid	4.064066
F-statistic	1.281980	Durbin-Watson stat	1.056607
Prob(F-statistic)	0.264876		

Unweighted Statistics

R-squared	0.314293	Mean dependent var	3.663793
Sum squared resid	4.675812	Durbin-Watson stat	0.918369

Dependent Variable: REL
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 10:26
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.119562	0.127762	0.935819	0.3543
LCOST	-0.015938	0.056364	-0.282769	0.7786
SECTOR	0.028551	0.104886	0.272210	0.7867
SCALE	0.012052	0.118358	0.101829	0.9193
GDP_PER_CAPITA	2.63E-05	6.56E-05	0.401354	0.6900
GDP_GROWTH	0.013053	0.013549	0.963411	0.3404
POP_DENSITY	-0.000515	0.000658	-0.781916	0.4383
FI	0.184328	1.020476	0.180630	0.8575
AIDA	-0.000355	0.005576	-0.063678	0.9495
REGQUAL	0.174644	0.215937	0.808773	0.4228
VOICE	-0.093658	0.129916	-0.720910	0.4746
C	3.804947	1.057928	3.596605	0.0008

Effects Specification	S.D.	Rho
Cross-section random	0.246177	0.4216
Idiosyncratic random	0.288364	0.5784

Weighted Statistics

R-squared	0.057156	Mean dependent var	1.958905
Adjusted R-squared	-0.168307	S.D. dependent var	0.504394
S.E. of regression	0.309082	Sum squared resid	4.394457
F-statistic	0.253505	Durbin-Watson stat	1.133018
Prob(F-statistic)	0.991178		

Unweighted Statistics

R-squared	0.079280	Mean dependent var	3.663793
Sum squared resid	6.278360	Durbin-Watson stat	0.793041

Sustainability dependent variable

Dependent Variable: SUST
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 10:40
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.061541	0.175888	-0.349889	0.7278
LCOST	-0.002483	0.070325	-0.035314	0.9720
SECTOR	0.172049	0.139400	1.234212	0.2226
SCALE	0.259360	0.164135	1.580166	0.1200
C	2.824329	1.253749	2.252708	0.0284

Effects Specification		
	S.D.	Rho
Cross-section random	0.275425	0.2843
Idiosyncratic random	0.437024	0.7157

Weighted Statistics

R-squared	0.071313	Mean dependent var	1.943388
Adjusted R-squared	0.001223	S.D. dependent var	0.533406
S.E. of regression	0.452117	Sum squared resid	10.83370
F-statistic	1.017454	Durbin-Watson stat	1.991037
Prob(F-statistic)	0.406823		

Unweighted Statistics

R-squared	0.063286	Mean dependent var	3.036552
Sum squared resid	14.86894	Durbin-Watson stat	1.450696

Dependent Variable: SUST
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 10:42
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.056223	0.179625	-0.313004	0.7556
LCOST	-0.032281	0.079321	-0.406972	0.6858
SECTOR	0.287230	0.148535	1.933753	0.0591
SCALE	0.287562	0.169788	1.693658	0.0968
GDP_PER_CAPITA	-0.000136	8.50E-05	-1.597458	0.1167
GDP_GROWTH	-0.006879	0.019183	-0.358591	0.7215
POP_DENSITY	0.001569	0.000842	1.863674	0.0685
FI	1.641080	1.219869	1.345291	0.1849
AIDA	0.006574	0.006743	0.974937	0.3345
C	2.861698	1.400352	2.043556	0.0465

Effects Specification

	S.D.	Rho
Cross-section random	0.261965	0.2604
Idiosyncratic random	0.441528	0.7396

Weighted Statistics

R-squared	0.181494	Mean dependent var	2.006608
Adjusted R-squared	0.028024	S.D. dependent var	0.531138
S.E. of regression	0.450217	Sum squared resid	9.729390
F-statistic	1.182604	Durbin-Watson stat	2.110479
Prob(F-statistic)	0.327526		

Unweighted Statistics

R-squared	0.219450	Mean dependent var	3.036552
Sum squared resid	12.39008	Durbin-Watson stat	1.657267

