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The Efficiency of Public Expenditures on Basic Services: The Case of South African Municipalities

Hammed Amusa
Macroeconomic, Debt Sustainability and Forecasting Division of the Research Department (ECMR.1)
African Development Bank (AfDB, Abidjan, Cˆote d'Ivoire).
E-mail: h.amusa@afdb.org

David Fadiran
School of Economics, University of Cape Town
Policy Research in International Services and Manufacturing (PRISM)
david.fadiran@uct.ac.za

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Abstract

In this paper, we investigate the efficiency of South African municipalities in providing key basic services of water, solid waste removal, sewerage (& sanitation) and electricity. We construct a composite index of municipal service provision and compute output-oriented efficiency in services for South Africa's 213 local and metropolitan municipalities. This approach accounts for quality of service provision and allows for a particular municipality's efficiency scores to be benchmarked against a sub-sample of relatively more efficient peer municipalities. The results indicate that for municipalities surveyed over the sample period, the number of efficient municipalities is highest in the delivery of electricity services (at 35%) and lowest in the provision of waste services (at 22%) . The results also indicate that two municipal categories – municipalities with large towns at their cores and municipalities covering small urban towns, account for the bulk of efficient local governments.

Keywords: South Africa, Municipalities, Efficiency, Partial Frontier Analysis

JEL Codes: C14, H11, H41, H72

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School of Economics Building, Middle Campus, University of Cape Town Private Bag, Rondebosch 7701, Cape Town, South Africa
Tel: +27 (0)21 6504470
Web: www.prism.uct.ac.za

1 Introduction

Since the late 1980s, inefficiencies of centralized bureaucracies and the desires of citizens to bring the management of government functions closer to themselves have created opportunities for central governments in various countries across the world to shift the administration of development initiatives to sub-national authorities (Smoke, 2001). The move away from centralized administration and provision of public goods also extended to many sub-Saharan African countries, with the past two decades characterised by significant governance and economic reforms that coincided with political transitions seeking to promote more democratic dispensations. A central element of the reform agenda has been the design and implementation of mechanisms to increase the fiscal and institutional autonomy of sub-national administrative units. The drive towards greater fiscal decentralization is premised on theoretical arguments that a greater degree of decentralization allows for better alignment between the spending and funding responsibilities of public authorities. The alignment of revenues and expenditures creates opportunities for sub-national authorities to improve the efficiency and effectiveness of spending on public services (Boetti et al., 2010). Moreover, such inefficiencies may be detrimental to economic growth prospects (Rayp and Van De Sijpe, 2007). Scholars of fiscal federalism have argued that the potential welfare gains from improved efficiency and effectiveness of public expenditures highlight the need for accountability among elected public officials (Oates, 1999; Musgrave, 1983). Such a need can be achieved by granting sub-national units a greater degree of fiscal autonomy (Weingast, 2009).

For South Africa, the practice of decentralization is embodied by the country's system of intergovernmental fiscal relations, which places a strong emphasis on the 'developmental role' of sub-national authorities in addressing the apartheid era legacy of race based resource allocation and governance. As the focal point for local democratic participation and decision-making, the legal and administrative framework of South Africa's local government sphere is geared towards enhancing the efficiency of municipalities in mobilizing and directing public funds towards service delivery programs targeting improvements in the social, economic and material needs of communities. However, the general consensus among policymakers and researchers is that the local government sphere has struggled to fulfill its strategic developmental mandate (Masiya et al., 2021; Koelble and Siddle, 2014). Since 2004, (often violent) community protests have become a constant feature of South Africa's municipal landscape. While the exact nature of protests differ across municipalities, a common thread is the deep-rooted frustration with the inadequate levels of service delivery and the inability of local administrations (and institutions) to respond to the needs of local citizens in a timely and satisfactory manner (Mamokhere, 2019). Can these frustrations be addressed by dealing with inefficiencies in the provision of basic services? Better yet, would clearer understanding of the nature and patterns of inefficiency in delivery of services provide deeper insight into the maladministration that exists at the local government level?

The threat posed by protests and poor municipal performance to social cohesion have led to numerous support interventions - the deployment of expertise to boost the capacity in skills-deficient municipalities, and attempts to use centralized intergovernmental relations to coordinate municipal spending on growth and poverty reduction initiatives. Such efforts have come from both national and provincial governments as well as from the private sector. With the failure to sufficiently institutionalize the improvement gains from the various intervention strategies, municipal challenges

with service delivery remain. The persistently poor state of service delivery has raised concerns about municipality's' capacity to efficiently carry out their functions in a manner that meaningfully contributes to improving the spatial, social and economic environments in which local citizens live and work. National government has also proposed and implemented amalgamations and demarcations as possible solutions to achieve financial viability and improve the administrative performance of local governments. The economic benefits from such suggestions are likely to be negligible when municipal functions are characterized by inefficiencies that are not necessarily influenced by boundary changes (Ncube and Monnakgotla, 2016).

A growing number of studies have examined the efficiency aspects of municipal spending in South Africa (see for example Dikgang et al. (2017); Moonkam (2014); Mahabir (2014); van der Westhuizen and Dollery (2009). This present study adds to the South African literature assessing municipal spending efficiency in two ways. First, unlike previous studies that measure efficiency using the Data Envelopment Analysis (DEA) and Stochastic Frontier Analysis (SFA) techniques, this paper carries out efficiency estimations using robust order-m partial frontier efficiency analysis approach. The application of robust partial frontier analysis helps overcome two main drawbacks of the DEA and SFA methods, namely, their high vulnerability to potential outliers as well as their susceptibility to measurement errors (de Witte and Marques, 2010). With the added flexibility of not requiring prior knowledge of a production function, the partial frontier approach allows us to derive representative approximations of true efficiency values. This represents a methodological value-add to the literature as we are unaware of any parallel work in South Africa and indeed in the rest of Africa, that has applied this technique to the study of efficiency performance of sub-national governments. Second, we estimate municipal efficiency while explicitly accounting for the quality of the service provided using the 'infrastructure quality-index' approach proposed by Balaguer-Coll et al. (2019) and van der Walt and Haarhoff (2004). By measuring infrastructure quality through reference to the level of service provided to consumer units (households), the infrastructure quality index not only captures appropriate performance indicators of municipal outputs, but also achievements along the dimensions of access to services.

The rest of the paper is structured as follows: Section 2 provides some stylized facts about the institutional structure of South Africa's local government sphere. Section 3 describes data and variables, and the methodological approach used in deriving municipal efficiency scores. Section 4 discusses the results of the non-parametric efficiency analysis while Section 5 concludes the paper.

