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A Multilevel Approach to Measuring Revenue Collection Efficiency in Local Governments.

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Abstract

Urban local governments of Zimbabwe are owed billions of dollars by citizens. This inability, by the local authorities, to collect revenue from citizens has resulted in poor service delivery. This research, measures the efficiency levels of urban local governments of Zimbabwe in collecting revenue from given sources using four frontier models. The main objective of the research is to establish the efficiency levels of urban local authorities of Zimbabwe using a proposed multilevel stochastic frontier. Tied data with two levels, the source and the municipality, is collected from a sample of urban local authorities. The data is analysed and the results show that the proposed multilevel model generates efficiency levels that are significantly higher than those of any of the other three models.

Key Words: multilevel, frontier, tied data, efficiency.

Background

Local governments, a derivative of the state government, elected independent of the state, government, composed of qualified persons and made up of people resident to the area of operation, (Gomme, 1987), are supposed to collect revenue from various sources at their disposal for use in service provision. In Zimbabwe, these local councils, especially in urban areas, have suffered significantly for more than two decades. Citizens go for weeks, sometimes for months, without water, a basic commodity. Roads are in a state of shame, and when you walk along the streets you see piles of garbage almost everywhere and in every town. The authorities do not have enough money to provide the obliged services yet they are owed billions of dollars by the residents.

Although there are several factors, that include shortage of foreign currency, rapid population growth, low revenue bases, among others, contributing to this service delivery problem, it is revenue collection that looks to be the main challenge. The efficiency of local authorities in revenue collection has never been properly modelled. Researches like that by (Adenya & Muturi, 2017), have titles that suggest efficiency modelling in these local authorities but it is

simple revenue collection that they discuss. Efficiency estimation techniques, parametric or non-parametric, are still to find their way into the field of revenue collection.

Not only does this research introduce frontier estimation in revenue collection for local authorities, the research also makes use of a newly proposed multilevel stochastic frontier model in doing so. Local governments data is multilevel. The conventional Stochastic Frontier Model by Aigner et al. (1977) neglects the hierarchical structure of data, (Siciliani, 2006). The use of the single-level Stochastic Frontier Model on multilevel data in very recent researches like (Kongolo, 2021) and (Chandel et al., 2022) provides supporting evidence that there is, still, novelty in the development and use of a Multilevel Stochastic Frontier Model.

The next sections of the paper are as follows: Section 2 reviews the literature on revenue collection and its sources in urban local governments. Section 3 reviews the factors affecting revenue collection in local governments. Section 4 reviews literature on modelling revenue collection in local governments. Section 5 looks at revenue collection efficiency estimation in local governments. Section 6 presents the methodology of this research, with section 7 providing the analysis of the data and section 8 concluding.

1. Revenue Collection and its Sources in Urban Local Governments

Revenue collection is a field that has given a lot of challenges in local governments, (Balunywa et al., 2014). Echoing this view is (Fjeldstad, 2005) who argues that revenue collection is inefficient in African states as large amounts of revenue remain uncollected. The researcher goes further to point out that the collected revenue is also inappropriately managed, suggesting that indeed, revenue collection is an issue of concern for local authorities, particularly in African countries. It is the purpose of this section to identify and discuss some of the sources of revenue for local governments.

Sources of revenue in Zimbabwe municipalities include sale of stands (housing and industrial), rates, water, shop licences, bus entry, supplementary charges, refuse removal, graveyards, hall hire, roads, street lighting, fire charges and inspection fees, (Zivanai et al., 2014). Brief descriptions of some of these sources follow.

“A property tax is a recurrent tax imposed by a government on the ownership and/or occupation of property”, (Monkam, 2011). The author goes on to classify property as immovable or movable. Among the immovable property are buildings and land. This is also called real

property. Vehicles and livestock are examples of movable property. Property can also be categorised as tangible property or intangible, with all property mentioned above being tangible, and shares and rights being examples of intangible property.