Dependent Variable: SUST
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 10:46
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.039966	0.186163	-0.214685	0.8310
LCOST	-0.029980	0.083620	-0.358531	0.7216
SECTOR	0.301242	0.150855	1.996894	0.0518
SCALE	0.286064	0.174346	1.640789	0.1077
GDP_PER_CAPITA	-0.000112	9.40E-05	-1.195743	0.2379
GDP_GROWTH	-0.010368	0.019793	-0.523833	0.6029
POP_DENSITY	0.001763	0.000935	1.886008	0.0656
FI	1.489964	1.327281	1.122568	0.2674
AIDA	0.005170	0.007471	0.691965	0.4924
REGQUAL	0.112087	0.280514	0.399579	0.6913
CORR	-0.186467	0.226423	-0.823536	0.4145
C	2.786067	1.558932	1.787164	0.0805

Effects Specification

	S.D.	Rho
Cross-section random	0.306287	0.3316
Idiosyncratic random	0.434874	0.6684

Weighted Statistics

R-squared	0.188680	Mean dependent var	1.824891
Adjusted R-squared	-0.005332	S.D. dependent var	0.535871
S.E. of regression	0.445678	Sum squared resid	9.136933
F-statistic	0.972518	Durbin-Watson stat	2.194734
Prob(F-statistic)	0.484085		

Unweighted Statistics

R-squared	0.217442	Mean dependent var	3.036552
Sum squared resid	12.42194	Durbin-Watson stat	1.614332

Initial conditions lagged

Dependent Variable: VFM
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 12:42
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.006515	0.080506	0.080925	0.9368
LCOST	-0.167447	0.053642	-3.121541	0.0088
SECTOR	0.204094	0.071239	2.864907	0.0142
SCALE	0.151646	0.091201	1.662763	0.1222
LAGGDP_PER_CAPITA	-0.000425	9.29E-05	-4.576356	0.0006
GDP_GROWTH	-0.042185	0.015685	-2.689457	0.0197
POP_DENSITY	0.004801	0.001506	3.187017	0.0078
LAGFI	1.820117	1.027951	1.770627	0.1020
LAGAIDA	0.020669	0.004829	4.279969	0.0011
C	5.932131	1.120137	5.295897	0.0002

Effects Specification

	S.D.	Rho
Cross-section random	0.129696	0.6201
Idiosyncratic random	0.101513	0.3799

Weighted Statistics

R-squared	0.509238	Mean dependent var	1.415133
Adjusted R-squared	0.141167	S.D. dependent var	0.612940
S.E. of regression	0.201864	Sum squared resid	0.488988
F-statistic	1.383531	Durbin-Watson stat	0.912765
Prob(F-statistic)	0.294206		

Unweighted Statistics

R-squared	0.593191	Mean dependent var	3.293864
Sum squared resid	0.905455	Durbin-Watson stat	0.492936

Dependent Variable: EFFIC
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 12:49
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.413229	0.197687	-2.090316	0.0585
LCOST	-0.294878	0.100286	-2.940371	0.0124
SECTOR	0.542385	0.147387	3.680001	0.0031
SCALE	0.359469	0.194044	1.852513	0.0887
LAGGDP_PER_CAPITA	-0.000575	0.000161	-3.573204	0.0038
GDP_GROWTH	-0.039905	0.029996	-1.330342	0.2081
POP_DENSITY	0.006864	0.002735	2.509601	0.0274
LAGFI	2.578520	1.801290	1.431485	0.1778
LAGAIDA	0.034024	0.007711	4.412298	0.0008
C	7.431329	2.184876	3.401259	0.0053

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.268435	1.0000

Weighted Statistics

R-squared	0.848836	Mean dependent var	3.026818
Adjusted R-squared	0.735463	S.D. dependent var	0.602458
S.E. of regression	0.309864	Sum squared resid	1.152185
F-statistic	7.487101	Durbin-Watson stat	2.699879
Prob(F-statistic)	0.000995		

Unweighted Statistics

R-squared	0.848836	Mean dependent var	3.026818
Sum squared resid	1.152185	Durbin-Watson stat	2.699879