2 Stylized Facts on the South African Local Government Sphere

Prior to the democratic transformation in 1994, South Africa's system of decentralization was largely shaped by the demarcation of jurisdictions and governance structures on the basis of race, rather than on the basis of functional linkages or similar criteria (van Rynevald, 1996). During the apartheid period, the geographical configuration of South Africa along racial lines manifested a system of fiscal and administrative decentralization organized along three tiers. The first tier was made up of the central/national government while the second tier comprised four provinces mainly set aside for the country's white population, and administrative regions for black South Africans delineated into six self-governing/non-independent territories and four "independent" homelands. The last tier resem-

bled a local government structure and consisted of two parallel structures: White Local Authorities (WLAs) and Black Local Authorities (BLAs). WLAs represented the earliest example of decentralized governance in South Africa. Established in the early 1900s, they covered most of the country's urban commercial and industrial areas, and were primarily responsible for providing services to urban white, coloured and Indian citizens residing in areas outside of the homelands. In contrast to black homelands, access to relatively wealthy sections of society allowed WLAs a high degree of fiscal autonomy, with the ability to levy property rates and charge trading services (on the provision of electricity, water and solid waste removal). This ensured the status of WLAs as the only sub-central authorities that generated a majority of revenues from own sources.

Initially administered by adjacent WLAs, the BLAs evolved from the community councils introduced in response to the political uprisings of the late 1970s. However, BLA structures enjoyed very little political legitimacy as they were viewed as a facade of the apartheid regime to grant some form of democracy to blacks while entrenching the system of racial segregation (Bahl and Smoke, 2003). This meant apartheid restrictions on economic activities and development in black areas coupled with a hugely disproportionate allocation of socio-economic infrastructure and a lack of access to property, quality education and formal employment. This impaired the capacity of BLAs to develop productive tax bases. As a result, BLAs generated very little own revenue, operated inefficient fiscal systems, and lacked capacity to provide necessary socio-economic services.

By 1987, dissatisfaction with the weak financial positions within township administrations and stagnant economic development of the Bantustans led to the creation of Regional Services Councils (RSCs) and Joint Services Boards (JSBs). Excluding the SGTs and TVBC states, the RSCs and JSBs amalgamated all black and white authorities and were assigned two main responsibilities, namely: (i) performing stipulated local functions on a sub-regional basis; and (ii) financing bulk infrastructural investment in priority areas particularly poor black areas, as well as some rural areas. To fulfill the latter, RSCs and JSBs generated revenue by imposing levies on the payroll and turnover of businesses located within their jurisdictions (Lemon, 1992; Witternberg, 2003).

Following the first democratic elections in 1994, the 1996 Constitution and the Local Government Municipal Structures Act (1998) consolidated a complex system of 843 urban and rural transitional administrations into a local government structure in which municipalities were divided into three categories: (i) *Category A* municipalities (metropolitan councils) with exclusive coverage over large urban areas; (ii) *Category B* municipalities (local councils) that administer non-metropolitan areas that vary both in size and extent of urbanization, and (iii) *Category C* municipalities (districts councils) that are successors to the previous RSCs. Since 1998, several demarcation processes have led to a rationalisation of the 843 municipalities down to the current 257 municipalities: 8 category A, 205 category B and 44 category C municipalities (see the illustration below).[1]

[1]Apart from the metropolitan municipalities, local governments function within a two-tier structure in which category C municipalities geographically encompass several category B municipalities. Under this arrangement, category C municipalities are tasked with coordinating integrated development planning for the entire district, and providing services on behalf of less capacitated category B municipalities located within their borders, particularly those in the country's most rural areas.

Organization of South Africa's Local Sphere:

- Local Government Sphere
  - Category A (Metropolitan) Municipalities (**8**)
  - Category C (District) Municipalities (**44**)
  - Category B (Local) Municipalities (**205**)
    - B1: Secondary Cities (**19**)
    - B2: Large towns (**23**)
    - B3: Small towns (**104**)
    - B4: Mostly rural (**59**)

In the context of South Africa's unitary system, the 1996 Constitution outlines a 'developmental' role for the local government sphere and mandates municipalities to give priority to fulfilling the 'basic needs' of their communities. While there is no clear definition of what services are to be considered basic, the Constitution together with existing policies and legislation - the Municipal Systems Act (2000) and Municipal Structures Act (1998), identifies nine public services – portable water, sanitation, solid waste removal, electricity, roads, municipal health, storm water management, fire-fighting (and emergency services) and street lighting, as basic services. To fund their significant service delivery functions, the Constitution grants municipalities a number of relatively broad revenue sources. Table 1 shows the most important revenue sources and expenditure categories as a share of total revenues and total expenditures, respectively (for the year 2018). The figures indicate that with their substantial revenue-raising powers, municipalities are largely self-financing, with around 65% of municipal budgets financed through own-revenue collections from property rates and user-fees for municipal services. The bottom half of Table 1 shows that property rates and user fees for electricity and water services account for more than two-thirds of income generated by municipalities from own-sources. Owing to asymmetry in resource endowments and economic development, the ability to raise revenues from assigned bases differs considerably across the various municipal jurisdictions. The Constitution thus entitles municipalities to an equitable share of nationally collected revenue in order to address the existence of horizontal fiscal inequities and ensure that that all municipalities are appropriately funded to fulfil their service delivery mandates.

Table 1 : Structure of municipal revenues and expenditures in 2018
(in % of total revenues [1] and total operating expenditures [2])

Revenues (450.8 billion Rands)[1]	[1]	Operating Expenditure (368.2 billion Rands)	[2]
Prop. rates & Service charges	64.9	Employee related costs	27.5
Transfers & subsidies	22.1	Bulk purchases[2]	27.2
Interest income	6.54	General services	14.9
Other revenue	6.41	Depreciation & asset impairment	10.1
		Debt impairment	6.9
		Other expenditure	13.4
Prop. rates & Service charges (% of total own-revenues)		% Share of Operating Expenditure	
Property taxes	22.9	Category A	57.9
Service charges - electricity revenue	37.7	Category B	35.0
Service charges - water revenue	12.6	Category C	7.0
Service charges - sewerage revenue	5.5		
Service charges - solid waste removal revenue	4.7		

Source: Adapted from the National Treasury Municipal Budget Information (2018).
[1] The respective shares, of total revenues, per municipal category ares: Category A - 57.4%; Category B - 34.5% and Category C - 8.1%. [2] Reflects costs incurred in purchasing electricity (from the national electricity utility firm - ESKOM) and water (from external providers such as Water Boards) supplies in bulk before re-selling to residents, businesses and government.