Under normal circumstances, the government and urban councils are the principal land allocators in towns and cities in Zimbabwe. Cases of corruption and mismanagement of funds has been on the rise since 2000, (Newsday, 6th of September 2012) and (Zivanai et al., 2014) and the normal channels of issuing stands have been derailed. Amendments have been made to the Urban Councils Act (29,15) and these amendments include the re-introduction of the ceremonial mayors in place of executive ones and the appointment of special interests councillors, (Muchadenyika, 2015). The researcher clearly points out that these ceremonial mayors as well as the special interests councillors were appointed by the Minister of Local Government, Public Works and National Housing. Following all these anomalies, urban municipalities of Zimbabwe go broke to the extent of going for months without paying their employees. As a way of solving this problem, these municipalities often end up giving land to their employees, as payment for their services. This clearly leads to a reduction in the quantity of revenue that the local authorities receive from land sales as a source of revenue.

Roads are another source of revenue for urban local authorities. Every local authority has roads that are in its jurisdiction. The local authority has the responsibility of maintaining these roads and receive user charges from people who use these roads.

Income generating projects are another source of revenue for local authorities, Zimbabwe Urban Councils Act [Chapter 29: 13]. Some urban local authorities operate liquor-selling bars while others have schools under them and hence receive fees from these schools. Even with all these sources, for Zimbabwe, the income generated from them has proved to be insufficient for the efficient provision of obliged services. Grants from the central government, donor-funds and loans from banks and building societies often act as supplementary revenue sources, (Zhou & Chilunjika, 2013).

Regardless of all this, services like water-provision and refuse-collection, for example, often go undelivered for weeks in most urban centres, supporting the point by (Fjeldstad, 2005) that the realised revenue is often mismanaged. To evidence the claim by (Fjeldstad, 2005) that the collected revenue is mismanaged, the 6th of September 2012 Newsday, a newspaper, reported the dismissal of seven Chipinge Town Council officials and Gokwe Town Secretary by the Minister of Local Government, after being found guilty of revenue mismanagement. This is

echoed by (Zivanai et al., 2014) who noted the filing of corruption charges against some members of municipality staff between 2009 and 2012 in Zimbabwe. Low wages are cited as one of the causes of corruption (Prud'homme, 1992).

User fees are charges that are paid to local authorities by residents for the services provided to the latter by the former, (Slack, 2009). These fees are either, service fees, for example, fees paid for getting a marriage certificate or public prices, for example, revenue from the sale of private property. Most countries of the world have user fees on water, health, education and electricity, (Zhou & Chilunjika, 2013)

Water is another source of revenue for urban councils. All urban municipalities are mandated to supply water to the residents of the cities and towns. The residents, in return, pay user charges for the water.

The services that urban municipalities are supposed to deliver include the provision of education facilities for residents. In addition to supporting education through water delivery, refuse collection and providing many other services in all schools, most cities, towns and municipalities own libraries and schools. These facilities are a source of revenue as residents pay for using them.

Health, like education and water, is a socio-economic service that should be delivered by local authorities in urban settings. Local authorities take health not as an expense but as a revenue generating source. In low-income countries, user charges appear to be the only additional revenue source for the health sector, outside government grants, (Mwabu, 1997). In such countries, the sector is expected to raise significant figures of revenue for service to be efficiently delivered.

Some urban local authorities own property like houses and halls. These building are let to tenants and private organisations for use. In return, the tenants and organisations pay the local authorities for using the facilities.

Business are run in areas that are within jurisdictions of some urban or rural local authorities. The local authorities require that you submit an application for the land for your business. Upon being successful one pays for the land acquired. In addition to paying for the land one pays for the license that permits him or her to do whatever business applied for.

2. Factors Affecting Revenue collection in Local Governments

The delivery of services such as provision of water, refuse collection, maintenance of roads and sewerage systems depend on the availability and proper management of revenue, hence the need to see all the challenges in its collection resolved. Many researchers are thus into this area of revenue collection in local authorities. The researches carried out have been mainly on the identification of the factors that affect revenue collection in local governments. Regression analysis is the modelling technique that has been mainly used by most of these researchers to try and establish to what extent the identified factors influence revenue collection. Although some of these researches have titles that suggest efficiency modelling, for example, (Adenya & Muturi, 2017), it is simple revenue collection that is modelled. Efficiency estimation techniques, parametric or non-parametric, are still to find their way into the field of revenue collection.