Dependent Variable: EFFECT
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 13:57
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.060317	0.225538	0.267436	0.7937
LCOST	-0.077509	0.137648	-0.563091	0.5837
SECTOR	-0.195251	0.191326	-1.020517	0.3276
SCALE	-0.016366	0.242249	-0.067557	0.9473
LAGGDP_PER_CAPITA	-0.000412	0.000233	-1.766310	0.1027
GDP_GROWTH	-0.028117	0.041004	-0.685695	0.5059
POP_DENSITY	0.005992	0.003829	1.565038	0.1436
LAGFI	3.814771	2.645186	1.442156	0.1748
LAGAIDA	0.008279	0.011899	0.695767	0.4998
C	4.118639	2.916547	1.412163	0.1833

Effects Specification

	S.D.	Rho
Cross-section random	0.277935	0.4768
Idiosyncratic random	0.291140	0.5232

Weighted Statistics

R-squared	0.251867	Mean dependent var	1.696288
Adjusted R-squared	-0.309233	S.D. dependent var	0.745532
S.E. of regression	0.479968	Sum squared resid	2.764431
F-statistic	0.448880	Durbin-Watson stat	1.688272
Prob(F-statistic)	0.882258		

Unweighted Statistics

R-squared	0.208764	Mean dependent var	3.227273
Sum squared resid	3.848286	Durbin-Watson stat	1.212777

Dependent Variable: REL
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 14:00
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.069172	0.248748	0.278079	0.7857
LCOST	-0.041944	0.126789	-0.330822	0.7465
SECTOR	-0.125542	0.186239	-0.674089	0.5130
SCALE	-0.183803	0.244336	-0.752258	0.4664
GDP_PER_CAPITA	-0.000369	0.000208	-1.773331	0.1015
GDP_GROWTH	-0.058236	0.038237	-1.523020	0.1537
POP_DENSITY	0.004684	0.003419	1.369948	0.1958
LAGFI	1.377047	2.276484	0.604901	0.5565
LAGAIDA	0.013286	0.009669	1.374152	0.1945
C	4.622004	2.762413	1.673176	0.1201

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.339379	1.0000

Weighted Statistics

R-squared	0.424467	Mean dependent var	3.795455
Adjusted R-squared	-0.007183	S.D. dependent var	0.295163
S.E. of regression	0.296221	Sum squared resid	1.052964
F-statistic	0.983359	Durbin-Watson stat	1.342748
Prob(F-statistic)	0.498480		

Unweighted Statistics

R-squared	0.424467	Mean dependent var	3.795455
Sum squared resid	1.052964	Durbin-Watson stat	1.342748

Dependent Variable: SUST
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 14:04
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.043185	0.070027	0.616697	0.5490
LCOST	-0.059712	0.045955	-1.299350	0.2182
SECTOR	0.328457	0.061549	5.336489	0.0002
SCALE	0.187134	0.078566	2.381862	0.0346
LAGGDP_PER_CAPITA	-7.07E-05	7.93E-05	-0.892248	0.3898
GDP_GROWTH	0.020433	0.013490	1.514688	0.1557
POP_DENSITY	-0.000399	0.001288	-0.309972	0.7619
LAGFI	3.151001	0.881440	3.574835	0.0038
LAGAIDA	0.006137	0.004109	1.493623	0.1611
C	3.310233	0.962059	3.440781	0.0049

Effects Specification

	S.D.	Rho
Cross-section random	0.108160	0.5981
Idiosyncratic random	0.088667	0.4019

Weighted Statistics

R-squared	0.445927	Mean dependent var	1.423791
Adjusted R-squared	0.030372	S.D. dependent var	0.622520
S.E. of regression	0.255420	Sum squared resid	0.782875
F-statistic	1.073087	Durbin-Watson stat	1.196113
Prob(F-statistic)	0.444062		

Unweighted Statistics

R-squared	0.530456	Mean dependent var	3.205455
Sum squared resid	1.494813	Durbin-Watson stat	0.626437