While the Constitution decides the mandated responsibilities of municipalities, community demand and expenditure patterns necessitates that about two–thirds of municipal functions are focused on the provision of water, solid waste removal, roads, storm water drainage and electricity. With legal prescripts in the Systems and Structures Acts making a distinction between mandate and authorization, service delivery within the local government sphere is undertaken in an asymmetrical manner. Part B of schedule 4 of the Constitution mandates the provision of water services as a municipal responsibility. All municipalities are, however, not authorised to provide water. Guided by the Water Services Act (1997), authorisation for the provision of water services is granted to all category A (metros) municipalities while category B (local) and category C (district) municipalities are authorised in certain instances. Schedule 4B of the 1996 Constitution and the Municipal Systems Act (2000) tasks municipalities with the function of providing electricity service.[2] However, in practice, both the national utility (Eskom) and municipalities distribute electricity to consumers.

The Electricity Regulation Act (Act No. 4 of 2006, as amended) requires a licence for entities or persons operating an electricity 'distribution facility'. In this regard, approximately 168 municipalities are licensed by the National Energy Regulator of South Africa (NERSA) as electricity service providers, a role that includes maintaining infrastructure, providing new connections, setting minimum service level standards, pricing and subsidy levels for poor consumers. Owing to the authorisation framework, disparities in population size, income distribution, revenue base as well as differentiated levels of urbanization and administrative capacity, the actual distribution of responsibilities varies markedly within and across all local government categories. Municipalities covering metropolitan centers and

[2]The Act ensures that service provision function is distinct from an authority function. The latter function includes the development of policies, drafting by-laws, setting tariffs, and regulating the provision of services in terms of the by-laws and other mechanisms

large urban areas take responsibility for all of the four major services, while for other municipalities, such services are usually shared or undertaken exclusively by either the local municipality or its corresponding district municipality.

In keeping with their functions, municipalities dedicate a major portion of expenditures to cover recurrent (i.e. operating) costs in service provision, with this component accounting for over 80% of municipal expenditures in the 2017/18 financial year.[3] The right side of Table 1 provides the composition of total municipal operating expenditure for the 2017/18 financial year. This shows that employee costs (salaries and wages of municipal staff) as well as bulk purchases of electricity and water services, account for over half of total operating expenditures. Spending on general services (covering items such as rental, plant and equipment hire, audit fees, accommodation and travelling costs) and 'other' expenditure (on items that include repairs and maintenance, remuneration of councillors, departmental fees and consumables) require almost a third of total municipal operating budgets. This indicates that input (labour and supplies/materials) and administrative costs dominate municipal operating expenditure and are vital for service delivery within local governments. Due to the significant concentration of people and economic activities that drive a higher demand for services, the largest amount of operating expenditure occurs in the eight metropolitan (Category A) municipalities, which account for 57.9% of the municipal sphere's total operating expenditure. Local (Category B) municipalities account for the second highest share - 35%, of municipal operating expenditure. Compared to the 7% share for district (Category C) municipalities. The relatively higher share for Category B municipalities reflects the general practice for districts to invest in infrastructure while utilising service delivery agreements to delegate the operational provision of services to local municipalities.

3 Empirical Methodology

3.1 Sample Selection

The literature examining the efficiency of production units, commonly referred to as decision-making units (DMUs), emphasises the homogeneity assumption of the DMUs more than the actual number of DMUs. Here, homogeneity refers to each DMU having comparable inputs and outputs, similar objectives and providing similar services. The absence of such homogeneity limits the ability to fairly evaluate and compare the relative efficiencies of DMUs, since some DMUs may not be equally endowed or tasked with similar responsibilities economically. In this study, the DMUs are municipalities that provide similar services, premised on whether or not a municipality is constitutionally mandated to provide a service or a group of services. The heterogeneity in assignment of service delivery functions creates difficulties in comparing the outcomes of spending patterns across municipalities. To avoid poorly constructed efficiency scores, it is necessary that municipalities are placed on an "equal footing" when carrying out the analysis. For this purpose, only municipalities legally authorized and functionally providing one or more of the four basic services (water, sewerage, solid waste/refuse removal, and electricity) are included in the sample for the efficiency analysis.

[3] Municipal expenditure is classified into two types - capital and operating expenditure, respectively. The former comprises investments in socio-economic infrastructure and long-term purchases of assets, while the latter consists of the day-to-day costs to deliver municipal services.

For the four basic services being considered in this study, sample sizes are determined by the constitutional mandate for each basic service or grouping of services, for the municipalities. This sample selection approach allows for a balanced efficiency assessment.[4] For example, in the provision of water services, only 119 municipalities are constitutionally authorized to provide water. Therefore, the sample of municipalities included in the assessment of efficiency in the provision of water would be 119. In comparison, when analysing a combination of services, such as water and electricity, only municipalities constitutionally mandated and legally empowered to supply both water and electricity services would be included in the sample to assess efficiency of municipalities' in providing these two specific services. In this case, a total of 107 municipalities would be included in the sample. Table 2 provides the different sample sizes for the individual as well as the grouping (or combination) of all four services.

Table 2 : Sample Size of Municipalities by Service Groupings

Service	Municipal Sample	% of Total
Waste	183	85,9
Electricity	151	70,9
Sewerage	112	52,6
Water	119	55,9
All Services	97	45,5

3.2 Choice of Methodological Approach - The Partial Frontier Efficiency Analysis

Efficiency measures are based on the assumption of no information asymmetry with regards to the production frontier of the perfectly efficient unit. Given that this assumption is often broken, the production frontier is usually estimated using two possible techniques, namely: (i) non-parametric/non-stochastic piecewise-linear convex frontier, such that the frontier of the perfectly efficient unit is the limit. This is also referred to as mathematical programming. And (ii) parametric/stochastic function data fitment that also limits all observed points to the frontier of the fully efficient unit. This is also known as the econometric approach. In simple terms, both methods are similar theoretically, but differ in how they handle comparison of units in relative or absolute terms. They also differ in the techniques used to envelop the observed data, in how they adjustment for random noise, and lastly in how flexible the structure of the production technology is (Worthington, 2014).