The quantity of revenue collected from these sources is governed by factors that include the size of jurisdiction, personnel competence, political interference and level of corruption. Zimbabwe is an example of countries where local governments are owed millions of dollars by citizens, (Newsday, a Zimbabwe independent newspaper of July 6 2012). The causes of this include hyperinflation, staff incompetence and ineffective means of law enforcement. Resource availability is critical for both revenue collection and service delivery, (Heller, 2005). Municipalities get these resources from the revenue they collect. Without adequate resources like vehicles and manpower, for example, huge amounts of revenue are not collected, hence some of the services that the local authorities are supposed to provide go undelivered. Some services, for example, the maintenance of roads, equally affect the paid-up and the unpaid-up citizens. When such services fail to be delivered, the paying citizens may be demotivated and refrain from paying in future.

The exercise of revenue collection in local government authorities (LGAs) has been found to be affected by assets, approved budget as well as the number and qualifications of the personnel of the concerned authority, (ILO, 2010). The urban councils act of Zimbabwe, however, does not say anything regarding the minimum qualifications of a prospective councillor. Because of the inflation and low salaries, skilled and qualified staff are leaving employment choosing to go to neighbouring countries, especially South Africa, where there are better salaries.

Compliance, the citizen's willingness to pay, has been found to affect revenue collection in developing countries. (Kiprotich et al., 2012), argue that Kenya is one of the countries where

compliance to tax remission is still a problem. Law enforcement is another factor that helps ensure that citizens comply. (Adenya & Muturi, 2017) proposed a multiple linear regression model in which revenue, which the researchers chose to call revenue efficiency, was the dependent variable and law enforcement was one of the explanatory variables. These researchers argued that it is necessary to take some kind of recovery measures against defaulters. Tax payers who are not compliant need to be educated so that they view the revenue collected as beneficial to them, (Bahl & Linn, 1992). Giving them reminders before taking punitive measures is one way of educating such citizens.

The relationship between local authorities and tax payers is of fiscal exchange in that one pays and the other provides the services that are paid for, (Levi, 1997). The decision to or not to pay derives from the perception that the local authority will provide the services that are paid for. When these services are undelivered, even the element of coercion that is seen in imposing fines and penalties does not work. A good example is in the attempt by the urban local authorities of Zimbabwe to disconnect defaulters from the water supply system when the municipalities are not supplying the water at all. Such measures do not make sense since they do not inflict any pain to the defaulter. In addition, the defaulter is unlikely to be pushed by such a measure into taking any positive action.

Adenya and Muturi (2017) suggest that fines should be enforced to defaulters by local authorities as this deters tax payers from defaulting in future. The researchers built a multiple linear regression model in which law enforcement was found to be one of the significant explanatory variables. Effective means of law enforcement help mitigate revenue collection challenges in local governments, (Francis and James, 2003). Punishing non-compliant citizens will teach them to be compliant in future, and by the social learning theory (Bandura, 1986), it will teach the compliant that defaulting attracts punishments.

Law enforcement is one of the variables that are key to revenue collection. If residents default and discover that they still receive municipality services and no action is taken against them, they are less likely to make payments in future. Even those who pay may also be tempted not to do so since they will be seeing no difference between them and the non-paying citizens.

Since the collapse of industry in 2000, after the war-veterans-led farm invasion, informal trading has emerged as the main source of income for the majority of citizen in urban centres of Zimbabwe. These informal traders are supposed to register with the local government so that

they are licenced to operate in their respective cities or towns, paying tax to the local authorities. Instead of registering, these informal traders, often called vendors, choose to operate without licences paying less to local government employees and to police officers in the form of bribes.

