PRIVATE PROVISION OF PUBLIC SERVICES IN DEVELOPING COUNTRIES?

THE CASE OF UGANDA'S LOCAL GOVERNMENTS

Ndandiko Charles

Ndandiko Charles, MPhil, MBA, is a PhD Candidate at the University of Twente in the Netherlands and a Lecturer at Kyambogo University School of Management in Uganda. His Teaching, Research and Consulting interests are in Public Procurement Audit, Public Private Partnership and Public Service Operations Management.

Email: *ndandiko.phd04@msm.nl / cndandiko@yahoo.co.uk*

Abstract

.
While in general the idea of a PPP is theoretically appealing, its practical implementation in developing countries is not as easy as theory suggests. We sought to establish the extent to which private providers are comparable to the public providers in achieving higher efficiency levels in public service provision. The co-existence of public and private service providers in the waste collection and water supply services constituted an opportunity to examine the claim that private provision leads to higher efficiency than public service provision. Data Envelopment Analysis was used to determine efficiency levels of up to 30 local government units, and regressions to explain the efficiency distribution. Accordingly we established that contrary to theory, private involvement in local service delivery does not imply the attainment of higher levels of efficiency; perhaps owing to, in the context of a developing country, the absence of strong public and private institutions and an enabling environment. The waste collection service represented services that have not created an enabling environment for private provision while the water supply service represented one that has deliberately supported private provision in a systematic way. We conclude that private provision in a developing country must be accompanied by financial and skills' enhancement of both the private and public institutions. Public procurement practitioners must establish prevalence of conditions that favour private provision before transferring a service to the private sector; otherwise the anticipated solution to the problem ends up creating a much bigger problem!

BACKGROUND AND ORIENTATION

For much of post world war two, the majority of governments both in the developed and developing countries entrusted the delivery of services such as transport, telecommunication, energy, water, health, education, policing, defense, etc. to the public sector/government departments and state owned enterprises (Grimsey, 2002; Harris 2003). It was taken for granted that the existence of market failure and imperfections implied that government was the only plausible provider of most goods and services. In many countries, the situation was that government builds or purchases a physical asset, retains ownership, uses public sector employees or a private contractor to deliver the required service (Grout 2003) – the traditional approach to procuring infrastructure and delivery of public service. However this mode of procuring infrastructure and delivering public services proved untenable as the public sector entities mandated with provision and execution were characterized by insufficient government investments, budget deficits, inefficiencies, poor pricing policies, corruption, overstaffing, mismanagement, and stagnation (Harris, 2003, Rwelamira 2004) and therefore did not provide value for money to the public clients. Hence in the last three decades governments, both the developed and the developing world have been moving away from the traditional approaches; where government is solely and completely involved, to alternative arrangements that embrace more private sector involvement, in provision and delivery of public service. Concomitant to this are persistent debates on the appropriateness of private provision vis-à-vis public sector provision; whether the public sector or private sector is a more efficient service provider is still a contentious and empirical issue since the results are mixed.

INSPIRATION FOR THE RESEARCH

The pessimist view of the public sector in service provision

One strand of literature has painted a negative picture of service provision by the public sector. This strand contends that the public sector can never be expected to deliver services as efficiently as the private sector because the public agencies lack incentives to perform efficiently. They are inefficient because they address the objectives of politicians rather than maximise efficiency (Boycko et al, 1996); they provide services desired by politicians rather than by clients (Shleifer et al, 1994)); they are overstaffed due to the fear of losing votes of the

otherwise retrenched state-employees, and due to the political bargaining power of trade unions (Boycko et al, 1996); they have no bankruptcy and takeover constraints and threats (Vickers et al, 1988) and that generally they have no competitive pressures that would force them maximise efficiency since they tend to be monopolies – as Public choice theory suggests that if public officials monopolize service delivery, then the result is oversupply and inefficiency (McMaster et al, 1996). The property rights view, most commonly associated with Alchian (1965) and Alchian and Demsetz (1972), suggests that public ownership attenuates property rights, leading to monitoring problems and adverse behavioural incentives, creating mismanagement and inefficiency.

Global interest in private provision of public services

Frustration of service delivery by public sector in the 1970s and 1980s led to the expanded experimentation with private sector provision in many countries (Warner 2008). Private provision of public services was popularized by the UK and US governments of the 1980's after they deliberately adopted the privatization policy. The motives were many but the anticipation of reduced fiscal pressures and higher efficiency underscored the expectations of the governments. In the 1980's Governments world over found themselves with large budget deficits in the aftermath of the oil crisis and the subsequent debt crisis; both domestic and foreign borrowing could not sustain financing of the deficits. Private involvement was seen as a way of improving cashflow by reducing the outflow of cash (in the form of subsidies and grants) to the loss making and inefficient state owned enterprises. It was believed that due to incentives originating from agency, property rights and competition the private sector was bound to deliver services more efficiently. The increasing inadequacy of traditional public organizations in satisfying their public clients' requests therefore pushed toward externalization of public service provision (Ancarani, 2003). It was envisaged that private sector involvement enables competition which results in improved outcomes such as greater efficiency, higher quality of service, a clearer focus on clients and better value for money (Parker 2000 in Ancarani 2003); that the private sectors' skillful management and capacity to innovate would lead to increased efficiency (Hemming 2006).

The Paradox of private Provision in Developing countries

Whereas the developed world consciously operationalized private provision basing on some intrinsic merits, the developing world launched private provision under pressure. In the developing world, the interest in private sector involvement in service delivery was not only due to the need for exploiting efficiency gains but rather more of pressure by international lending agencies (George 1997 in Miraftab 2004). World bank (WB), International Monetary Fund (IMF), United States Agency for International Development (USAID) and other multilateral organizations put pressure on developing countries to pursue a policy where the private sector plays an increased role in public service delivery as part of a package of economic and structural reforms (Aylen 1987; Batley 1996). Such pressure came at a time when a big proportion of developing countries' budgets were being funded by donors and multilateral organizations. These organizations conditioned the release of financial aid and loans on the adoption of greater market freedom and in desperate need, developing countries allowed private involvement without proper analysis and visualization of its appropriateness.

Kirkpatrick et al 2003, provide a summary of the critical differences between the markets, management, property rights and government in developed and developing countries (Table …. Below). When the perceived justification for private provision are mapped against the common features prevailing in the developed and developing world, the differences demonstrate contradictions which augment the debate on private provision of services in developing countries. For instance, competition is listed as a major driver for private involvement that explains efficiency, but the common feature shows insufficient competition in developing countries. In similar vein, a skilled and financially strong private sector is proffered as justification for private provision, but the features indicate inadequacy in this aspect as well. Is it not a contradiction that the same government exhibiting incompetence in service provision must take responsibility for regulating private firms without any deliberate enhancement? In light of this scenario is it realistic to homogeneously launch private provision without recourse to the country situation.

Critical differences between Developed and Developing Countries

Justification for Private Provision (Mapping)	Commonly found features of[**]:	
	Developed Countries	**Developing Countries**
Competition on products (to supply)	Competitive product markets	Imperfectly competitive and incomplete markets
Competition – Provision of capital (financing)	Competitive capital markets	Under-developed capital markets
Exploiting – managerial and innovative skills	Organised and competitive labour markets	Regionalised and sometimes ethnically distinct labour markets, with appointments through connections
Exploiting – managerial skills	Competitive managerial labour markets; Institutionalized management training	Management weaknesses and patronage in appointments
Property rights and the use of private assets	Protected and well-defined private property rights; understood standards of business conduct	Poorly protected private property rights; under-developed business codes of behaviour
Public sector capacity (supervision and regulation)	Relatively high standards of probity in public administration	Relatively low standards of public administration, including cronyism and corruption

**Adapted from Kirkpatrick C and Parker D (2003)

Perspective for Research

While private provision arrangements of public services have received much publicity as efficient and effective modes of implementing public procurement policy in the developed world, little has been considered in the context of a developing country (Ndandiko 2006). While in general the idea of private sector provision is theoretically appealing, its practical implementation in developing countries is not as easy as theory suggests (Pessoa 2006). The common features highlighted by Kirkpatrick et al (2003) above show clearly that developing countries' markets are underdeveloped, with less competition, and weak private and public sectors – the basis of arguments for choosing between the two modalities of service provision. In view of such circumstances is it reasonable to expect higher efficiency levels? Besides, studies show inconclusive evidence on efficiency and quality standard in the private relative to the public sector (UNDP-HRD Report 2003).

Research objective

The assumption for private provision originates from the pessimistic view of public provision. It is portrayed that the public sector providers are bound by bureaucratic inertia, lacking incentives to be efficient (Kessler 2004). That private provision – perceived to obtain superior efficiency, is the remedy of public provision failure. However we do not share the enthusiasm of those who suggest that private provision always yields superior efficiency considering that the empirical and theoretical research is fairly inconclusive (Parker et al 2002). Some studies of private sector versus public sector performance, for example by Davies (1971, 1977), Cubbin et al (1986), Burgat and Jeanrenaud (1990), Megginson et al (1994), Estache and Kouassi (2002) and Kirkpatrick et al. (2006), have reported higher efficiency in the private sector. Yet on the contrary Byrnes et al (1986), Bruggink (1982), Lambert et al (1993), Parker et al (1998), Garcia-Sanchez (2006), and Garcia-Sanchez 2008 have reported results more favourable to the public sector or no statistically significant differences. These studies allow us to pose questions about policies that favour, without a doubt private provision. Moreover most of the literature on the private providers' superior efficiency comes from the developed and advanced economies whose features are quite different from that of developing countries.

Our study is an attempt to contribute to the debate on the relative efficiency of private provision vis-à-vis public provision of public services but concentrating on developing countries. We question the

pragmatism of private provision in the absence of ideological conditions that justify it. Does private provision per se make sense in the absence of the salient conditions? It is understood that private provision thrives under conditions of well developed capital markets; sufficient competition; a vibrant, skilled and financially sound private sector; and an organised public sector competent in supervision and regulatory roles. Our ultimate goal is bring to bear new insights to the existing literature on private provision and ignite debate on policy change in light of a developing country situation.