At a general level, parametric and non-parametric methods have been well explored in the literature. Non-parametric approaches - such as Malmquist productivity indexes(MI), have a distinct advantage in the sense that, the need for apriori determined production function is not a necessary step. Instead, it allows for the post-derivation of representative approximations of true efficiency values. While non-parametric methods seem to have an advantage over parametric ones in terms of efficiency analysis, a drawback is that such non-parametric methods are not embedded in the traditional regression framework for empirical analysis. Furthermore, the lack of unified assumptions-the DEA technique assumes convexity while the full disposal hull (FDH) method assumes non-convexity, highlights contrasting core inferences of mathematical programming techniques which can lead to different results. In our case, we estimate municipal efficiency using robust order-m partial frontier

[4]The analysis excludes all district municipalities, as the primary function of such municipalities is to co-ordinate development and delivery across local (i.e. Category B) municipalities within the district.

efficiency analysis (PFEA). As a parametric approach, the PFEA circumvents the susceptibility of non-parametric approaches to outliers and measurement errors (de Witte and Marques, 2010). This is done by allowing municipalities, for example, that are most efficient, to be situated beyond the predicted production possibility frontier. Thus, the estimated frontier avoids over-dependence on a few outliers, and is not entirely shaped by few abnormal observations which might represent artifacts of measurement error.

The basic setup of a partial frontier analysis involves three parts: a group of decision making units (DMUs), which in our case would be the municipalities; a set of inputs for production; and lastly, a set of outputs from production. The overarching objective being to obtain the efficiency score (or *escore*) for each municipality in our sample. As a generalization of the FDH technique, PFEA allows for the element of randomness, achieving both regression framework embedding and also removing the outlier issue faced by the FDH. Accordingly, instead of comparing a municipality to the best performing municipality (absolute), each municipality is compared to its expected best performance based on a sample of *m* peers (relative). This is known as the $order\text{-}m$ efficiency.The computational procedure for PFEA $order\text{-}m$ follows four steps: (i) a sample of *m* peer municipalities are drawn randomly with replacement; (ii) pseudo-FDH efficiency score is computed using the reference sample; (iii) the steps are repeated a selected number (D) of times, and (iv) order-m efficiency score is obtained as the average of the pseudo-FDH scores over the selected D times. The $order\text{-}m$ is computed based on the equation:

$$\hat{eScore}_{mi} = \frac{1}{D}\sum_{d=1}^{D} \hat{FDH}_{mi} \tag{1}$$

Where

$$\hat{FDH}_i = \underset{j \epsilon B_i}{max}\left\{\underset{k=1,\ldots,K}{min}\left(\frac{x_{ki}}{x_{kj}}\right)\right\} \tag{2}$$

B_i is the set of peer municipalities which satisfy the condition $y_{lj} \geq y_{li}\ \forall\ l$. And for all the municipalities, the municipality with the highest output will serve as reference to municipal i, whereby the municipality being compared is municipal j. Therefore, the municipalities that exhibit the highest output among all the compared peers (when comparing x_{kj} and x_{ki}, the output k in municipal i and j respectively), will obtain a $\hat{FDH}_i$ value equal to 1 thus limiting municipality$i$ to the confines of the production possibility frontier. This is problematic, since every other municipality with less output than the most efficient municipality is deemed inefficient and assigned a score lower than 1. The *order-m* partial frontier analysis framework was developed to address this shortcoming. In equation 2, the escore is the sum of the efficiency scores obtained from the FDH technique, albeit, with municipalities categorized into peer groups, each of size m. Accordingly, multiple municipalities with efficiency scores less than 1 will exist in the calculated outcome (i.e. observations outside the full efficient production possibility frontier). [5] That is there can be more than one efficient municipality. *D* is the number of times the calculation is repeated, during which a random sampling to obtain peer categories is carried out. The following equation presents the estimated model for this study, whereby efficiency scores for each municipality is obtained:

[5] In the output-oriented approach to order-m, the lower the efficiency score, the more efficient the municipality is

$$\hat{eScore}_{mi} = \frac{1}{D}\sum_{d=1}^{D} \underset{j\epsilon B_i}{max} \left\{ \hat{\underset{k=1,....,K}{min}} \left(\frac{HH_{ki}}{HH_{kj}} \right) \right\} \tag{3}$$

where $\hat{eScore}_{mi}$ is the computed efficiency score for the ith municipality, relative to the m municipalities in its peer group. For a sample of N DMUs (or municipalities), a set of inputs (x_{i1},....., x_{ik}) utilised in production to generate a set of outputs (y_{i1},....., y_{iL}) is observed for each municipality, i = 1,....,N. In evaluating how efficient municipalities are in transforming inputs into outputs, the calculation of $\hat{eScore}_{mi}$ can follow two main approaches: the "*output-oriented*" approach which measures the ability of a DMU to maximize output levels while leaving input consumption constant, and the "*input-oriented*" approach which evaluates a DMU's ability to lower input consumption without changing the quantities of output produced.

In principle, the choice of orientation is driven by the underlying model describing the behavior of a DMU within the specific industry it operates in. As discussed by Borger and Kerstens (1996), if one assumes that local governments exercise substantial control over inputs and their outputs are exogenous (for example, determined by citizens' demands), then an *input-oriented* approach seems appropriate. In this case, input-oriented efficiency measures capture the inability to minimize costs resulting from discretionary power and incomplete monitoring, and provide an indication of possible cost reductions. On the other hand, where municipalities face fixed budgets and have limited control over inputs, then an *output-oriented* approach may be quite informative. In this instance, *output-oriented* efficiency can indicate whether municipalities are providing the maximum level of services subject to available budgets.

In our empirical application, we consider the *output-oriented* approach in estimating efficiency scores. This choice is informed by the behaviour of South Africa's municipalities in the context of their roles and mandates. As previously indicated, to assist in fulfilling mandated functions, municipalities are assigned relatively broad revenue sources. However, strict rules govern how municipalities manage the process of adjusting rates and tariffs in raising revenues. For instance, in setting and reviewing tariffs imposed on electricity services, municipalities propose changes based on electricity tariff guidelines issued by the National Electricity Regulator of South Africa (NERSA). Once those tariff proposals have been considered together with community inputs, authorized municipalities have to apply to NERSA for tariff approvals, and will only implement the tariffs as approved by NERSA. Similarly, legislative prescripts accords the Minister responsible for local government, with the concurrence of the Minister of Finance, powers to limit the rate on properties and prescribe norms and standards for imposing municipal surcharges on water and sewerage services (Fuo, 2017).[6] Factors such as socio-economic background of residents and the scope of economic activity within jurisdictions also impact revenues derived from user charges. The infusion of intergovernmental transfers is an important tool to ease constraints on municipal finances while ensuring service delivery is not compromised. However, the mechanism for allocating and transferring such grants lie outside the purview of municipalities.