3. Modelling Revenue collection in Local Governments

Multiple Linear Regression Analysis is the most common modelling technique that is used in modelling revenue collection in local governments. In this regression model, revenue collection is taken as the dependent variable while the various factors that are believed to affect revenue collection, are the independent variables.

A study carried out in Isingiro district, Uganda, by Ndyamuhaki (2013) established that the factors affecting revenue collection in local governments are administrative inefficiencies, lack of general sensitization, political interference and corruption. Most of these factors were identified by several other researchers, some of whom are mentioned in the introduction. The relationship between revenue collection and the listed factors, together with many others not listed by Ndyamuhaki (2013) is often assumed linear.

Recent researches on regression modelling of revenue collection in local governments include (Ataro et al., 2016; Adenya & Muturi, 2017; Ngicuru, 2017; Msenga, 2020). For (Ataro et al, 2016), revenue collection, which they chose to call revenue collection efficiency, was the dependent variable. Revenue collection practices, internal controls, Staff competencies and compliance level were the independent variables. Revenue collection practices was dichotomous, with the values automated systems and non- automated systems. The researchers did not clearly explain what values the other three explanatory variables, which are all qualitative, had. Their regression model was equation (1).

$$Y = \beta_0 + \beta_1 X_I + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \varepsilon \quad (1)$$

where Y is revenue collection efficiency and the x_1, x_2, x_3 and x_4 are respectively revenue collection practices, internal controls, Staff competencies and compliance level. All the four independent variables were found to be significant.

The researchers recommended for the computerization of all revenue collection offices, improvement of the training of staff and that the staff should be innovative create more revenue sources.

Another research that used regression analysis to model revenue collection is that by (Ngicuru et al., 2017). The study aimed at examining the effect of factors affecting revenue collection in Nairobi, Kenya. According to this research, local authorities encounter a lot of challenges in the process of collecting revenue. They cited absence of political backing for enforcement and poor collection methods as some the sources of the challenges. Political instability negatively affects revenue collection efficiency. They recommended that Central governments should, therefore, facilitate for conducive political environments at all levels of governance.

In their regression model, revenue collection was the dependent variable, while revenue diversification, tax administration, tax structure and forms of revenue were the independent variables. The regression model was similar to that by (Ataro et al, 2016). However, they clearly showed that they were modelling revenue collection and not revenue collection efficiency. In addition, the values of the qualitative independent variables were assigned on a clearly defined likert scale.

Parameters of the regression model were estimated using SPSS. All the independent variables were found to be significant. The coefficient of determination was calculated and the independent variables in the model were found to, jointly, explain 77% of the variation in revenue collection.

Multiple linear regression analysis was also used by (Harelimana, 2018). The research intended to establish the effects of tax audit on revenue collection in Rwanda. Tax audit was divided into four components, namely taxpayer's registration, revenue protection system, tax automation and tax revenue. Four simple linear regression models were run, with revenue collection as the dependent variable and the four factors mentioned above as the independent variables. One at a time. Analysis of variance was carried out in each of the four cases and all the four factors were found to be individually significant.

In addition to the regression models fitted, correlation analyses were carried-out. Each of the four factors was found to be significantly correlated to revenue collection. The multiple linear regression model was the last to be considered. The model was found to explain 29.4 percent of the variation in revenue collection. In conclusion, the researcher noted that tax audits are

positively related to revenue collection. It was reported that the more the number of audits done, the more the revenue collected.

4. Revenue collection Efficiency Estimation in Local Governments

Efficiency, the optimal use of resources, measures the extent to which an organization performs the tasks that it is supposed to do using a given bundle of inputs. This study will apply a proposed multilevel stochastic frontier model in the measurement of efficiency of urban local authorities of Zimbabwe in revenue collection.