Dependent Variable: SUST
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 11:01
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.048706	0.191193	-0.254750	0.8001
LCOST	-0.034822	0.086953	-0.400471	0.6907
SECTOR	0.289560	0.161572	1.792140	0.0797
SCALE	0.293297	0.183955	1.594394	0.1177
GDP_PER_CAPITA	-0.000135	8.90E-05	-1.519220	0.1356
GDP_GROWTH	-0.006891	0.020019	-0.344222	0.7322
POP_DENSITY	0.001554	0.000908	1.710765	0.0939
FI	1.572872	1.385244	1.135447	0.2621
AIDA	0.006509	0.007627	0.853390	0.3979
REGQUAL	0.024931	0.310846	0.080204	0.9364
VOICE	0.005782	0.189601	0.030496	0.9758
C	2.933122	1.615600	1.815501	0.0760

Effects Specification

	S.D.	Rho
Cross-section random	0.278941	0.2718
Idiosyncratic random	0.456545	0.7282

Weighted Statistics

R-squared	0.180811	Mean dependent var	1.975997
Adjusted R-squared	-0.015082	S.D. dependent var	0.532314
S.E. of regression	0.458006	Sum squared resid	9.649394
F-statistic	0.923009	Durbin-Watson stat	2.119957
Prob(F-statistic)	0.527014		

Unweighted Statistics

R-squared	0.218412	Mean dependent var	3.036552
Sum squared resid	12.40654	Durbin-Watson stat	1.648832

Institutional Index

Principal Components Analysis
Date: 08/01/24 Time: 14:44
Sample: 2002 2017
Included observations: 58
Balanced sample (listwise missing value deletion)
Computed using: Ordinary correlations
Extracting 3 of 3 possible components

Eigenvalues: (Sum = 3, Average = 1)

Number	Value	Difference	Proportion	Cumulative Value	Cumulative Proportion
1	1.883524	1.153998	0.6278	1.883524	0.6278
2	0.729526	0.342577	0.2432	2.613051	0.8710
3	0.386949	---	0.1290	3.000000	1.0000

Eigenvectors (loadings):

Variable	PC 1	PC 2	PC 3
VOICE	0.590103	-0.517968	0.619263
CORR	0.499304	0.836911	0.224222
REGQUAL	0.634408	-0.176887	-0.752488

Ordinary correlations:

	VOICE	CORR	REGQUAL
VOICE	1.000000		
CORR	0.292448	1.000000	
REGQUAL	0.591655	0.423344	1.000000

Dependent Variable: VFM
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 16:08
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.136584	0.125011	-1.092580	0.2801
LCOST	-0.045219	0.061121	-0.739837	0.4631
SECTOR	0.177394	0.108506	1.634887	0.1088
SCALE	0.135144	0.131628	1.026717	0.3098
GDP_PER_CAPITA	-3.90E-05	5.30E-05	-0.735785	0.4655
GDP_GROWTH	0.005136	0.013595	0.377802	0.7073
POP_DENSITY	0.000345	0.000560	0.616281	0.5407
FI	1.503541	0.767752	1.958369	0.0561
AIDA	0.001430	0.004122	0.346851	0.7303
INSTINDEX	0.014091	0.047088	0.299243	0.7661
C	3.549512	1.094204	3.243921	0.0022

Effects Specification	S.D.	Rho
Cross-section random	0.050417	0.0209
Idiosyncratic random	0.344818	0.9791

Weighted Statistics

R-squared	0.185299	Mean dependent var	3.095583
Adjusted R-squared	0.011959	S.D. dependent var	0.351275
S.E. of regression	0.352604	Sum squared resid	5.843499
F-statistic	1.068991	Durbin-Watson stat	1.192520
Prob(F-statistic)	0.404317		

Unweighted Statistics

R-squared	0.195300	Mean dependent var	3.232931
Sum squared resid	5.929069	Durbin-Watson stat	1.175309