In addition to the above, a key characteristics of developmental local government relates to the need for municipalities to maximise social and economic development. Given the existence of budget

[6]These prescripts may also determine the basis on which, and intervals at which municipalities may increase rates or surcharges. They also determine matters that must be assessed and considered by municipalities in imposing surcharges

constraints and the developmental role of municipalities, it is at least conceivable to describe the behavior of South Africa's municipalities as one driven by the need to maximize outputs in service delivery subject to available resources. In view of this behavior, focusing on the estimation of *output-oriented* efficiency scores is appropriate. In the *output-oriented* version of Eq.(3), the most efficient municipality will be the entity with the lowest input cost vis-a-vis the ratio of households (to municipal population) with access to the service or group of services in question. In this case, $\frac{Hh_{ki}}{Hh_{kj}}$ compares the households to population ratio with access to service k in municipality i to the households to population ratio with access in municipality j, given that $i \neq j$.

3.3 Measuring municipal input and output

Following extant literature, we employ total (net) operating expenditure on services as our main indicator of municipal input. Using operating expenditure has two distinct advantages, namely: (a) it strengthens the link between spending and chosen measures of output, and (b) because such expenditure results in the immediate provision of services, it avoids the likely bias in efficiency analysis across municipalities that may result from using capital expenditures that are mainly dedicated to long-term projects with fluctuating payment structures (Boetti et al., 2010; Kalb et al., 2012). As stated in Table 1, municipal operating expenditure includes labor inputs in terms of employee/personnel costs, material and bulk purchases (labour, material and capital costs) and capital inputs (repairs, maintenance and depreciation) that are necessary to provide municipal services. Our measure of operating expenditure includes these costs and excludes debt impairment, interests, and amortization repayments. Values for the input variable are obtained from audited information contained in the financial census of municipalities as compiled by Statistics South Africa. Given the lag in publishing audited financial statements of municipalities, the data covers all 257 municipalities over an 11-year period spanning 2007-2018.

Based on the primary constitutional mandate of municipalities, the levels of provision of main basic services - water, sewerage, electricity and solid waste removal, are used to proxy for municipal output. In specifying the level of municipal output, we follow the approach by van der Walt and Haarhoff (2004) and Statistics South Africa (2017), and calculate a composite index to indicate the level of municipal output. This composite index is constructed by categorizing the quality of a specific service into five different levels, namely: none, minimal, basic, intermediate, and full, with these five levels having corresponding scores ranging from 1 for no service (or the lowest level of service) to 5 for full provision (see Table 3).

Table 3 : Output indicators - Level of service received by total households

Service level	Electricity	Solid Waste Removal [a]	Sewerage	Water
1 = None	No access, Paraffin, Candle, Other	No rubbish disposal	No latrine or sewerage	Borehole, Dam, Water carrier/tanker/vendor, Other
2 = Minimal	Solar	Own refuse dump	Buckets latrine	Piped water/Communal standpipe more than 200 meters
3 = Basic	Gas	Communal refuse dump	Pit latrine	Piped water/Communal standpipe less than 200 meters
4 = Intermediate	N/A [b]	Removed by local authority less often	Chemical toilet	Piped water inside yard
5 = Full	Electricity (pre or post-paid meters in-house)	Removed at least once a week	Flush toilet (connected to sewerage system/septic tank)	Piped water inside dwelling

Source: Adapted from Statistics South Africa (2017). [a] (Solid) Waste management is also termed refuse removal and refers to the collection, treatment, and disposal of waste. [b] The non-financial census compiled by Statistics South Africa does not define an "intermediate" service in the case of electricity provision.

The outcome variable is then computed based on the categorization in Table 3, and using Eq.(4). An index of service delivery then obtained. What this equation captures is the share of the municipal population with access to the service, and the specific level or quality of the service they have access to. The service delivery index for each of the four different services is calculated as a simple weighted average and is specified as:

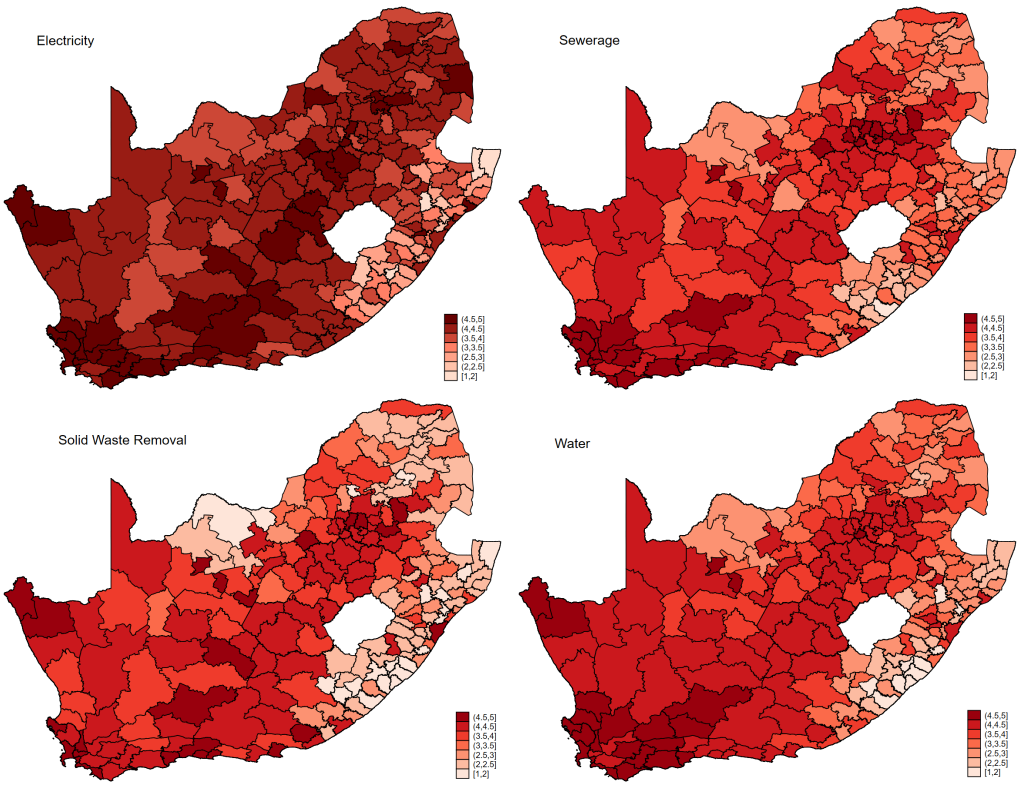
$$Service_i = \frac{N_{i,none} \times 1}{N_{i,total}} + \frac{N_{i,minimal} \times 2}{N_{i,total}} + \frac{N_{i,basic} \times 3}{N_{i,total}} + \frac{N_{i,intermediate} \times 4}{N_{i,total}} + \frac{N_{i,full} \times 5}{N_{i,total}} \quad (4)$$

where $Service_i$ is the output level for a specific service (i.e. for water, electricity, solid waste removal and sewerage) in the i^{th} municipality, $N_{i,j}$ is the number of households in municipality i with access to a specific service at level j (i.e. access at $none$, $minimal$, $basic$, $intermediate$, or $full$ levels, respectively), and $N_{i,total}$ is the $total$ number of households in municipality i.