Although literature is reach with revenue collection articles, nothing has been said so far on the efficiency of the revenue collection process in local authorities. A mention of the term ’efficiency’ by Adenya and Muturi in the title of their (2017) publication tempts one to consider it (the publication) as one on revenue collection efficiency when this is not so. These researchers discussed on factors affecting revenue collection in the county of Kiambu, Kenya. Like (Ataro et al., 2016), they modelled revenue collection under the name ’revenue collection efficiency’. Revenue collection personnel capacity, internal controls, technology and enforcement of laws were the independent variables. Data was collected by means of a questionnaire, and SPSS and Excel were used in the analysis of the collected data. All the explanatory variables in the model were found to be significant. Although the title of the publication by (Adenya & Muturi, 2017) has the term ’efficiency’ in it, what the whole document talks about is not efficiency as such. Their model was just a multiple linear regression equation like that of (Ataro et al., 2016). No efficiency levels where calculated though the title of the document purported efficiency.

Efficiency is known to be estimated by techniques that include stochastic frontier analysis and data envelopment analysis. These models are all beyond the scope of (Adenya & Muturi, 2017), suggesting that their model is not an efficiency estimation one. What the researchers did was simply to find the factors that affect revenue collection and to build the model connecting the factors and the collected revenue as the dependent variable. It is the objective of this research to bring the models of efficiency estimation to revenue collection in local authorities and to apply a proposed model of efficiency estimation to urban local authorities in Zimbabwe. The model will have efficiency as the dependent variable. The independent variables will be identified at two levels, the source level and the local authority level. The model will, therefore, be multilevel. It will differ from (Adenya & Muturi, 2017) in three ways which are:

1. it models revenue collection efficiency and not revenue collection.
2. it is multilevel and not single-level.
3. it has a two-component error term and not the usual idiosyncratic error term.

In most, if not all countries worldwide, there is a decentralization of governance of one form or another. Two most common levels of government are the central and the local governments. Central governments collect taxes and provide services to the citizens at the national level. They (central governments) also provide the service indirectly by making transfers to urban local governments. Local governments, on the other hand, provide services to their residents at local level.

Governments are like businesses in that they provide services to residents while the residents, being the clients, pay for the services. Local governments receive grant transfers from central governments. In addition to the grants, local governments, worldwide, fund themselves through collecting revenue from many sources, that include rates, business licenses, rents land sales and user charges.

In a study in which the main objective was to examine the effect of factors affecting revenue collection in Nairobi, Kenya, (Ngicuru et al., 2017) discovered that, generally, these local authorities encounter a lot of challenges in the process of collecting revenue. They cited absence of political backing for enforcement and poor collection methods as some the sources of the challenges. Political instability negatively affects revenue collection efficiency. They recommended that central governments should, therefore, facilitate for conducive political environments at all levels of governance.

Effective means of law enforcement help mitigate revenue collection challenges in local governments, (Francis & James, 2003). Municipalities have the capacity to terminate service to residents who fail to pay user charges. For example, supply of water may be blocked for households that owe the local authorities. Enforcement of penalties and fines to defaulters ensures that revenue is, in the end, collected from such residents, (Adenya & Muturi, 2017). It is corruption again, which betrays these legal practices.

The exercise of revenue collection in local government authorities (LGAs) has been found to be affected by assets, approved budget as well as the number and qualifications of the personnel of the concerned authority, (ILO, 2010). This means that in order to perform efficiently in

revenue collection, LGAs should employ skilled personnel since the skills and commitment of the employees of LGAs have a considerable effect in revenue collection.

5. Methodology

The survey technique was used in the collection of data. Multistage sampling was used to come up with the sample. At stage 1, seven urban centres were chosen out of a total of thirty-two. Five sources of revenue were randomly chosen from a list of the sources described. The chosen sources were education, health, rent, roads and water. Each of these sources was followed up for three years, 2019, 2020 and 2021. This resulted in a total of one-hundred and five observations. A questionnaire was designed and administered to the chosen urban centres.

In this research, the factors that literature identifies as affecting the efficiency of revenue collection in municipalities are divided into two groups, with some coming from the source and others coming from the municipality level. This makes the data in question multilevel. The sources are nested in municipalities, resulting in the former being level 1 and the latter being level 2 of the dataset. The variables at level 1 that were assumed to affect the efficiency of revenue collected are listed in the table (1) below. Those variables that are not scale had their values measured on a likert scale. The dependent variable here is the amount of collected revenue and is represented by letter Y.