Dependent Variable: EFFIC
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 16:22
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.259401	0.181804	-1.426819	0.1602
LCOST	-0.119142	0.084460	-1.410635	0.1649
SECTOR	0.422582	0.150573	2.806504	0.0073
SCALE	0.381426	0.180514	2.113004	0.0399
GDP_PER_CAPITA	-8.42E-05	8.25E-05	-1.020549	0.3127
GDP_GROWTH	0.000285	0.019386	0.014719	0.9883
POP_DENSITY	0.000370	0.000850	0.434967	0.6656
FI	1.155434	1.244459	0.928463	0.3579
AIDA	0.008614	0.006542	1.316810	0.1943
INSTINDEX	0.101251	0.074178	1.364985	0.1788
C	4.469168	1.515911	2.948173	0.0050

Effects Specification

	S.D.	Rho
Cross-section random	0.225089	0.1967
Idiosyncratic random	0.454823	0.8033

Weighted Statistics

R-squared	0.301511	Mean dependent var	2.193947
Adjusted R-squared	0.152896	S.D. dependent var	0.607530
S.E. of regression	0.451949	Sum squared resid	9.600124
F-statistic	2.028808	Durbin-Watson stat	1.645862
Prob(F-statistic)	0.051213		

Unweighted Statistics

R-squared	0.342118	Mean dependent var	3.021466
Sum squared resid	11.53103	Durbin-Watson stat	1.370258

Dependent Variable: SUST
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 16:26
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.053315	0.185777	-0.286986	0.7754
LCOST	-0.027213	0.084606	-0.321638	0.7492
SECTOR	0.288671	0.151480	1.905668	0.0628
SCALE	0.279936	0.180280	1.552787	0.1272
GDP_PER_CAPITA	-0.000135	8.81E-05	-1.530655	0.1326
GDP_GROWTH	-0.007643	0.019809	-0.385822	0.7014
POP_DENSITY	0.001616	0.000899	1.797765	0.0786
FI	1.669453	1.337346	1.248333	0.2181
AIDA	0.006558	0.006989	0.938377	0.3528
INSTINDEX	-0.011818	0.078872	-0.149841	0.8815
C	2.761948	1.522549	1.814029	0.0761

Effects Specification

	S.D.	Rho
Cross-section random	0.279741	0.2804
Idiosyncratic random	0.448086	0.7196

Weighted Statistics

R-squared	0.180308	Mean dependent var	1.953347
Adjusted R-squared	0.005905	S.D. dependent var	0.533090
S.E. of regression	0.451724	Sum squared resid	9.590555
F-statistic	1.033860	Durbin-Watson stat	2.129304
Prob(F-statistic)	0.430778		

Unweighted Statistics

R-squared	0.217022	Mean dependent var	3.036552
Sum squared resid	12.42861	Durbin-Watson stat	1.643080

Dependent Variable: EFFECT
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 16:31
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.279346	0.221580	-1.260702	0.2136
LCOST	-0.079527	0.109066	-0.729167	0.4695
SECTOR	-0.013996	0.193774	-0.072229	0.9427
SCALE	0.241506	0.235136	1.027093	0.3096
GDP_PER_CAPITA	-1.14E-05	9.35E-05	-0.121724	0.9036
GDP_GROWTH	0.004081	0.024206	0.168606	0.8668
POP_DENSITY	0.000216	0.000990	0.218578	0.8279
FI	1.461166	1.339765	1.090614	0.2810
AIDA	-0.004383	0.007226	-0.606658	0.5470
INSTINDEX	0.060218	0.082656	0.728538	0.4699
C	4.404094	1.952781	2.255294	0.0288

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.620136	1.0000

Weighted Statistics

R-squared	0.135894	Mean dependent var	3.275862
Adjusted R-squared	-0.047958	S.D. dependent var	0.539431
S.E. of regression	0.552215	Sum squared resid	14.33224
F-statistic	0.739147	Durbin-Watson stat	1.296204
Prob(F-statistic)	0.684277		

Unweighted Statistics

R-squared	0.135894	Mean dependent var	3.275862
Sum squared resid	14.33224	Durbin-Watson stat	1.296204