Research Goal and Questions

From the foregoing discussion it is clear many questions remain unanswered with respect to public provision vis-à-vis private provision. Our study will be guided by the following goal and questions

Research Goal

We aim to determine whether there is a difference in the relative efficiency of private and public service providers in developing countries and factors explaining their efficiency levels

The Main Research question

1. To what extent are private providers comparable to the public providers in achieving higher efficiency levels in public service provision

    a. What are the relative efficiency levels of public and private providers of the waste collection and water supply services in Uganda? And is there a difference between the efficiency levels of the public and private service providers?

    b. Does modality of service provision (Public or Private) explain efficiency levels of service providers

    c. What are the other factors that explain the efficiency levels of service providers (based on public and/or private modalities)

    d. What support is there for the policy of private involvement in public services and how has this affected efficiency

Uganda's experience with private provision

When Museveni's NRM guerrilla movement took power in 1986, it inherited 146 public sector enterprises, excluding banks (Ddumba-Ssentamu et al 2001); enterprises dealing in wide range of businesses including supermarkets, transport – buses, hotels, hardware, insurance, airline, etc. The majority of these performed poorly as a result of country's violent political history and collapsed economy. The public sector enterprises suffered from low capacity utilization, large operating losses or low profitability, and being illiquid and indebted (Ddumba-Ssentamu et al 2001). Like any other developing country, the convergence of poor performance of the public enterprises, budgetary pressure and donor demands prompted the government to ally with private provision! In the late 1980s the government commenced WB and IMF sponsored economic and structural recovery programme that was pegged on public sector and market reforms, and trade liberalization. The reforms necessitated government to transform the economy from an in-ward centrally planned and dominated by the public sector to an out-ward looking economy where service provision is decentralized to the private sector and the lower tiers of government. This was done without critically appreciating the conditions prevailing in terms of competition, property rights, management as outlined in Kirkpatrick 2003. Accordingly the move was at odds with Ancarani 2003 who has observed '…despite the well known benefits expected from entrusting the service provision with private partners, there is need for exercising caution in extending its application to situations where both markets and government regulatory capacity may be weak".

A brief of Uganda's Private sector

The term private sector is ambiguous in relation to private provision. When academics and policy makers talk of the private sector, what kind of private sector do they refer to? Are they referring to large, multi national enterprises or small medium enterprise (SMEs)? – which also will variously depend on country level of development. Our view is that the private sector portrayed in literature is certainly not the kind that is prevailing in the developing world particularly Uganda! The private sector in Uganda, like any other developing country is composed of micro, small, and medium enterprises most of which are family businesses with no serious corporate structure to talk of – which to us makes the threat of takeover managerial incentive in agency theory almost irrelevant. Such firms constitute 90% of Uganda's private sector

(Uganda Investment Authority 2008). According to UIA 2008 "…inherent challenges faced by SMEs in Uganda include limited access to finance, lack of entrepreneurial skills, lack of general skills, marketing and financial planning, lack of business plans, lack of business records, deficient corporate governance, poor banking and borrowing history and a culture that disrespects business contracts." But such are the private sector firms entrusted with private provision especially in the lower tiers of government.

To enhance our research goal and questions therefore, in the absence of some contextual policy on private provision, should we expect private providers to be superior?

The Significance of the Study

Public procurement practitioners find themselves being told to use private provision instead of public provision based on some minimum monetary threshold without any assessment as to whether this course of action is better than the in-house provision; or whether there is competition; or whether even relevant private providers are available. The study highlights to the public procurement policy maker the need to incorporate an assessment of the salient conditions that make private provision work in the decision making process.

The study applies the market phenomena on a developing country and highlights the flaws that need to be addressed. That applying the concept of the market wholesale does not yield anticipated positive results. Introducing a one-fit-all policy, from one context will normally not work if the basic conditions justifying it are not dealt with. Conditions for controlling market failure must be available.

Any policy decision at macro level, to involve private sector in service delivery for efficiency gains, must first assess whether the salient conditions that justify efficiency are available that is, competition, management, property rights etc, so that if unavailable, government policy deliberately and simultaneously creates these conditions.

RESEARCH ROADMAP

Geographical scope

Decentralization and private sector involvement were regarded crucial in Uganda's transformation. In line with this we choose the decentralized local governments in Uganda, specifically the urban local governments (ULG) in Uganda whose setup is presented in Table….below.

Table …: Local Government Setup as of June 2007

Level	Population	Number
City	> 500,000	1
City Division = Municipal Council	> 50,000	5
Municipal Councils	> 50,000	13
Town Councils	> 5,000, <50,000	83
Total		**102**

The local government reforms in Uganda culminated in the enactment of the Local Government Act 1997. The Act gives urban local governments autonomy over the financial and planning matters. In the second schedule of the Act, functions and services of local government are elaborated which among others include provision of public street lighting, street maintenance and repairs, waste collection and street cleaning services, water supply, municipal markets, recreation and park maintenance, public transport terminal management, and other decentralized services.

Stages of the research

In order to answer the research questions, our study blended both qualitative and quantitative techniques which involved several stages in which a step-by-step move towards data collection, data analysis and discussion of results took place as depicted in Figure 1.

I.   We initially reviewed literature on public and private provision which allowed us to formulate study areas and concepts. ULG at both municipal and town council level were targeted units of analysis because they were at the forefront of implementing private participation arrangements in their traditional services.

II. Preliminary interviews with technical officers in seven pilot LGs allowed us to identify services that were common to most LGs and establish input and output parameters used in measuring efficiency.

III. A comprehensive questionnaire was designed and sent to 40 ULGs that were purposively selected based on size, geographical region and availability of common services and also the modality of service provision. At this stage most services including waste collection, municipal markets, street cleaning, street parking, street lighting, recreation, public transport, water supply etc were a target of research and therefore covered in the questionnaire. We initially got data relating to the financial year 2006/2007 from 35 ULGs. On scrutinizing the returned questionnaires only two services were noticeable; waste collection and water supply had data across several LGs and therefore necessitated detailed analysis. Unavailability of relevant data across services and LGs restricted us to assessing the efficiency of only 28 LGs for waste collection services and 32 LGs for water supply services.

IV. We utilized Data Envelopment Analysis (DEA) approach to analyze the data. In light of the assessment that was required, it was essential to use a methodology that could analyze and compare efficiency between two categories of service provision – public and private and it was imperative that the tool used for the analysis be compatible for both categories. Besides DEA is flexible in handling multiple input and output measures, which was essentially required in this study. DEA uses linear programming (LP) to obtain the measures of technical efficiency (TE). There are two possibilities for formulating the DEA models. One puts the emphasis on input reduction (input orientation) and the other on output enhancement (output orientation). The input-orientated DEA LP is set up so as to maximise the TE score of the i-th firm, subject to production remaining within the feasible set of production possibilities. This involves the solution of the following LP problem assuming variable scale to returns.

Let y_i be a vector of M outputs and x_i a vector of K inputs for the ith Service Provider. If we have data for N Service Providers, then x is a K×N matrix of input data for all Service Providers and y is a M×N matrix of output data. The envelope, or efficiency frontier, is derived by solving the following variable returns to scale problem:

$$\min{}_{\theta,\lambda}\ \theta,$$

$$\text{st}\quad -y_i + Y\lambda \geq 0,$$

$$\theta x_i - X\lambda \geq 0,$$

$$N1'\lambda = 1.$$

$$\lambda \geq 0 \qquad\qquad\qquad\qquad (1)$$

where N1 is an N x 1 vector of ones. This approach forms a convex hull of intersecting planes which envelop the data points more tightly. The convexity constraint ensures that an inefficient Service Provider is compared against providers of a similar size. This means that the VRS specification gives "pure" technical efficiency scores, which are free of scale efficiency effects.

Choice of DEA Model Orientation

There are two possibilities for formulating the DEA models. One puts the emphasis on input reduction (input orientation) and the other on output enhancement (output orientation). We adopted the input orientation considering that the initial emphasis in government policy is usually on the input dimension, and inputs are more amenable to scrutiny whereas outputs are often disputed Ganley and Cubbin (1992). Furthermore the control over utilization of inputs lies with the service providers and therefore they can change them in order to become more efficient.

In terms of Charnes, Cooper and Rhodes (CCR) and Banker, Charnes and Cooper (BCC) DEA options, we observe that the LGs vary in terms of service operations and with such variations in size, it would be inappropriate to assume constant returns to scale. DEA under CRS option when all units are not operating at optimal scale may result to efficiency scores confounded by scale efficiency. Using the variable returns to scale (VRS) specification, it is possible to calculate the technical efficiency measures devoid of scale efficiency (Banker 1984) and to observe its influence over the OPEX. We therefore opted for VRS.