Table 1: Source level (Level 1) variables

X_1	Number of units	X_2	Staff Competence
X_3	Law Enforcement	X_4	Expenditure

Model (2) below, shows the standard stochastic frontier model with the variables described above.

$$\ln(Y_{ijt}) = \beta_0 + \beta_1 X_{1ijt} + \beta_2 X_{2ijt} + \beta_3 X_{3ijt} + \beta_4 X_{4ijt} + v_{it} - u_{it} \quad (2)$$

At municipality level are factors such as the city or town population, number of Employees, number of Councillors and informal traders' participation. Table (2) below, shows the level 2 variables, together with cross-level interactions.

Table 2: Municipality Level (level 2) Variables and Interactions

	Level 2 Variables		Interactions
X_5	Number of Employees	X_9	Expenditure and Population Interaction
X_6	Number of Councillors	X_{10}	Expenditure and Councillors Interaction
X_7	Population	X_{11}	Expenditure and Employees Interaction
X_8	Informal traders' Participation		

Because of the fact that the variables in table (1) and those in table (2) are at different levels, standard linear regression, which has always been used in stochastic frontier estimation, ceases to apply, hence the need for a multilevel stochastic frontier.

Multilevel models, a special case of random coefficients models, are like random coefficients models in general in that they can be random intercept, random slope or random intercept-random slope. In this research, the random slope format is adopted. Expenditure, a source variable, is affected by the population of the town or city, the number of employees and the number of councillors, which are variables at level 2, the municipality. It is expenditure whose coefficient is considered to vary.

The proposed multilevel stochastic frontier has source variables at level 1 and municipality variables at level 2. Repeated measures are used here for purposes of facilitating the construction of individual source frontiers. These MLMs are a system of equations, with one equation at level 1 and one or more equations at other levels. In this research, there is one equation at each of the two levels. At level 1 of the system is equation (3) with the coefficient of $\ln(X6_{ijt})$ depending on cluster (municipality). β_{6j}, the varying coefficient of $\ln(X6_{ijt})$ is modelled in equation (4).

Level 1

$$\ln(Y_{ijt}) = \beta_0 + \beta_1 \ln(X_{1ijt}) + \beta_2 X_{2ijt} + \beta_3 X_{3ijt} + \beta_4 \ln(X_{4ijt}) + \beta_5 X_{5j} + \beta_6 X_{6j} + \beta_7 X_{7j} + \beta_8 X_{8j} + v_{it} - u_{it} \quad (3)$$

Where
$v_{it} \sim N(0, \sigma_v^2)$ and $u_{it} \sim N^+(0, \sigma_v^2)$ $i = 1, 2, 3, \ldots\ldots N$ *and* $t = 1, 2, 3, \ldots\ldots T$.

Level 2

$$\beta_{4j} = \lambda_0 + \lambda_1 \ln(X_{5j}) + \lambda_2 X_{6j} + \lambda_3 X_{7j} + \tau_{0j} \quad (4)$$

The level 2 errors, τ_{0j} are assumed to follow a normal distribution with mean zero and constant variance. Substituting the level 2 equation into level 1 and rearranging gives equation 5.

$$\ln(Y_{ijt}) = \beta_0 + \beta_1 \ln(X_{1ijt}) + \beta_2 X_{2ijt} + \beta_3 X_{3ijt} + [\lambda_0 + \lambda_1 \ln(X_{5j}) + \lambda_2 X_{6j} + \lambda_3 X_{7j} + \tau_{0j}] \ln(X_{4ijt}) + \beta_5 X_{5j} + \beta_6 X_{6j} + \beta_7 X_{7j} + \beta_8 X_{8j} + v_{it} - u_{it} \quad (5)$$