Dependent Variable: REL
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 16:36
Sample (adjusted): 2002 2017
Periods included: 15
Cross-sections included: 22
Total panel (unbalanced) observations: 58
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.083153	0.124419	0.668329	0.5072
LCOST	0.004152	0.055048	0.075426	0.9402
SECTOR	0.002058	0.099334	0.020714	0.9836
SCALE	-0.012903	0.116675	-0.110590	0.9124
GDP_PER_CAPITA	2.98E-05	6.51E-05	0.458191	0.6489
GDP_GROWTH	0.011324	0.013420	0.843817	0.4030
POP_DENSITY	-0.000280	0.000652	-0.428756	0.6701
FI	0.303721	0.986848	0.307769	0.7596
AIDA	0.001435	0.005107	0.280969	0.7800
INSTINDEX	-0.048558	0.057013	-0.851689	0.3987
C	3.344965	0.997289	3.354060	0.0016

Effects Specification	S.D.	Rho
Cross-section random	0.244902	0.4263
Idiosyncratic random	0.284079	0.5737

Weighted Statistics

R-squared	0.055401	Mean dependent var	1.946205
Adjusted R-squared	-0.145577	S.D. dependent var	0.504218
S.E. of regression	0.305591	Sum squared resid	4.389125
F-statistic	0.275657	Durbin-Watson stat	1.160168
Prob(F-statistic)	0.983655		

Unweighted Statistics

R-squared	0.048187	Mean dependent var	3.663793
Sum squared resid	6.490382	Durbin-Watson stat	0.784565

Best model fit

Dependent Variable: VFM
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 06:49
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.028686	0.086030	-0.333441	0.7451
LCOST	-0.189388	0.047032	-4.026758	0.0020
SECTOR	0.139729	0.072580	1.925176	0.0804
SCALE	0.129981	0.093277	1.393502	0.1910
LAGGDP_PER_CAPITA	-0.000301	8.96E-05	-3.363108	0.0063
GDP_GROWTH	-0.006318	0.015382	-0.410757	0.6891
POP_DENSITY	0.002686	0.001592	1.686787	0.1198
LAGFI	1.130791	0.922727	1.225487	0.2460
LAGAIDA	0.018553	0.003544	5.235091	0.0003
INSTINDEX	0.076841	0.052760	1.456423	0.1732
C	6.336451	1.036456	6.113576	0.0001

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.116699	1.0000

Weighted Statistics

R-squared	0.682708	Mean dependent var	3.293864
Adjusted R-squared	0.394261	S.D. dependent var	0.325558
S.E. of regression	0.253379	Sum squared resid	0.706211
F-statistic	2.366839	Durbin-Watson stat	1.335224
Prob(F-statistic)	0.086832		

Unweighted Statistics

R-squared	0.682708	Mean dependent var	3.293864
Sum squared resid	0.706211	Durbin-Watson stat	1.335224

Dependent Variable: EFFIC
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 06:36
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	-0.406332	0.204382	-1.988096	0.0723
LCOST	-0.326237	0.111736	-2.919711	0.0139
SECTOR	0.481788	0.172430	2.794112	0.0175
SCALE	0.430216	0.221599	1.941415	0.0783
LAGGDP_PER_CAPITA	-0.000476	0.000213	-2.233365	0.0472
GDP_GROWTH	-0.025404	0.036543	-0.695189	0.5014
POP_DENSITY	0.004981	0.003783	1.316715	0.2147
LAGFI	1.711024	2.192140	0.780527	0.4516
LAGAIDA	0.031981	0.008419	3.798528	0.0030
INSTINDEX	0.093778	0.125342	0.748176	0.4700
C	8.168551	2.462327	3.317412	0.0069

Effects Specification

	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.277244	1.0000

Weighted Statistics

R-squared	0.854481	Mean dependent var	3.026818
Adjusted R-squared	0.722191	S.D. dependent var	0.602458
S.E. of regression	0.317541	Sum squared resid	1.109159
F-statistic	6.459140	Durbin-Watson stat	2.545401
Prob(F-statistic)	0.002421		

Unweighted Statistics

R-squared	0.854481	Mean dependent var	3.026818
Sum squared resid	1.109159	Durbin-Watson stat	2.545401