Figure 1: Research Roadmap
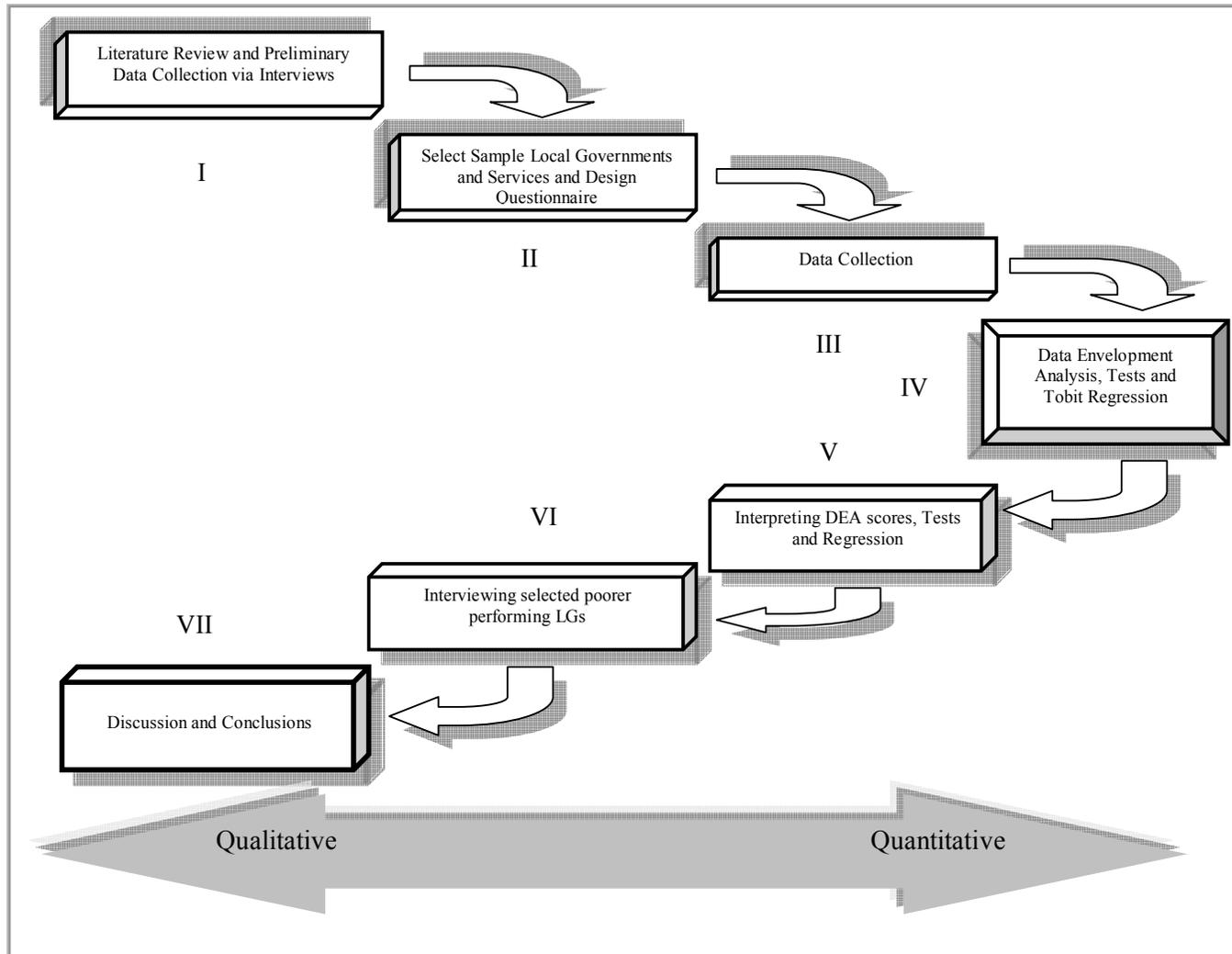
DEA Model Specification

It should be noted that DEA performance could be sensitive to the number of variables included in the model and the extent to which they correlate (Pedraj-Chaparro et al 1999). According to the literature, the danger of model misspecification is most serious when relevant variables are omitted rather than when irrelevant ones are included (Smith 1997; Ruggerio 1997). Banker et al. (1989) highlights the issue of degrees of freedom vis-à-vis the sample size. The relative nature of DEA makes it, as in every empirically oriented methodology, vulnerable to problems with the degrees of freedom. Hence Banker et al. 1989 suggest a rough rule of thumb. Let m be the number of inputs and s be the number of outputs used in the analysis, then the sample size n should satisfy $n \geq \max\{m \times s; 3(m + s)\}$; in our case we have one input and two outputs $n \geq 9$.

Specifying inputs and outputs

In order to derive efficiency measures, we needed data on inputs and outputs for waste collection and Water supply services. The input–output variable selection, as is usually guided by expert opinion, past experience, economic theory, and degrees of freedom constraints encountered when using a small sample size (Banker 1989). Previous efficiency measurements studies of this nature with in the context of Uganda are scarce. However Domberger et al 1986; Bosch 2001; Worthington 2001 and Moore 2005 provide some initial benchmark guidance with respect to the choice of inputs and outputs in terms of the DEA approach to waste collection. While for water supply, Mugisha 2007, Kirkpartrick 2006, Garcia-Sanchez 2006, Coelli 2005, and Thanassoulis 2000 provide guidance.

Analysis of Data

In analyzing the data, we first run the DEA model using *Frontier Analyst 4 software by Banxia*, on the data comprising of LGs in our sample, categorized according to modality of service. This was done to determine the separate group's performance as well as individual performance within the group and establish efficiency scores that would later be used to compare consistency and validate LG performance. Secondly DEA model was run on the data comprising of all the LGs in our sample, irrespective of modality of service to determine individual and group performance within the combined lot.

V. Explaining the Efficiency Scores

Three methods were used to determine whether modality of service provision (private or public) has a positive effect on efficiency: (i) a comparison of the observed average performances of the individual groups (ii) the Brockett–Golany (1996) procedure, and (iii) a second-step econometric analysis – *Tobit*, which regresses the efficiency measures obtained from DEA against dummy variables for modality of service provision.

Brockett and Galony (1996) includes:
a) Computing two separate frontiers: one frontier made of LGs utilizing public or in-house service provision and the other one utilizing private service providers.
b) Applying a Mann-Whitney's test, with the following null hypothesis: H_0 the two types of modality of service provision, public and private present the same level of efficiency distribution

Tobit Regression

The general tobit model formulation with limited dependent variable, as proposed by Greene (2003), is given by

$$y_i^* = X_i \beta + \varepsilon_i$$

Where y_i^* is the latent variable; X_i represents a vector of explanatory variables; and β are the parameters to be estimated. It is assumed that the errors are normally distributed, with mean zero and variance σ^2, $\varepsilon_i \sim N(0,\sigma^2)$.

Considering that in our study the efficiency scores were defined by DEA, where the limit for a unit to be efficient is 1, the observed variables (y_i) were defined as follows:

$$y_i = \begin{cases} y_i^* & \textit{if } y_i^* > 0, \\ 0 & \textit{if } y_i^* \leq 0. \end{cases} \qquad (2)$$

The standard interpretation of Tobit coefficients focuses either on the magnitude, direction, and significance of the coefficients or on an undecomposed first-order effect. Such interpretations can verify theory, confirm prior research, or provide information on the effect of an independent variable across all dependent variables (LeClere 1994). It is important to note that the dependent variable in the model is the DEA efficiency score. The sign of the coefficients of the environmental variables indicate the direction of the influence, and standard hypothesis tests can be used to assess the strength of the relationship. The two-stage method accommodates both continuous and categorical variables. Tobit regression is used because it can account for truncated data McCarty (1993).

STYLIZED FACTS ON WASTE COLLECTION AND WATER SUPPLY SERVICES

Solid Waste Collection Services

Solid waste management (SWM) encompasses generation, storage, collection, transportation and disposal of urban waste as described in Figure … Our study concentrates on the collection and transportation activities where private involvement is most utilized. In most of Uganda's urban areas, solid waste management is ultimately the responsibility of municipal / town councils, while among most of the rural populations the wastes are handled at the household level.

Figure… Solid Waste Management System
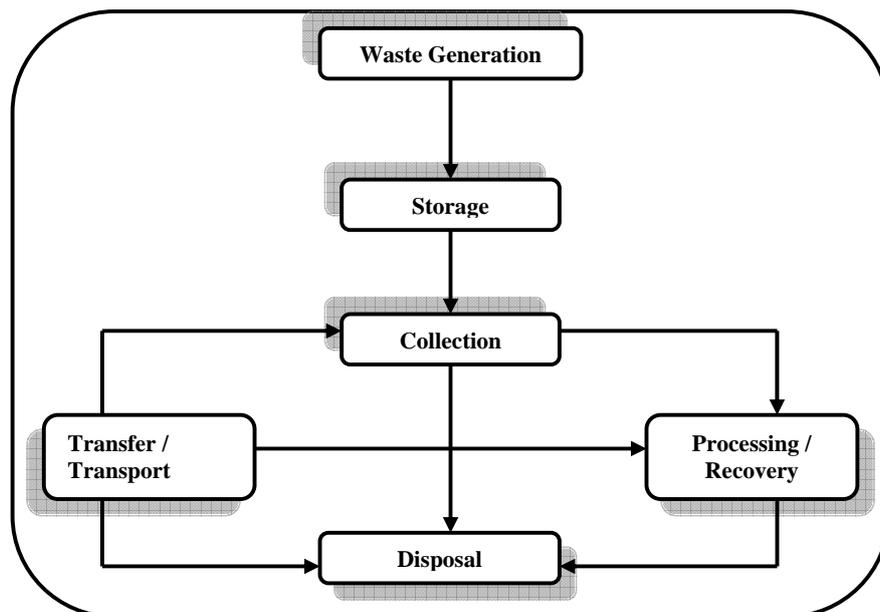
SWM in Uganda is based on either the House-to-House (HtH) system or the Central Collection Center (CCC) system; both of which are either run by the public sector or by private operators. The HtH system is a relatively new approach (started in the 1990s) and is mainly used in the affluent areas of the urban centers whilst the CCC system (which had been the only approach for a long time) is predominantly applied in general public areas such as streets, markets, bus terminals etc and therefore is what municipal budgets reflect. In the CCC system individuals bring the accumulated waste to a central point, a conveniently placed container (skip), from where it is collected and transported to the dumping site. The main focus of our study was the CCC system since it is widely used by most urban areas and appears in the LG budgets; besides it allows for comparison amongst modalities of service provision of LGs.

Waste collection is one of the services delegated to the private sector after government policy in the 2002, required that local governments outsource or put to tender all expenditures that are above the threshold of the Ushs 2,000,000. We note that LGs transferred the service to a private sector that lacked experience in the operations and management of waste collection and did not have the requisite financing muscle but largely depended on the contractual fees from the client LG to sustain operations. Furthermore, the policy guide enabling and enforcing private sector involvement in waste collection was not in place. Given such context, we expected that the public sector will be more efficient and that involvement of the private sector in waste collection services will negatively influence efficiency.

Water Supply Service

The Urban Water Supply and Sanitation subsector which is the main concern of our study embraces gazetted towns and centres with a population of more than 5,000, and is further divided into small and large towns. While large towns are under the jurisdiction of the National Water and Sewerage Corporation (NWSC), the supply of water services in small towns is the responsibility of Local Governments (LGs) with support from the Ministry of Water, Lands and Environment (MWLE) through the Directorate of Water Development (DWD).