Removing the square brackets and rearranging we have equation (6)

$$\ln(Y_{ijt}) = \beta_0 + \beta_1 \ln(X_{1ijt}) + \beta_2 X_{2ijt} + \beta_3 X_{3ijt} + (\lambda_0 + \tau_{0j}) \ln(X_{4ijt}) + \beta_5 X_{5j} + \beta_6 X_{6j} + \beta_7 X_{7j} + \beta_8 X_{8j} + \lambda_1 \ln(X_{9ij}) + \lambda_2 \ln(X_{10ij}) + \lambda_3 \ln(X_{11ij}) + v_{it} - u_{it} \quad (6)$$

It is equation (6) which was run in Limdep version 11 and the results are discussed in the next section.

6. Results and Discussion

The collected data was analysed using the software Limdep version 11. Table (3) below gives the descriptive statistics of the data. It is clear, from this table, that efficiency levels given by model 4 are significantly larger than the levels of any of the three other models. The proposed model has the highest mean, the highest minimum, the highest maximum and the lowest standard deviation. The implication here is that the models that ignore context tend to take, as a component of inefficiency at the level of analysis, the higher levels error terms as well as inefficiency due to factors at higher levels. Taking explanatory variables from other level increases efficiency levels. With model 4 having interactions, in addition to all the variables in model 3, efficiency levels significantly increased.

Table 3: Descriptive Statistics

	Mean	Std Dev	Min	Max
Model 1 (OLS)	0.125351206	4.17153	0.0002898	0.6706247
Model 2 (RC)	0.125341109	4.17153	0.000013	0.6706181
Model 3 (OLS) disaggregated	0.127847257	4.07466	0.0002785	0.6554676
Model 4 (MLM)	0.96436135	.97881	0.9640732	0.9943289

Table 4 below shows the parameters of all the four models. Three asterisks at the top right-hand corner of the parameter estimate shows that the parameter is significant at the 1% level of significance while two signify significance at the 5% and one implies significance at the 10% level of significance. For all the models, except model 3, the constant term is significant.

Table 4: Coefficients, Standard Errors.

		Variable	Model 1	Model 2	Model 3	Model 4
Coefficients	Fixed	Constant	9.67578***	9.67648***	-0.51655	-26.5283**
		X1	0.06229	0.06231	0.09540	0.04252**
		X2	0.72755**	0.72748**	0.62853*	0.51544***
		X3	0.33994	0.33983	0.24716	0.41630***
		X4	0.34450***		0.26065	
		X5			-1.10620	-11.9126***
		X6			6.14493	-2.24306
		X7			5.29005	10.4015***
		X8			-0.06171	-05101
		X9				-0.41026***
		X10				-0.44266
		X11				0.70659***
	Random	X4		0.34449***		1.72141***

X_1, the number of units, has a positive coefficient for all the four models though it is significant for only model 4. For X_2, staff competence, all the four models agree that this factor affects revenue collection, hence efficiency, positively and significantly. For the first three of the models, this factor is significant at the 1% level while for model 4 the significance is at 1%. The models 1, 2 and 3 agree that law enforcement has a positive effect on revenue collection efficiency although the models also take the effect of this factor to be insignificant.

Cited literature takes staff competence and law enforcement to be some of the significant factors affecting revenue collection. All the four models support the literature that staff competence positively and significantly, affects revenue collection. It is on law enforcement where model 4 differs from the other three. Although all the four models agree on the direction

of the relationship between law enforcement and revenue collection, model 4 takes this factor to be highly significant whereas the other three models, with the same dataset, take the factor to be insignificant. It follows that if we were to consider any of the first three models as our final model then we would consider it without law enforcement, since it is insignificant. For model 4, our final model would have this factor since it is significant. A model that takes as insignificant, factors that are significant cannot be a good model. It is only model four that is in line with literature that staff competence and law enforcement are significant factors in revenue collection. This in itself suggests the strength of model 4 over the other three.

Expenditure, X_4, is the variable that was taken to have random coefficients in models 2 and 4, with the other two models leaving the coefficient fixed. For this variable, all the four models agree on both the direction of its relationship to revenue collection and the significance level. It is positively correlated to revenue collection for all the four models and significant at the 1% level of significance for all the models.