4 Results

Before presenting the results for the estimated efficiency scores, we briefly describe the findings on the extent of access to basic services across municipalities. Using estimates derived from Eq.(4) and data on municipal boundaries, we create maps of the relative access to basic services in Figure 1. The maps depict service index scores averaged over the sample period and overlaid atop municipal locations (darker areas correspond to higher levels of access to a particular basic service) and indicate that the access index scores vary quite substantially across municipalities.[7] In particular, clusters of relatively higher access across the four main basic services are primarily found in municipalities located in the western and northern parts of South Africa (i.e. the provinces of the Western Cape and Northern Cape), while clusters of low service access are mainly observed in municipalities located in the coastal and eastern regions of the country (i.e. the provinces of Kwazulu-Natal and the Eastern Cape). Over the sample period and across all municipalities, the average service access index score was highest for electricity (4.03) while the lowest was for solid waste removal (3.36). In the post-1994 dispensation, the high access score for electricity reflects the commitment to not only expand South Africa's electricity supply infrastructure, but to also provide free basic electricity services to indigent households (See Figure 2).

Figure 1 : Service Access Index Scores Across Municipalities, 2007-2018



Source: Authors' Calculations. Index scores are averages for the sample period

Table 4 translates the index score maps in Figure 1 into municipality rankings - the top and

[7] Figure A1 in the appendix provides a similar spatial map for the last year, i.e. 2018, in the sample

bottom 10, respectively, for each basic service. In terms of household access to electricity over the sample period, municipalities categorized as small towns or rural (i.e. Category B3 and Category B4) account for 70% of the 10 local governments with the highest electricity access, with 80% of these located in the Western Cape province. Regarding access to sewerage services, we find that all but one (the City of Johannesburg) of the ten municipalities with the best index scores are distributed across local governments classified as secondary cities, large towns and small towns. 7 of the 10 municipalities with highest index scores are located in the Western Cape. In terms of the quality of household access to solid waste removal services, the rankings in Table 4 indicate with the exception of three municipalities, local governments with the highest access index scores were either secondary cities or metropolitan centers located in the provinces of Mpumalanga (one), Northern Cape (two), Gauteng (one) and Western Cape (six). Households in municipalities located in the Western Cape enjoy much better access to higher levels of water service facilities with 9 of the 10 highest ranked municipalities located in this province. The majority of the municipalities (eight) are Category B3 municipalities servicing areas with relatively small populace that are mostly urban and based in a few small towns.

Across all four basic services, the bottom end of the scale displays a common trend. Specifically, Table 4 shows that municipalities with the ten lowest scores over the sample period were all rural municipalities with locations equally split between the provinces of the Eastern Cape and Kwazulu-Natal. In terms of access to sewerage services, all but two of the ten municipalities with the worst index scores were located in the Eastern Cape. 90% of the ten municipalities where households had the least access to solid waste removal were located in the Eastern Cape. Lastly, of the ten lowest ranked municipalities in terms of access to water services, seven were located in Eastern Cape and three in KwaZulu-Natal, respectively.

Figure 2 : Distribution of Service Access Across Municipalities, 2007-2018

Source: Authors' Calculations. Index scores are averages for the sample period (2007-18)