Large Towns

The National Water and Sewerage Corporation (NWSC) is a utility parastatal 100% owned by The Government of Uganda. Its current mandate is derived from the National Water and Sewerage Corporation Statute of 1995, where Section 5 (1), authorizes it to operate and provide water and sewerage services in areas entrusted to it, on a sound, commercial and viable basis. The Statute requires the Minister responsible for the water sector to enter into a performance contract with NWSC in relation to its operations in accordance with the provisions of the Water Statute.

Small Towns

For over 60 small towns, the responsibility for water service delivery rests with the respective local authorities, with support of DWD. A local authority signs a performance contract with MWLE and through a Water Board has the obligation of providing, maintaining, managing, controlling, renewing and extending the assets as agreed with MWLE. The local authority is in turn required to enter into a Management Contract with a Private Operator (PO) for service delivery. The PO is responsible for day-to-day management of the facilities to agreed standards, charges and collects revenue, manages routine and urgent repairs, and undertakes system extensions. PO remuneration consists of: a base fee which covers fixed costs like energy and consumables; a water sales fee which is directly proportional to the volume of water sold; a billing fee which relates to bills preparation and revenue collection; a pipe maintenance fee which corresponds to the length of transmission and distribution piping maintained; a new connection fee which relates to administration and installation of new service pipes; and an unaccounted for water (UfW) fee which encourages the PO to keep water losses as low as possible.

Like in the waste collection service, originally the water service providers had inadequate experience in water supply, however, in the three years preceding this study there had been a deliberate effort to enhance their capabilities in operating and managing the service. Furthermore, the policy guideline was clear on the responsibilities of the different stakeholders and allowed the private providers to deposit revenue collections to a joint escrow bank account which somehow reduced delayed and/or non payment. Given this context, we expected (hypothesized) private involvement to positively influence efficiency.

SPECIFYING THE INPUTS FOR USE IN THE DEA MODEL

Waste Collection Services

Many municipalities in developing countries spend a large proportion of their budgets on the collection, transportation and disposal of solid waste. Their solid waste management is a costly service that consumes between 20 and 50 percent of available operational budgets for municipal services, yet serves no more than 70 percent of the urban inhabitants (Cointreau (1994). Like any other production environment, the production process of the waste collection service relies on the supply of labour and capital. Labour usually represented by drivers, cleaners, and loaders who in the context of Uganda can either be hired on fulltime or part-time basis; a situation that creates difficulty in defining the physical units of labour at LG level. Capital includes trucks, containers (skips), and usable (loose) tools. Studies by Bosch 2001 and Garcia 2008, have utilized physical units of labour and capital as inputs to determine relative efficiency of LG in the waste collection service. However in the context of Uganda, we found this line inadequate due to the difficulty in obtaining information on labour especially part-time (casual) labour – a major component of the production process. Hence **Operating expense (OPEX)** was preferred as a single composite input measure since it encompasses the compensation to labour whether fulltime or part-time and other costs such as fuel, vehicle repairs and maintenance, loose tools besides covering the depreciation of vehicles and skips used in the production process. It Sums up all variable resources expended in producing and delivering the service for the public client and thus provides a clear picture of what resources are being used and what is being achieved by expending them.

Water Collection Services

The production process of the water supply service relies on the stock of capital comprising of the plants, reservoir tanks, and the network of pipes without detracting the importance of labour as well as the usable materials such as chemical, energy and etc. In our case such detailed breakdown is not possible due to data availability constraints and also given our sample size, degrees of freedom would not allow us have such disaggregated inputs. Hence, *Operating expense (OPEX)* is preferred as a single input measure since it encompasses the compensation to labour, energy, chemicals, maintenance, and depreciation as a proxy for capital used in the production process.

SPECIFYING OUTPUTS FOR USE IN THE DEA MODEL

Waste Collection Services

Garcia 2008 observes that the *tonnage* and *collection points* variables are the most frequently used indicators for identifying the final product of waste collection activity. They are said to represent the mass of solid waste generated, and the number of places, but not homes, in streets where it is collected, respectively. *Tonnage* symbolizes a quantitative indicator for waste collection, while from the perspective of the public clients and/or citizens, *collection points* signify quality. It has been observed by Garvin (1988) that customers among other factors rate accessibility and convenience of service when evaluating the quality of a service delivery system, hence the more the collection points the less the distance from homes and therefore the better in terms of accessibility and convenience of service. Whereas we appreciate the use of both variables as output measures especially the use of tonnage, our opinion is that number of collection points taken in isolation does not clearly bring out the level of operation that significantly induces OPEX; for instance the number of collection points could be available but without being visited for collection and therefore redundant which leads to accumulation of waste that becomes a health hazard to the citizens besides it leaves out another important quality dimension – reliability. We recognize that *Frequency of collection per collection point per week* will have a major impact on OPEX since the more frequently you collect the more the cost of operation. But we prefer to combine it with number *of collection points* in order to derive the *number of collections made per week.* We believe *number of collections made per week* captures the level of the *transporting* activity including distances since the frequency of collection implies moving to collection points. Furthermore it acts as a proxy for the quality as seen by the citizen, that is, the number of collection points implies that the citizens will access the service conveniently while the frequency of collection from those points makes the service reliable and reduces the possibility of health hazards arising from stockpiles of waste at collection points. In summary, the waste collection service production has two identifiable transformation processes namely *collection* and *transportation,* and our DEA output measures preferred reflect the two activities; which ideally influence our chosen input – OPEX.

1. ***number of tons of waste collected per a week***; which apart from representing the *collection* activity acts as a quantitative measure in the model and

2. ***the total number of collections done per week*** – derived from combining number of collection points and the average frequency of collection per week. This represents the *transporting* activity and provides a qualitative measure in our model.

Water Supply Services

The outputs must reflect the main activities from the water service providers, that is, they have to deliver water to clients. Figure ... depicts a typical water utility in the Ugandan situation. As described in the figure, when water is distributed, a certain proportion is delivered to units connected to the network grid (*water delivered*) while the other proportion is lost via bursts and leaks arising from defective pipelines and inadequacy in maintenance and repairs of the ageing networks. Furthermore while some of the water delivered reaches its anticipated destination that is clients legally connected on the grid and therefore are billed another proportion is lost via illegal connections. The water that reaches the legally connected clients represents water sold and clients are billed for it while the water that is lost via network bursts, leaks and illegal connections represents unaccounted for water or non revenue water.
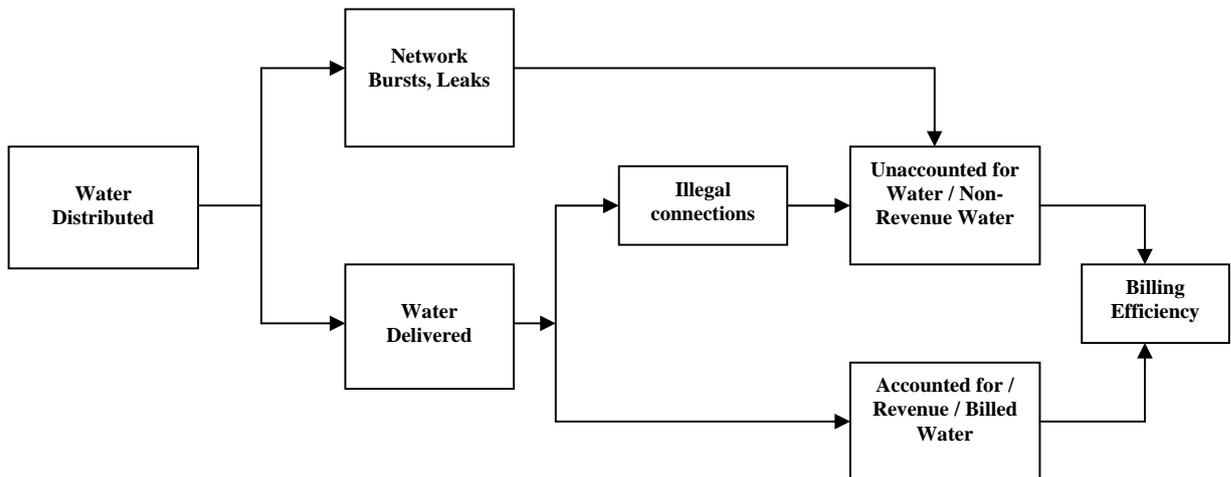
Figure: Typical Water Supply System in Uganda

Volume of Water Sold (Billed) as a Proxy for Water Delivered

As observed from the studies above, *volume of water delivered (VoWD)* is the most commonly used single output variable in the water efficiency measurement. To some extent we concur with its use because we also believe that the *total amount of water delivered*, is an estimate of work done in conveying the water to the clients and therefore will have an enormous influence on the level of OPEX. However quite often in developing countries and particularly in the context of Uganda the total amount of water delivered is not actually known since it includes *unaccounted for water (UfW)* arising from water lost due to *illegal connections and non metered water*. The better option would be to use the *amount of water sold* (*VoWS)* which is implied in bills, as it best represents the actual amount of water delivered to the client. Hence, considering that *VoWD* and *VoWS* are highly correlated we were inclined to use *VoWS* as our quantitative measure in the DEA model.