Dependent Variable: SUST
Method: Panel EGLS (Cross-section random effects)
Date: 11/04/24 Time: 07:08
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PPP	0.081508	0.083217	0.979461	0.3484
LCOST	-0.131049	0.045495	-2.880535	0.0150
SECTOR	0.306386	0.070207	4.364027	0.0011
SCALE	0.206652	0.090227	2.290351	0.0428
LAGGDP_PER_CAPITA	-1.68E-05	8.67E-05	-0.193475	0.8501
GDP_GROWTH	0.054351	0.014879	3.652878	0.0038
POP_DENSITY	-0.001829	0.001540	-1.187228	0.2601
LAGFI	2.000484	0.892560	2.241288	0.0466
LAGAIDA	0.009080	0.003428	2.648629	0.0226
INSTINDEX	0.096705	0.051035	1.894890	0.0847
C	4.617426	1.002570	4.605590	0.0008

Effects Specification	S.D.	Rho
Cross-section random	0.000000	0.0000
Idiosyncratic random	0.112884	1.0000

Weighted Statistics

R-squared	0.614574	Mean dependent var	3.205455
Adjusted R-squared	0.264186	S.D. dependent var	0.389355
S.E. of regression	0.333987	Sum squared resid	1.227022
F-statistic	1.753983	Durbin-Watson stat	1.348603
Prob(F-statistic)	0.185091		

Unweighted Statistics

R-squared	0.614574	Mean dependent var	3.205455
Sum squared resid	1.227022	Durbin-Watson stat	1.348603

Correlated random effects – robustness checks

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	50.856116	10	0.0000

** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
PPP	0.136159	-0.028686	0.065240	0.5187
LCOST	0.061760	-0.189388	0.043543	0.2288
SECTOR	0.358917	0.139729	0.018332	0.1055
SCALE	-0.058017	0.129981	0.089205	0.5291
LAGGDP_PER_CAPITA	-0.001075	-0.000301	0.000004	0.6908
GDP_GROWTH	-0.105246	-0.006318	0.001092	0.0028
POP_DENSITY	0.074044	0.002686	0.001034	0.0265
LAGFI	-14.868871	1.130791	36.522183	0.0081
LAGAIDA	0.044001	0.018553	0.005128	0.7223
INSTINDEX	0.559787	0.076841	0.607636	0.5356

Cross-section random effects test equation:
Dependent Variable: VFM
Method: Panel Least Squares
Date: 11/04/24 Time: 16:41
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.212161	4.018446	0.052797	0.9664
PPP	0.136159	0.269521	0.505191	0.7022
LCOST	0.061760	0.213904	0.288727	0.8211
SECTOR	0.358917	0.153621	2.336372	0.2575
SCALE	-0.058017	0.312898	-0.185418	0.8833
LAGGDP_PER_CAPITA	-0.001075	0.001948	-0.552077	0.6789
GDP_GROWTH	-0.105246	0.036452	-2.887255	0.2123
POP_DENSITY	0.074044	0.032190	2.300233	0.2611
LAGFI	-14.86887	6.113396	-2.432179	0.2483
LAGAIDA	0.044001	0.071697	0.613706	0.6496
INSTINDEX	0.559787	0.781293	0.716487	0.6042

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.993881	Mean dependent var	3.293864
Adjusted R-squared	0.871507	S.D. dependent var	0.325558
S.E. of regression	0.116699	Akaike info criterion	-2.640388
Sum squared resid	0.013619	Schwarz criterion	-1.598938
Log likelihood	50.04427	Hannan-Quinn criter.	-2.395054
F-statistic	8.121673	Durbin-Watson stat	4.560977
Prob(F-statistic)	0.270664		

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	13.430089	10	0.2006

** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
PPP	-0.021527	-0.406332	0.368219	0.5260
LCOST	0.261319	-0.326237	0.245758	0.2359
SECTOR	0.640501	0.481788	0.103465	0.6217
SCALE	-0.110152	0.430216	0.503476	0.4463
LAGGDP_PER_CAPITA	0.000640	-0.000476	0.000021	0.8093
GDP_GROWTH	-0.188338	-0.025404	0.006164	0.0380
POP_DENSITY	0.067283	0.004981	0.005834	0.4147
LAGFI	-22.453791	1.711024	206.132571	0.0924
LAGAIDA	0.054523	0.031981	0.028942	0.8946
INSTINDEX	1.736184	0.093778	3.429520	0.3751