Table 4 : Rank of HH Access to Services

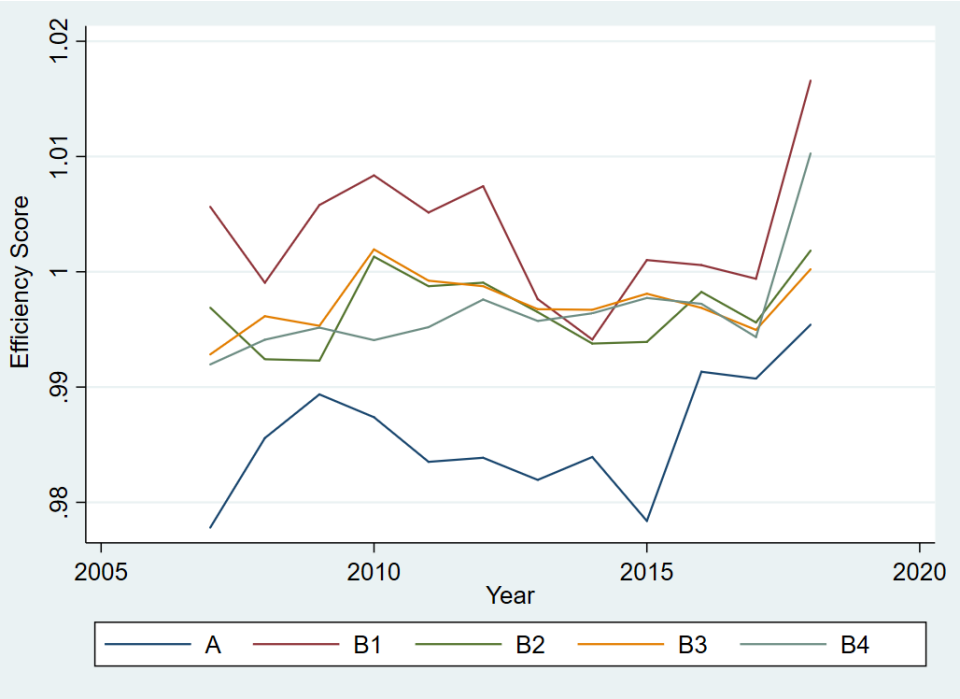
2007-2018				
Rank	Electricity	Sewerage	Solid waste removal	Water
Top 10				
1	Hessequa (B3;WC)	Hessequa (B3;WC)	Bitou (B3;WC)	Drakenstein (B1;WC)
2	Drakenstein (B1;WC)	Stellenbosch (B1;WC)	Kgatelopele (B3;NC)	Langeberg (B3;WC)
3	Langeberg (B3;WC)	Mossel Bay (B2;WC)	Govan Mbeki (B1;MP)	Cederberg (B3;WC)
4	Mossel Bay (B2;WC)	City of Johannesburg (A;GP)	Overstrand (B2;WC)	Kgatelopele (B3;NC)
5	Bergrivier (B3;WC)	Overstrand (B2;WC)	Gamagara (B3;NC)	Hessequa (B3;WC)
6	Cape Agulhas (B3;WC)	Kgatelopele (B3;NC)	Mossel Bay (B2;WC)	Cape Agulhas (B3;WC)
7	Saldanha Bay (B2;WC)	Drakenstein (B1;WC)	Knysna (B2;WC)	Beaufort West (B3;WC)
8	Swartland (B3;WC)	Emfuleni (B1;GP)	City of Cape Town (A;WC)	Saldanha Bay (B2;WC)
9	Dr JS Moroka (B4;MP)	Beaufort West (B3;WC)	City of Johannesburg (A;GP)	Swartland (B3;WC)
10	Richtersveld (B3;NC)	Saldanha Bay(B2;WC)	Saldanha Bay (B2;WC)	Bergrivier (B3;WC)
Bottom 10				
204	Umhlabuyalingana (B4;EC)	Mbhashe (B4;EC)	Mbhashe (B4;EC)	Mbizana (B4;EC)
205	Ntabankulu (B4;EC)	Engcobo (B4;EC)	Msinga (B4;KZN)	Ngquza Hill (B4;EC)
206	Msinga (B4;KZN)	Intsika Yethu (B4;EC)	Engcobo (B4;EC)	Port St Johns (B4;EC)
207	Jozini (B4;KZN)	Nyandeni (B4;EC)	Intsika Yethu (B4;EC)	Mbhashe (B4;EC)
208	Maphumulo (B4;KZN)	Port St Johns (B4;EC)	Ntabankulu (B4;EC)	Nyandeni (B4;EC)
209	Nkandla (B4;KZN)	Ntabankulu (B4;EC)	Nyandeni (B4;EC)	Msinga (B4;KZN)
210	Ndwedwe (B4;KZN)	Msinga (B4;KZN)	Port St Johns (B4;EC)	Ntabankulu (B4:EC)
211	Elundini (B4;EC)	Nongoma (B4;KZN)	Mhlontlo (B4;EC)	Maphumulo (B4;KZN)
212	Matatiele (B3;EC)	Mnquma (B4;EC)	Mbizana (B4;EC)	Umzumbe (B4;KZN)
213	Umzimvubu (B4;EC)	Emalahleni (B4;EC)	Ngquza Hill (B4;EC)	Engcobo (B4;EC)

Source: The terms in brackets indicate municipal category and provincial location of municipality, respectively. B1 -B14 are municipal categories as previously defined. EC denotes Eastern Cape province; KZN denotes province of Kwazulu-Natal; MP denotes the province of Mpumalanga; NC is the Northern Cape province, and WC is the province of Western Cape.

4.1 Results of the PFEA Analysis

In the first step of the analysis, a 'one input-four output' approach is used to compute efficiency scores for municipalities mandated to provide *all* four basic services. Accordingly, the input measure employed in the PFEA model is the total operating cost municipalities incur in providing mandated services, whereas the measures of outputs are the indices of levels of service provision estimated using Eq.(4). From the *output-oriented* PFEA model, a municipality is considered efficient in its basic services delivery function if its efficiency score - $e\hat{Score}_{mi}$, equals 1. An efficiency score greater than unity indicates an inefficient municipality, one for which its output quantities can be proportionally increased without changing the the level or quantities of input(s) used. Alternatively, an $e\hat{Score}_{mi}$ less than 1 designates a municipality as a DMU located beyond the estimated production possibilities frontier, suggesting that such a municipality is highly or super efficient.

Figure 3 : Average Efficiency score per municipal category, 2007-2018



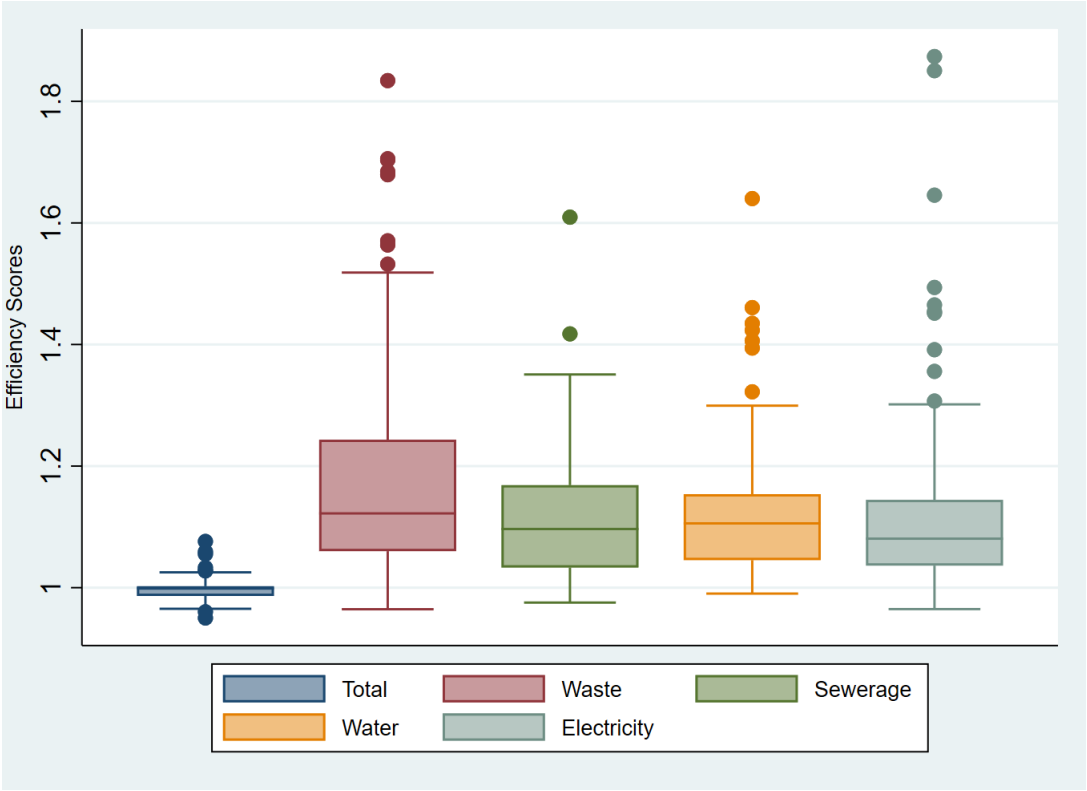
Source: Authors' Calculations.