Unaccounted for water [leakage, losses and illegal connections]

As observed earlier, Figure 9.2, the production and distribution of water supply technology results into both accounted for (water sold) and unaccounted for water (water loss) as outputs. Coelli et al. (2003) regard water loss (*Unaccounted for water)* as an indicator of the technical quality of service, which has been ignored by many studies. Tynan and Kingdom (2002) point out, that the *Unaccounted for water* (*UfW*) ratio captures commercial losses attributable to inefficient billing or illegal connections, as well as physical losses. Thus high levels of unaccounted-for water (or low levels of accounted-for water) indicate poor system management and/or poor commercial practice as well as inadequate pipeline maintenance. Garcia and Thomas (2001) utilized *UfW* as an output that is "produced" jointly with water delivered to customers. They argued that the occurrence of network leaks, losses and illegal connections as part of the production and distribution can be considered as part of the overall inefficiency of the system. Hence, analyzing the water production process by incorporating water network losses generates essential and positive indications for water utility and public policy managers. Furthermore, their view was that overlooking water losses in the analysis may produce unreliable results if water utility manager's decisions regarding production are not independent from network water losses; a situation prevalent in Uganda. Given the production technology, utilities use different levels of inputs and outputs, and a utility appears to be inefficient if it uses more resources to supply

water than the 'best practice' utility does. Usually, in the water performance measurement, total water produced or water delivered is considered a function of available resources and the efforts of utilities made towards reducing *UfW* are ignored (Kumar 2008). Such initiatives involve identifying strategies that address the issue of *UfW* via intensified leak detection, reduction of illegal use, repairs and replacement of defective networks in addition to reactivation of inactive accounts. Implementing these strategies impacts on OPEX and often times diverts resources from producing accounted for water to reducing unaccounted for water. When resources are directed at reducing *UfW*, rather than producing water, the output/input ratios of the utility are lower and the efficiency of the utility appears lower. An output efficiency measure, which is the amount by which outputs can be increased while maintaining the level of inputs, will label the utility as less inefficient than it would be in the absence of this diversion of resources. But reducing UfW is a vital performance objective and a quality issue.

It was mentioned in the seminal work of Koopmans (1951) that the production process may generate undesirable outputs like smoke or waste. Like any other production process; water supply also generates both desirable (accounted for water) and undesirable (UfW) outputs. However, we note that DEA usually assumes that providing more outputs relative to less input resources is a criterion for efficiency, that is, inputs have to be minimized and outputs maximized. However it would not be sensible to aim at increasing inputs in order to increase UfW (an undesirable output); instead it was logical to increase inputs in order to reduce UfW levels, hence the need to incorporate UfW, as an undesirable output measuring quality within our DEA model. Including *UfW* allowed us to recognize the reduction of an undesirable output *UfW* while simultaneously crediting the increase in a desirable output – *accounted for water*.

Table: Selected Variables for DEA Model

Waste Collection			Water Supply	
Inputs			*Inputs*	
Operating Expenses per week	X		Operating Expenses per week	X
Outputs			*Outputs*	
Waste collected per week in tons	X		Unaccounted For Water	X
Total number of collections per week	X		Volume of water Sold	X

Table: Descriptive Statistics for the input and output variables

	N	Minimum	Maximum	Mean	Std. Deviation
Waste Collection Service					
Operational Expenditure	28	250000	3600000	990792	923742
Waste collected Per Week (tons)	28	2	948	222	236
Total Number of Collections per Week	28	2	236	58	56
Water Supply Service					
Operational Expenditure Shs "000"	32	22,152	2,506,485	550,578	643,257
Volume of Water Sold per annum (in cubic meters)	32	17,069	1,975,782	386,851	496,776
Unaccounted for Water	32	5%	39%	17%	8%

We believe the three variables chosen for each service are the relevant ones based on the arguments highlighted and a maximum of three variables used in our analysis satisfies the rule of thumb suggested by Banker et al (1989).

Statistical Validation of the Selected Inputs and Outputs

When selecting the variables, we considered it worthwhile to analyze the relationship between the different variables proposed. Using Pearson's coefficient, we tested the bi-variate correlation of the possible variables relating to inputs and outputs with the objective of detecting factors with the same significance. In this way, we could determine variables that do not fulfil the isotonic property, which requires that there should be no negative correlation between inputs and outputs, and that variables be perfectly defined as to their role in the analysis Banker 1992. Our preferred inputs and outputs fulfil the isotonic property of non negative correlation between the input and outputs. Furthermore, the two output variables we propose to use are not highly correlated hence they can be analyzed within the same DEA model.

OVERALL EXPLANATORY VARIABLES

Modality of Service Provision

Public choice, agency and regulation theories suggest that type of ownership – public or private influences performance because different owners pursue different goals and possess different incentives. In private organizations, owners and shareholders have a direct monetary incentive to monitor and control the behaviour of managers. Similarly, managers themselves are likely to benefit from better performance, either because they own company shares or because their pay is linked to financial success. By contrast, property rights in the public sector are diffuse and vague. Monitoring is a 'public good' – individual citizens have little to gain from increasing effort on this activity. Moreover, managers do not usually obtain direct financial benefits from enhancing organizational efficiency. Hence property rights theorists contend that private ownership is inherently superior to state ownership (De Alessi, 1983). The private sector is thought to be creative and dynamic, bringing access to finance, knowledge of technology, managerial efficiency and entrepreneurial spirit (UNDP 1998).

To provide an initial explanation of the difference in efficiency scores and therefore the possible sources of efficiency we classify the LGs according to their modality of service provision that is Delivery in-house by the LG (public procurement) and Delivery of service by a private service provider.

Defining Modality of Service Provision of Waste Collection Service

The current options being used in practice for CCC waste collection service provision in the local government include:

i) LG provides the service in-house that is, employs staff, uses own equipment and generally meets all costs pertaining to the service delivery;

ii) Private firm provides the service on behalf of LG, with the LG paying a lump sum to private firm for the service; the trucks and labour are all the responsibility of private firm.

iii) LG and Private contribute resources towards the daily operations of the service provision or agree to share operational roles; e.g. LG

contributes trucks and private firm contributes labour and daily operation. LG pays private firm lumpsum.

In our study only LGs in i) were classified public while those in ii) and iii) were categorized "*private*".

Defining Modality of Service Provision of Water Supply Service

The current options being used in practice for water supply service provision in the local government include:

i)   Public entity (NWSC) provides the water supply service;

ii)   LG contracts the water supply service to a private operator

In our study only LGs in i) were classified *public* while those in ii) were categorized as "*private*".

Explanatory Variables Specific to Waste Collection Services

Administrative Level Setup

The different ULG administrative setups have different mandates with respect to procuring private service providers for instance, whereas the municipal councils were autonomous and executed the whole procurement process the town councils' procurement process was handled by their parent district; that is, town councils only came in at contract signing stage and contract management. Hence a comparison was appropriate and we expected the administrative setup to influence efficiency results.

Private Sector involvement characteristics

Kumar 2004 and Jamali (2007) identified *asset ownership, operation/management, capital investment, and duration of contracts* as elements which define private involvement and therefore could influence performance. Under the private involvement schemes, the government specifies the services it wants the private sector to deliver, and then the private partner designs and builds a dedicated asset for that purpose, finances its construction, and subsequently operates the asset and provides the services deriving from it. It is anticipated that giving the

private sector combined responsibilities for designing, building, financing, and operating an asset is a source of increased efficiency in service delivery (IMF 2004). Hence it is imperative to determine the trend of influence parameters such as *asset ownership, operation/management, financing, and duration of contracts* have on efficiency.

In similar vein, arguing that no organization is wholly public or private, Bozeman (1987) synthesized; *ownership, funding and control* – into a "dimensional" model of a construct denominated *"publicness"*. He then located public and private firms on these three dimensions. We note that the publicness elements reflect components of private sector involvement and that the relative importance of the components will vary from one contract to another depending on the purposes for which it was constituted and the needs and nature of the partners involved. Relating the publicness construct to private involvement elements, *Ownership* could be operationalised by ownership of assets, funding by capital investment and control by the partner in charge of operations or whether the operations are shared or not. Based on these dimensions each contract is more public in one dimension and less public in another. However, research has so far not modeled the complementary elements that form private involvement. Hence it is crucial to determine the trend of influence parameters such as *asset ownership, operation/management, financing, and duration of contracts* have on efficiency.

Asset ownership

There are two possibilities of ownership of assets that are used in delivering the waste collection service: a) the LG ownership of the assets or b) private firm ownership. In the former case, the trucks and equipment would be owned by the respective LG and given, lent or leased to the private operator for the duration of the contract. The LG retains full control over the assets, which could create problems with respect to maintenance and renewal. The private operator has little incentive to maintain the vehicles to a level that extends their economic life beyond the contract term (Domberger et al 1997). Therefore, whether ownership of assets remains in the public sector or is transferred to the service provider can be a vital influence to efficiency. Hart (1995) has shown that ownership of assets matters because it confers power to control ex-post contractual outcomes when contracts cannot completely specify the rights and obligations of the parties. We therefore expected that private ownership of the assets would positively influence efficiency.

Operation/management

Private participation in waste collection service involves the allocation of responsibilities for operations/management of the service delivery. The two prevalent options include a) a situation where the LG shares operational responsibilities with the private operator, for instance the private operator cleans the streets, collects and loads waste and the LG transports to the dumping site and/or vice versa. On the other hand, b) the private operator could be responsible for all the operational activities that is collection and transportation. The former arrangement could create inefficiency especially where one of the parties does not play their part. Hence whether the operational responsibilities' are shared or not is a vital aspect in the waste collection service and could influence efficiency.

Duration of contracts

Determining contract length involves a balancing act between the desirability of periodic competition to ensure cost-containment and the need to ensure adequate contract length to permit capital-cost recovery (Scarlett 1996). It could be argued that in a well developed market in which considerable competition and private sector involvement is prevalent, the issue of duration of contract is less important. This is because the private firm can easily dispose of the collection trucks and equipment to other firms if the contract is not renewed. But in the case of Uganda, where private involvement in waste collection was a new phenomenon, duration of contract is an important issue. It is argued that contracts should be short in order to increase the opportunity for competition. Short-term contracts are said to be sufficient to attract qualified bidders and to maximize the benefits of competitive contracting by going out to bid as often as possible. However, contracts of short duration may deter competition during the bidding process if private firms calculate that they will be unable to recoup equipment investment costs. Short-term contracts could reduce the level of competition and increase the cost of service to the public client for two primary reasons: the high cost of modern refuse trucks and other equipment; and the smaller number of potential bidders for short-term contracts. The cost of waste trucks requires a large financial commitment and the high cost of equipment makes it practically impossible for many qualified contractors to submit a competitive bid on a short-term contract. On the other hand incentives to perform better could be expected when shorter period contracts are given to the private providers considering that they will be expected to compete and secure continuity at shorter intervals. But such incentive is only possible if the LG honours their part of bargain in terms

of timely payments and other contractual obligations. If payments are delayed, the motivation for efficiency is negatively affected since the private providers will just be looking to see out their contract. The longer the duration of contracts the more likely private operators are to invest in appropriate (cost-saving) equipment as time allows for the depreciation of their capital expenditures. Hence the length of contract is likely to influence efficiency.