Models 1 and 2 have factors from level 1 only and of these, only two are significant, namely staff competence and expenditure. In addition to these two factors, the constant is also significant. Model 3 has factors from both levels. However, of all these, it is only expenditure which is significant. Model 4, which is the proposed model, has all the 11 variables of which only two, participation of informal traders and the interaction of expenditure and the number of councillors. Though insignificant, this interaction has a negative effect on revenue collection. The other two cross-level interactions are very significant, with the expenditure-population interaction being negatively related to revenue collection and the other being positively related to revenue collection.

Of more interest in this research are the efficiency levels produced by the various frontier models. As a follow-up to table 3 on descriptive statistics is table 5, below, showing the medians of the efficiency levels generated by the four models.

Table 5: Medians of the Models

Model 1 (OLS)	Model 2 (RC)	Model 3 (OLS) aggregated	Model 4 (MLM)
0.0870152	0.0870015	0.0897756	0.9668943

The median efficiency levels shown in table 5 portray the same picture described by table 3. Efficiency levels generated by model 4 are still superior, according to the medians, table 5. It is the multilevel stochastic frontier model that has the highest median.

A surprising feature for this dataset here is that of the number of employees, X_5 which is negatively related to revenue collection for both models, 3 and 4. Though insignificant for model 3, the coefficient of this variable is very significant for the proposed model. This result may imply that municipalities are employing more people than necessary some of whom may end up engaging in immoral activities like corruption.

To support the significance of the coefficients of the factors and variables in table 4 are the p-values shown in table 6.

Table 6: P-values.

		Variable	Model 1	Model 2	Model 3	Model 4
P-Value		Constant	0.0000	0.0000	0.6114	0.0104
		X1	0.4304	0.3794	0.2073	0.0251
		X2	0.0241	0.0202	0.0152	0.0000
		X3	0.1784	0.3358	0.4515	0.0006
		X4	0.0007	0.0090	0.0020	0.0000
		X5	0.0101	0.0101	0.3892	0.0000
		X6			0.1055	0.5554
		X7			0.1107	0.0000
		X8			0.9562	0.6409
		X9			0.1000	0.0001
		X10			0.7983	0.1522
		X11				0.0000

It is clear from the table that most of the p-values under models 1, 2 and 3 are greater than 0.05 suggesting the insignificance at the 5%. For model 4, almost all the p-values are less than 0.001 implying all are significant at 1%.

7. Concluding Remarks

A proposed multilevel stochastic frontier was fitted to data from urban local authorities. The main objective of the study was to see how the efficiency levels of the proposed model compare with efficiency levels of three other models that have been in use for quite some time. Two of the three old models, models 1 and 2, used variables from level 1, the revenue source only. The

other two models, 3 and 4, used variables from both levels, the source and the municipality. Models 1 and 2 were different in that model 1 had fixed coefficients while model 2 had mixed coefficients. Models 3 and 4, on the other hand, were different in that model 3 had fixed coefficients, with disaggregated variables and with no interactions while model four had mixed coefficients and cross-level interactions.

Results of the analysis showed that among the explanatory variables on revenue collection and efficiency, staff competence, is the only factor which was found to be the positively and significantly related to revenue collection by all the four models. This means that municipalities should strive and ensure that they call for the services of qualified and skilled personnel.

Expenditure also showed to be positively related to revenue collection in all the four models. The relationship was significant for all except model 3, the OLS model with disaggregation. It is rational to have revenue and expenditure positively related as shown especially when the staff is competent. Municipalities are therefore advised to put in place conditions that that call and retain experienced and competent staff.

Model 4, the proposed model, proved to be superior to all the other in producing the highest efficiency levels and recognizing as significant, factors that literature says are significant. Of most importance is that the estimation of efficiency in situations where data has layers, should take into cognizance the structure of the data, otherwise the inefficiency of the level of analysis is magnified by the malfunctioning of high level variables.

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