Cross-section random effects test equation:
Dependent Variable: EFFIC
Method: Panel Least Squares
Date: 11/04/24 Time: 16:47
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.146345	9.546696	-0.434322	0.7392
PPP	-0.021527	0.640306	-0.033620	0.9786
LCOST	0.261319	0.508177	0.514230	0.6976
SECTOR	0.640501	0.364961	1.754984	0.3297
SCALE	-0.110152	0.743358	-0.148182	0.9063
LAGGDP_PER_CAPITA	0.000640	0.004627	0.138253	0.9125
GDP_GROWTH	-0.188338	0.086599	-2.174819	0.2744
POP_DENSITY	0.067283	0.076474	0.879817	0.5406
LAGFI	-22.45379	14.52371	-1.546010	0.3655
LAGAIDA	0.054523	0.170332	0.320101	0.8028
INSTINDEX	1.736184	1.856133	0.935377	0.5212

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.989916	Mean dependent var	3.026818
Adjusted R-squared	0.788227	S.D. dependent var	0.602458
S.E. of regression	0.277244	Akaike info criterion	-0.909788
Sum squared resid	0.076864	Schwarz criterion	0.131661
Log likelihood	31.00767	Hannan-Quinn criter.	-0.664454
F-statistic	4.908139	Durbin-Watson stat	4.560977
Prob(F-statistic)	0.343427		

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	95.291902	10	0.0000

** WARNING: estimated cross-section random effects variance is zero.

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	Prob.
PPP	-0.369680	0.081508	0.061044	0.0678
LCOST	0.190508	-0.131049	0.040742	0.1111
SECTOR	0.576908	0.306386	0.017153	0.0389
SCALE	-0.140828	0.206652	0.083467	0.2291
LAGGDP_PER_CAPITA	0.003816	-0.000017	0.000004	0.0417
GDP_GROWTH	-0.087149	0.054351	0.001022	0.0000
POP_DENSITY	0.085404	-0.001829	0.000967	0.0050
LAGFI	0.998897	2.000484	34.173118	0.8640
LAGAIDA	-0.338200	0.009080	0.004798	0.0000
INSTINDEX	0.365529	0.096705	0.568553	0.7215

Cross-section random effects test equation:
Dependent Variable: SUST
Method: Panel Least Squares
Date: 11/04/24 Time: 16:52
Sample (adjusted): 2006 2015
Periods included: 10
Cross-sections included: 11
Total panel (unbalanced) observations: 22

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.227581	3.887068	-1.602128	0.3552
PPP	-0.369680	0.260709	-1.417980	0.3910
LCOST	0.190508	0.206911	0.920724	0.5263
SECTOR	0.576908	0.148599	3.882316	0.1605
SCALE	-0.140828	0.302669	-0.465287	0.7228
LAGGDP_PER_CAPITA	0.003816	0.001884	2.025354	0.2920
GDP_GROWTH	-0.087149	0.035260	-2.471598	0.2448
POP_DENSITY	0.085404	0.031137	2.742803	0.2226
LAGFI	0.998897	5.913525	0.168917	0.8935
LAGAIDA	-0.338200	0.069353	-4.876517	0.1288
INSTINDEX	0.365529	0.755750	0.483664	0.7132

Effects Specification

Cross-section fixed (dummy variables)

R-squared	0.995997	Mean dependent var	3.205455
Adjusted R-squared	0.915944	S.D. dependent var	0.389355
S.E. of regression	0.112884	Akaike info criterion	-2.706869
Sum squared resid	0.012743	Schwarz criterion	-1.665419
Log likelihood	50.77555	Hannan-Quinn criter.	-2.461534
F-statistic	12.44161	Durbin-Watson stat	4.560977
Prob(F-statistic)	0.220297		