House to House (HtH) collection

Two alternative methods of waste collection favoured were the HtH and Central Collection Center (CCC). The HtH was mainly preferred by the private providers because payment of collection fees was made directly to the providers by the public clients and besides it targeted affluent areas within the ULG hence there were no hassles of delayed and/or non payment of fees, however as earlier noted, not all ULG had introduced the HtH method. We expected HtH to have a positive influence on efficiency since presence of HtH could reduce the operational workload that is, where it was absent, a larger proportion of the waste would be taken to the collection center increasing the workload of CCC service provider.

Explanatory Variables Specific to Water Supply Services

Sources of Water

The water delivery cost and technology is linked to the source of water (Bhattacharyya et al., 1995). In some cases, especially in mountain areas, water delivery cost from high altitude sources is low and little maintenance is required. On the other hand, groundwater requires not only require lumpy investments to pump out water and carry it to any destination but also requires frequent maintenance (Battacharyya et al 1995). Underground water sources generally require greater pumping costs, but above ground water sources will require greater treatment costs. Just over 15% of the total surface area of Uganda is covered by open water and there is an annual water supply of 66 Km3 in the form of rain and inflows. The open water sources are mainly in the form of rivers and lakes. Despite Uganda's significant water resources, their spatial and temporal variability often renders many parts of the country water stressed over long periods of the year. Groundwater is the major source of water supply in the rural, semi-arid and arid areas in Uganda. There has been an increase in groundwater development for town water supply since early 1990s due to the need to have water supply systems that can

easily be operated and managed by the users. In addition, groundwater normally has good quality and requires little or no treatment unlike surface water. The potential of groundwater in various areas of the country is exhibited by presence of deep boreholes, shallow wells and springs. Therefore, it is hypothesized that the utilities depending more on surface water will be having higher technical efficiency.

Network Length

Technical efficiency of a water utility may depend on the size of its operation and available resources. Length of distribution network can be used as a measure of size of operation (Bhattacharyya et al., 1995). Network length also determines operating costs of a utility. Utilities having larger network are supposed to bear higher operating costs and depreciations. UFW are supposed to be higher for the utilities having larger networks since leakages and energy costs depend on distance for pumping (Lin and Berg, 2008). We consider using network length as an explanatory variable with the hypothesis that the level of efficiency would be lower in the utilities having larger distribution networks.

PRESENTATION OF THE EFFICIENCY SCORES

Using DEA formulation in LP equation 1, the descriptive statistics of the results according to Modality of Service Provision are in table below

Descriptive Statistics – Modality of Service Data

Statistic	Waste Collection		Water Supply	
	Public	Private	Public	Private
Mean	84	78	85	80
Standard Dev	22	22	18	19
Maximum	100	100	100	100
Minimum	41	43	50	52
No. of Effic LGs	6	6	8	6
Percentage of Effic LGs	55%	35%	50%	38%
No. of LGs above Mean	6	10	9	8
Percentage of LGs above Mean	64%	59%	56%	50%
Total Number of LGs	11	17	16	16

Waste Collection Service

Efficiency results for modality of service provision are presented in Table…. Comparing the two categories, we note that the average

efficiency score achieved by the LGs using public service delivery is higher than that achieved by those utilizing private providers at 84% and 78% respectively. We also observe that 55% of the of the LGs using public service delivery were at the efficient frontier compared to only 35% of the LGs using private firms. Furthermore 64% of the LGs using public service delivery were above their group's average compared to only 59% for those utilizing private service providers. The descriptive statistics generally showed a better performance by the LG using public sector means.

Water Supply Service

Efficiency results for modality of service provision are presented in Table …Comparing the two categories, we note that the average group efficiency score achieved by the LGs using public service delivery is slightly higher than that of LGs utilizing private providers at 85% and 80% respectively. We also observe that 50% of the of the LGs using public service delivery were at their group's efficient frontier compared to only 44% of the LGs using private firms. Furthermore 56% of the LGs using public means were above their individual group's average efficiency compared to only 50% of the LGs using private means. Hence for all individual group's assessment parameters, the public mode of service delivery was more efficient than the private mode of service delivery.

Results of combined group

Unit name	Scores Based on Combined Original Data	
Descriptive Statistic	**Waste Collection**	**Water Supply**
Mean	76%	72%
Standard Dev	23%	22%
Maximum	100%	100
Minimum	39%	34%
No. of Effic LGs	9	8
Percentage of Effic LGs	32%	25%
No. of LGs above Mean	16	17
Percentage of LGs above Mean	57%	53%
Total Number of LGs	28	32
Percentage Municipals above Mean	58%	44%
Percentage Towns above Mean	56%	50%

Percentage Public above Mean	64%	19%
Percentage Private above Mean	53%	31%

Waste Collection Service

The descriptive statistics reflected in Table… show an overall mean efficiency of 76%. Thus, on average, if the waste collection service operations had followed those of the 9 benchmarks identified, all else being equal, current production levels could have been achieved with a 24% mean reduction of resources utilized, that is, technical inefficiency accounts for 24%. Furthermore, 57% of the LGs are above the average efficiency score of 76%. The average TE score among the inefficient LGs was 64%, which means that these LGs could, on average, produce their current levels of output with 36% less OPEX than they were currently using based upon the observable best practice.

Water Supply Service

The results from the analysis combining all LGs in one group irrespective of modality of service provision imply considerable variation in the water supply productive efficiency of LGs. As shown by the distribution of efficiency scores presented in Table…we observe that 25% of the LGs were technically efficient since they had a relative efficiency score of 100%. The remaining 75% were identified as potentially under-performing to some extent compared to the 8 best practice benchmarks. The descriptive statistics show an overall mean efficiency of 72%. Thus, on average, if the water supply service operations had followed those of the 8 benchmarks identified, all else being equal, current production levels could have been achieved with a 28% mean reduction of resources utilized, that is, technical inefficiency accounts for 29%. Furthermore, 53% of the LGs were above the average efficiency score of 72%.

EXPLAINING THE RESULTS USING SIMPLE AVERAGES

Waste Collection Service

We sought to explain efficiency levels by analyzing *modality of service, the administrative level, Ownership of assets, sharing operational responsibility and duration of contracts* via simple averages; that is whether using public or private means to deliver waste collection service

had an effect on efficiency; whether being a town or municipal council influenced efficiency; whether who owned the trucks, equipments that were being used in the waste collection service influenced efficiency. Whether the sharing of responsibilities between the private and the public partners in delivering the service had an influence on efficiency; and whether the duration of contract had an effect on efficiency levels. We summarize the analysis in the table below:

	Total Number	Average Efficiency (%)	Percentage of Efficient LGs (%)	Percentage of LG above mean efficient score (%)
Modality of service provision				
Private	17	78	24	53
Public	11	84	45	64
Administrative set-up				
Town	16	74	25	42
Municipal	12	92	56	58
Ownership of Assets				
Private	6		33	67
Public	11		36	55
Operational Responsibilities				
Shared	14		43	57
Not shared	3		0	67
Duration of contract				
One year and above	12		**42**	**58**
Less than one year	5		**20**	**40**
House to house service				
Available	8		**63**	**75**
Not available	9		**11**	**44**

Water Supply Service

It is interesting to note that, when assessed within the combined group, 31% of LGs using private means were found to be efficient while only 19% of in-house were efficient. 50% of LGs using private service had an efficient score above the average while only 44% of LGs using public means were above average implying a slightly better performance from the LGs using private provision. It is also worthwhile mentioning that the water sector unlike the waste collection service had a relevant policy framework guiding private involvement and there was a deliberate effort

to develop private sector firms through enhancing there capacity in operation and management of water supply services.

With respect to sources of water, 45% of LGs using ground water were efficient compared to 40% of those using surface water. 64% of ground posted efficiency levels above the average while only 40% for the surface.

Summary

From the simple averages we observe that whereas LGs using public provision in the waste collection were more efficient there counterparts in the water supply were less efficient. The better performance of the private operators in the water sector could be attributed to the regulatory and supervisory conditions in that sector that support enhancement of private provision. In terms of other variables, presence of HtH services has a larger effect on efficiency in the waste collection service.

EXPLAINING THE EFFICIENCY RESULTS USING BROCKETT AND GALONY (1996)

After adjusting the inefficient LGs in the different groups to their input – output resources' level if they were efficient and running DEA on the pooled data (to be consistent with Brockett and Golany). In order to shed some more light on the issue of whether the modality of service provision implies a significant difference in efficiency levels, we performed a Mann-Whitney test with a null hypothesis that there was no difference between the efficiency levels obtained by modality of service provision that is public or private. Significance can be verified by using the computed test statistic (e.g., U) and comparing this statistic to the criterion (i.e., table) value. It is often much easier, however, to use the output file (table below) to verify interpretation of significance:

TEST	Waste Collection
Mann-Whitney Statistics U	80.000
W	233.000
P-Value	.497

There is sufficient information to accept the Null Hypothesis and to declare that there is no significant difference between modality of service

delivery groups in terms efficiency levels. By interpretation of the p (probability) value, it is observed that p = .5, which exceeds the Null Hypothesis declaration that $p <= .05$.

In case of the **Water supply service,** the Mann-Whitney test returned a critical z score for large samples and the asymptotic sign is therefore more appropriate (Corder 2009). Hence results of the test shows that there was a statistically significant difference in the distribution of efficiency levels for LGs using public provision and the ones with private service providers since P <0.05 at 95%.

Test Statistics[b]

	EffScore
Mann-Whitney U	54.000
Wilcoxon W	190.000
Z	-2.944
Asymp. Sig. (2-tailed)	.003
Exact Sig. [2*(1-tailed Sig.)]	.004[a]

a. Not corrected for ties.

b. Grouping Variable: ServiceType

Summary

This test also found a significant difference in the efficiency distribution levels for LGs using public provision and the ones using private provision in the water supply service although none was observed in the waste collection service perhaps due to the difference in the level of development in the private provision outlook.

EXPLAINING THE EFFICIENCY RESULTS USING TOBIT REGRESSION

Waste collection

The vector of explanatory variables considered in our regression included dummy variables for modality of service provision $LG = 1$, if private service provision and $LG = 0$, if not; for the administrative level $LG = 1$ if Town Council, LG = 0 if Municipal Council) and selected private sector involvement characteristics; $LG = 1$ if ownership of assets used is private and $LG = 0$ if not; $LG = 1$ if operations are shared and $LG = 0$ if not shared; duration of contract LG = 1 if less than one year, $LG = 0$ if not and LG = 1 if house to house (HtH) collection is available and

LG = 0 if not available. This may not be an exhaustive set to explain technical inefficiency, however it is enough to test our main assumptions and we believe technical efficiency departure from the frontier can be systematically explained in terms of the above set of variables.

Multicollinearity test

Before using the explanatory variables in tobit regression it is worthwhile to test for Multicollinearity. Multicollinearity is a problem with being able to separate the effects of two (or more) variables on an outcome variable. If two variables are significantly alike, it becomes impossible to determine which of the variables accounts for variance in the dependent variable. As a rule of thumb, the problem primarily occurs when *x* variables are more highly correlated with each other than they are with the dependent variable (Lynch 2003). Hence, multicollinearity refers to excessive correlation of the predictor variables. When correlation is excessive (some use the rule of thumb of $r > .90$), standard errors of the *b* and beta coefficients become large, making it difficult or impossible to assess the relative importance and unique role of the predictor variables.

While simple correlations i.e. coefficient correlation tell something about multicollinearity, the preferred method of assessing multicollinearity is to regress each independent on all the other independent variables in the equation (Garson 2009). Inspection of the correlation matrix reveals only bivariate multicollinearity, with the typical criterion being bivariate correlations > .90 (Garson 2009). Note that a corollary is that very high standard errors of *b* coefficients is an indicator of multicollinearity in the data. To assess multivariate multicollinearity, one uses tolerance or Variable Inflation Factor (VIF), which build in the regressing of each independent on all the others. Even when multicollinearity is present, note that estimates of the importance of other variables in the equation (variables which are not collinear with others) are not affected.

The SPSS output for both tolerance and VIF is presented in the table below:

Coefficients[a]

Model 1	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF

(Constant)	57.270	24.865			2.303	.032	
ServiceType	-1.528	19.802	-.033	-.077	.939	.211	4.748
AdminLevel	5.004	10.593	.110	.472	.642	.717	1.395
AssetOwnshp	6.421	15.970	.139	.402	.692	.324	3.088
SharedRespo	2.907	19.521	.065	.149	.883	.207	4.836
ContrDuratn	1.583	11.205	.052	.141	.889	.288	3.471
HtH	18.612	10.164	.414	1.831	.081	.763	1.311

a. Dependent Variable: EffiScore

In terms of tolerance, when interpreting results it is imperative to note that the higher the intercorrelation of the independents, the more the tolerance will approach zero and as a rule of thumb, if tolerance is <.20, a problem with multicollinearity is indicated (Garson 2009). VIF is the variance inflation factor, which is simply the reciprocal of tolerance. Therefore, when VIF is high there is high multicollinearity and instability of the *b* and beta coefficients. VIF >= 4 is an arbitrary but common cut-off criterion for deciding when a given independent variable displays "too much" multicollinearity: values above 4 suggest a multicollinearity problem. Some researchers use the more lenient cutoff of 5.0 or even 10.0 to signal when multicollinearity is a problem (Garson 2009).

There are several ways for dealing with multicollinearity when it is a problem (Lynch 2003). The first, and most obvious, solution is to eliminate some variables from the model. If two variables are highly collinear, then it means they contain highly redundant information. Another solution is to transform one of the offending *x* variables. As noted earlier, multicollinearity becomes particularly problematic when two *x* variables have a stronger relationship with each other than they have with the dependent variable. Ideally, if we want to model the relationship between each *x* and *y*, we would like to see a strong relationship between the *x* variables and *y*. Transforming one or both *x* variables may yield a better relationship to *y*, and at the same time, it will eliminate the collinearity problem. A final approach to remedying multicollinearity is to conduct 'ridge regression.' Ridge regression involves transforming all variables in the model and adding a biasing constant to the new (XTX) matrix before solving the equation system for *b*.

We opted to drop the variable with the highest VIF if multicollinearity is indicated. From the table it is clear that ServiceType and SharedRespo exhibit some multicollinearity since their VIF >4 the cut-off point; hence

it was advisable that they are not used in same model; SharedRespo. However we observe that the changes in tobit regression results did not warrant change in conclusions considering that results a not substantially different. It is important to note that the dependent variable in our tobit model is the DEA efficiency score. Hence a positive coefficient implied an efficiency increase whereas a negative coefficient meant an association with an efficiency decline. The results of the regression are significant at 95% level and therefore a coefficient is interpreted significant at $t > 1.96$. The computations were conducted by Stata 8.

```
Tobit estimates                         Number of obs   =       28

------------------------------------------------------------------------
      score |     Coef.         Std. Err.     t       P>|t|
------------+-----------------------------------------------------------
 ServiceType |   -5.974683      21.11343     -0.28    0.780
  AdminLevel |    7.129628      13.33387      0.53    0.598
  AssetOwnshp |   8.760615      16.04383      0.55    0.590
  ContrDuratn |  -1.699134      13.46438     -0.13    0.901
        HtH |    30.9783        13.03245      2.38    0.026
       _cons |   63.41567       27.97516      2.27    0.033
------------+-----------------------------------------------------------
        _se |    27.65812        4.821737         (Ancillary parameter)
------------------------------------------------------------------------

 Obs. summary:     19    uncensored observations
                    9 right-censored observations at score>=100
```

The results from the tobit estimation showed that only *HtH* had a statistically significant positive effect on efficiency; implying that the presence of *HtH* services in a LG was vital in achieving higher levels of efficiency. The results further showed that variables *modality of service* and *administration level setup* had no significant effect on efficiency; manifesting that these variables did not affect the attainment of higher efficiency in significant way. Nonetheless the negative coefficient on the *modality of service* binary variable could imply that it worsened efficiency. This could be expected in the context of Uganda where the services were transferred to inexperienced and financially weak private providers. We also noted that none of the three dummy variables representing the public private partnership characteristics was statistically significant.

Water Supply Services

The vector of explanatory variables considered in our regression included *modality of service provision* (LG = 1, if Private Service provision and LG = 0 if not; *source of water* (LG = 1 if Ground and LG = 0 if not and pipe network length as a continuous variable. We could not use administrative setup as a variable due to co-linearity constraints. We also considered using other variables that define private sector involvement characteristics including *ownership of assets, shared operations* and *duration of contract*, but all these were similar and standard for all the LGs using private provision. Hence the three variables selected may not be an exhaustive set to explain technical inefficiency, however it is enough to test our main assumptions and we believe technical efficiency departure from the frontier can be systematically explained in terms of the above set of variables. The efficiency results using Tobit Regression were as below:

```
Tobit estimates                    Number of obs   =      32
--------------------------------------------------------------------
    EffScore |     Coef.        Std. Err.         t        P>|t|
-------------+------------------------------------------------------
 ServiceType |   22.04243      18.68378        1.18       0.248
 WaterSource |  -10.58013      12.49387       -0.85       0.404
 PipeNetwork |   .1769059       .194615        0.91       0.371
       _cons |   58.80601      21.76373        2.70       0.011
-------------+------------------------------------------------------
        _se |   26.50397       4.098376      (Ancillary parameter)
--------------------------------------------------------------------

 Obs. summary:      24    uncensored observations
                     8 right-censored observations at EffScore>=100
```

The results from the tobit estimation show that none of the explanatory variables has a significant effect on efficiency. However two had positive coefficients an indication of positive influence on efficiency, which confirmed our expectations. Modality of service provision had a positive coefficient probably because of the efforts being done to enhance private firms.

CONCLUSION REMARKS

We sought to establish the extent to which private providers are comparable to the public providers in achieving higher efficiency levels in public service provision. Accordingly we established from the more robust tobit regression results that contrary to theory, private involvement in local service delivery does not imply the attainment of higher levels of efficiency; perhaps owing to, in the context of a

developing country like Uganda, the absence of strong public and private institutions and an enabling environment reminiscent of conditions that make markets work. However, based on simple averages, we determine that local governments utilizing the private operators in the water supply service posted slightly better efficiency levels, whereas the same did not occur with the waste collection service. The slight better performance can be attributed to the deliberate effort made by government to enhance the capacity of both the public sector and private operators in the water sector to appreciate their changed roles. With respect to policy enhancement, public procurement practitioners must establish prevalence of conditions that favour private provision before transferring a service to the private sector; otherwise the anticipated solution to the problem ends up creating a much bigger problem!

Bibliography

Afonso, A., Fernandes, S., 2006. Measuring local government spending efficiency: evidence for the Lisbon region. Regional Studies 40 (1), 39–53.

Afonso, A., Fernandes, S., (2007) Assessing and explaining the relative efficiency of local government, The Journal of Socio-Economics doi:10.1016/j.socec.2007.03.007

Ahadzi M, Bowles G, (2004) "Public-Private Partnerships and contract negotiations: an empirical study", Construction Management and Economics 22, 967-978.

Alchian, A.A. (1965), "Some economics of property rights", Il Politico 30, 4, 816-829

Alchian, A.A. and Demsetz, H. (1972), "Production, information costs, and economic organisation, American Economic Review 62, 777-795

Ancarani, A, (2003), The Impact of Public Firms Commercialization on Purchasing Management, Journal Public Procurement, Volume 3, Issue 3, 357-369

Awortwi, N, (2004) "Getting the Fundamentals Wrong: Woes of Public Private Partnerships in Solid Waste Collection in Three Ghanaian Cities", John Wiley and Sons.

Balaguer Balaguer-Coll, M, Prior-Jimenez, D. and Vela-Bargues, J., 2002. Efficiency and Quality in Local Government Management. The Case of Spanish Local Authorities, Universitat Autonoma de Barcelona, WP 2002/2.

Banker, R. (1992) Selection of efficiency and evaluation models, Contemporary Accounting Research, 9, 343–355.

Banker, R.D. Charnes, A., & Cooper, W.W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science, 30(9)*, 1078–1092.Farrell (1957)

Bing L, Akintoye A, Edwards P.J, Hardcastle C, (2005) "The Allocation of risk in PPP/PFI construction projects in the UK", International Journal of Project Management 23 25-35.

Bosch et al 2001, The efficiency of refuse collection services in Spanish municipalities: do non-controllable variables matter? Institut d'Economia de Barcelona

Bouckaert, G., 1992. Productivity analysis in the pubic sector: the case of fire service. International Review of Administrative Sciences 58 (2), 175–200.

Boycko, M, Shleifer A, And Vishny R (1996) 'A theory of privatisation', *The Economic Journal*, 106(March), pp. 309-19.

Brockett, P.L. & Golany, B. (1996) Using rank statistics for determining programmatic efficiency differences in data envelopment analysis, Management Science, 42, 466–472.

Burgat, P., Jeanrenaud, C., 1994. Technical efficiency and institutional variables. Swiss Journal of Economics and Statistics 130 (4), 709–717.

Charnes, A., Cooper, W., Rhodes, E., 1978. Measuring the efficiency of decision making units. European Journal of Operational Research 2 (6), 429–444.

Coelli et al (2005) Performance Measurement in the Australian Water Supply Industry, Centre for Efficiency and Productivity Analysis, School of Economics - University of Queensland

Davis, M., Hayes, K., 1993. The demand for good government. Review of Economics and Statistics 75, 148– 152.

De Borger, B., Kerstens, K., 1996, Cost efficiency of Belgian local governments: a comparative analysis of FDH, DEA, and econometric approaches. Regional Science and Urban Economics 26, 145–170.

Dumba-Ssentamu et al 2001, The Privatization Process and its Impact on Society, Makerere University Institute of Economics.

Estache A, (2002) Sector Organization, Governance, And The Inefficiency Of African Water Utilities, World Bank Policy Research Working Paper 2890, September 2002

Farlam, P, (2005), "Assessing Public-Private Partnerships in Africa", SAIIA, ISBN: 1-919969-17-9.

Farrell, M., 1957. The measurement of productive efficiency. Journal of the Royal Statistical Society Series A (General) 120 (3), 253–281.

Finbar, B and Allen, B (2001), "Value for Money in PPP: Myth and Reality", Administration 29(1): 46-58

Galagedera, D. U., and Silvapulle, P., Experimental evidence on robustness of data envelopment analysis. *J. Oper. Res. Soc.* 54:654, 2003.

Garcia-Sanchez (2006) Efficiency Measurement in Spanish Local Government: The Case of Municipal Water Services Review of Policy Research, Volume 23, Number 2 (2006)

Garcia-Sanchez (2008), The performance of Spanish solid waste collection, Waste Management Research 2008; 26; 327

Garvin, D. A. (1988). Managing quality. – New York: Free Press

Grimsey D, and Lewis M. K, (2004), "The Governance of Contractual Relationships in Public-Private Partnerships," GreenLeaf Publishing.

Grimsey D, and Lewis M.K, (2002) "Evaluating the risks of public private partnerships for infrastructure projects," International Journal of Project Management 20 107-118.

Grout P, (2003) "Public and Private Sector Discount Rates in Public-Private Partnerships," The Economic Journal, 113 C62-C68.

Harris, C, (2003) "Private Participation in Infrastructure in Developing Countries: Trends, Impacts, and Policy Lessons", IBRD/WB

Henderson, J, and McGloin (2004), "North/South Infrastructure Development via Cross-border PPP Mechanism", International Journal of Public Sector Management, Vol. 17 No. 5, 2004, PP 389 – 413

Institute of Public Private Partnerships (IP3) (2000), "Contract compliance and performance monitoring for public-private partnership projects", Training Workshop, Washington DC.

International Monetary Fund (IMF), "Public Private Partnerships" March 2004

Jamali, D, (2004), "A Public Private Partnership in the Lebanese Telecommunications Industry: Critical Success Factors and Policy Lessons", Public Works and Management, Vol. 9 No. 2, Sage Publications.

Karanja, A, M, (2003) "Informal Privatization of Garbage Collection and Disposal Services in Nairobi: - Socio-Economic Contributions", Conference Paper - Darussalam.

Kirjavainen, T. and Loikkanen, H.A. (1998), "Efficiency differences of Finnish senior secondary schools: an application of DEA and Tobit analysis, *Economics of Education Review* 17, 4, 377-94.

Kirkpatrick C and Parker D (2003), Privatization In Developing Countries: A Review Of The Evidence And The Policy Lessons, Centre on Regulation and Competition, Institute for Development Policy and Management, University of Manchester, ISBN: 1-904056-

Kirkpatrick C, Parker D, and Zhang Y (2006), An Empirical Analysis of State and Private-Sector Provision of Water Services in Africa, THE WORLD BANK ECONOMIC REVIEW VOL. 20, NO. 1, pp. 143–163

Kirkpatrick, C, Parker, D, and Zhang, Y, (2004), "State versus Private Sector Provision of Water Services in Africa: Emperical Analysis", Working Paper Series, University of Manchester.

Kontodimopoulos, N, et al (2006), Investigating Sources of Inefficiency in Residential Mental Health Facilities, J Med Syst (2006) 30:169–176

Kumar et al 2004, Public - private partnerships in urban infrastructure, Kerala Calling

Kuttner, R, (1997), "Everything for sale: The virtues and limits of Markets", Knopf, New York, NY

Lambert, D. K et al (1993); Ownership and Sources of Inefficiency in the Provision of Water Services. Water Resources Research, Vol. 29 (6), pp. 1573-1578

Loikkanen, H., Susiluoto, I., 2005. Cost efficiency of Finnish municipalities in basic service provision 1994–2002. Mimeo.

McFetridge, D, (1997), "The Economics of Privatization", C.D. Howe Institute, Toronto.

Miraftab F, Public-Private Partnerships: The Trojan Horse of Neoliberal Development? Journal of Planning Education and Research 2004; 24; 89

Ministry of Local Government Uganda, 2004, http://www.molg.go.ug

Moore, A, Nolan, J & Segal, G.F, (2005), Putting Out The Trash Measuring Municipal Service Efficiency Urban Affairs Review, Vol. 41, No. 2, November 2005 237-259 2005 Sage Publications

Mugisha S, (2007), Effects Of Incentive Applications On Technical Efficiencies: Empirical evidence from Ugandan water utilities, Utilities Policy 15 (2007) 225-233

Mustafa, A, (1999) "Public-Private Partnership: An Alternative Institutional Model for Implementing the Private Finance Initiative in the Provision of Transport Infrastructure," Journal of Project Finance Vol. 5, Issue 2.

Niskanen, W.A. (1971), Bureaucracy and Representative Government, Aldine, Chicago

Nordtveit, H,D, (2005) "The Role of Civil Society Organizations in Developing Countries: A Case Study Of Public-Private Partnerships in Senegal", PhD Dissertation, University of Maryland.

Osborne, P. (2000), "Public Private Partnerships Theory and practice in International Perspective", Routledge, London.

Pedraja-Chaparro, F., Salinas-Jimenez, J., Smith, P., On the quality of the data envelopment analysis model. *J. Oper. Res. Soc*. 50:636, 1999.

Pessoa, (2006), Public-Private Sector Partnerhsips in Developing Countries: Prospects, and Drawbacks, University de Porto

Pongsiri, N, (2002) "Regulation and Public Private Partnerships", International Journal of Public Sector Management, Vol. 15, No. 6, 487-495.

Prieto, A., Zofio, J., 2001. Evaluating effectiveness in public provision of infrastructure and equipment: the case of Spanish municipalities. Journal of Productivity Analysis 15 (1), 41–58.

Regan, M, (2005) "Public Private Partnerships: Do they Add Value to Infrastructure Procurement?" Melbourne Univeristy.

Rondinelli, D.A., (2004) "Partnering for Development: Government-Private Sector Cooperation in Service Provision", at http://unpan1.un.org/intradoc/groups/public

Ruggiero, J., A new approach for technical efficiency estimation in multiple output production. *Eur. J. Oper. Res.* 111:369, 1998.

Rwelamira, P.D, (2004) "Enhancing Development in Africa: Public-Private Partnerships", Pressgroup Holdings Europe S.A., Valencia Spain.

Savas, E, (2000) "Privatization and Public Private Partnerships" New York: Seven Bridges Press.

Shleifer, A, and Vishny R. W (1994) 'Politicians and firms', *The Quarterly Journal of Economics*, 109(4), pp. 995-1025.

Smith, P., Model misspecification in data envelopment analysis. *Ann. Oper. Res*. 73:233, 1997.

Spackman, M, (2002) "Public-Private Partnerships: Lessons from the British Approach," Economic Systems 26, 283-301.

Thanassoulis E, (2000), The use of data envelopment analysis in the regulation of UK water utilities: Water distribution, European Journal of Operational Research 126 (2000) 436-453

United Nations Centre for Human Settlements (UNCHS) Habitat, (2000) "Privatization of Municipal Services in East Africa",

Vitaliano, F.D., (1998), "Assessing Public Library Efficiency Using Data Envelopment Analysis", Annuals of Public and Cooperative Economics, 69:1

Warner, M. E and Bel, G, (2008), Competition Or Monopoly? Comparing Privatization Of Local Public Services In The Us And Spain, Public Administration Vol. 86, No. 3, 2008 (723–735), Blackwell Publishing Ltd

Worthington, A., Dollery, B., 2000.Anempirical survey of frontier efficiency measurement techniques in local government. Local Government Studies 26 (2), 23–52.

Worthington, Andrew and Dollery, Brian (2001) Measuring Efficiency in Local Government: An Analysis of New South Wales Municipalities' Domestic Waste Management Function. *Policy Studies Journal* 29(2):pp. 232-250