Figure 3 plots the average efficiency scores for each municipal category over the sample period. This visualization provides an initial picture of municipal performance in the constitutionally mandated basic services. From this initial picture, a few distinct trends can be observed. First, with the exception of B2 municipalities, the average efficiency scores per municipal category display an upward trend between 2007 an 2011. This suggests rising inefficiency in the service delivery functions of municipalities that coincides with a period when South Africa experienced a wave of (often violent) protests initially centered in poor urban areas but later on spreading to other municipalities across the country. While the exact nature of protests differed across municipalities, a common feature was deep-rooted frustrations with the (perceived) poor state of service delivery (Habib, 2010; Booysen, 2007). Second, with the exception of B4 municipalities, efficiency scores across all municipal categories declined between 2009/2010 and 2014/2015 period. This decline indicates improved efficiency in the

delivery of basic services by municipalities following the roll-out of the Local Government Turnaround Strategy (LGTAS) in 2009.[8]

However, data visualization alone cannot be relied upon to make detailed inference regarding service delivery efficiency between as well as across the different municipal categories. In this regard, efficiency outcomes are compared across municipalities and explored in terms of municipal location. Figure

Figure 4 : Municipal service delivery efficiency scores, average for 2007-2018



Source: Authors' Calculations

To further explore this distribution, Table 5 presents the ranking of the ten most and ten least efficient municipalities according to their efficiency scores averaged over the sample period (2007-2018). (In the Appendix section, Table A1 provides the full ranking of municipalities, while Table A2 details municipal ranking by efficiency scores for the last year in the sample). The main findings from this ranking exercise can be summarized as follows. First, municipalities that obtain efficiency scores equal to one are categorised as efficient DMUs. Given their efficiency scores of one, three municipalities all located in the eastern province of Mpumaplanga - two category B4 local governments (Nkomazi and Chief Albert Luthuli) and one category B3 municipality (Mkhondo), are benchmark

[8]The development of the LGTAS framework was based on analysis by the Department of Cooperative Governance and Traditional Affairs (COGTA) as detailed in the 2009.*State of Local Government Assessment Report*. The report found that despite significant gains and previous interventions to enhance the functionality of the local government sphere, many municipalities were in deep distress and faced challenges in the effective delivery of the core set of critical municipal services including include clean water, electricity and sewerage.The LGTAS was thus developed as a country-wide intervention program to address communities' rising dissatisfaction with poor municipal services, as well as to improve the administrative and financial performance of all municipalities. The Department of Cooperative Governance (DCoG) (2020) and Greffrath and G. van der Waldt (2016) provide a detailed review of the interventions and support programmes implemented at the local government sphere

or reference authorities for efficient DMUs. Second, 59 of the 97 municipalities attained efficiency scores less than 1. This suggests that in the case of municipalities tasked with providing all four basic services, 61% are highly efficient DMUs and are located beyond the estimated production possibilities frontier.

Table 5 : Municipal rankings by output-oriented efficiency scores

Ranking	Municipality	Category & Province	Efficiency Score
Top 10			
1	Saldanha Bay	B2; WC	0.950
2	City of Cape Town	A; WC	0.960
3	City of Johannesburg	A; GP	0.965
4	Drakenstein	B1; WC	0.974
5	Mossel Bay	B2; WC	0.974
6	Richtersveld	B3; NC	0.974
7	Swartland	B3; WC	0.975
8	Cape Agulhas	B3; WC	0.975
9	Beaufort West	B3; WC	0.975
10	Nama Khoi	B3; NC	0.978
Bottom 10			
88	Tokologo	B3; FS	1.020
89	Blue Crane	B3; EC	1.021
90	Newcastle	B1; KZN	1.024
91	Modimolle/Mookgophong	B1; LIM	1.025
92	Emalahleni	B2; MP	1.027
93	Dihlabeng	B2; FS	1.028
94	Lephalale	B3; LIM	1.033
95	Midvaal	B2; GP	1.055
96	Rustenburg	B1; NW	1.059
97	Buffalo City	A; EC	1.076

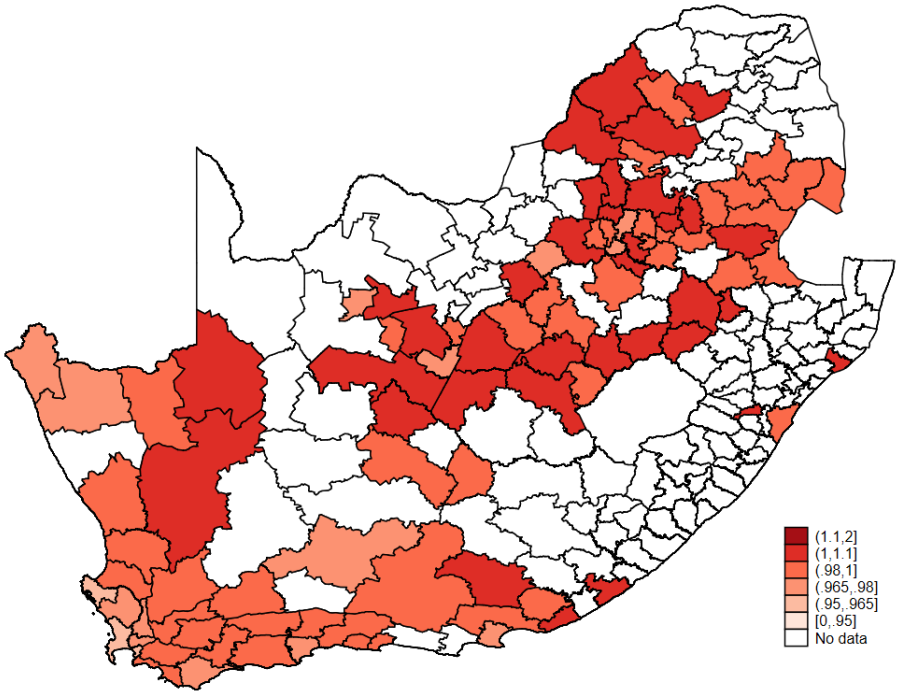
Note: Efficiency scores are the average for the 2007 - 2018 sample period. Municipal categories - A and B1-B4 are as previously defined. Provinces are abbreviated as follows: EC - Eastern Cape; FS - Free State; GP - Gauteng; KZN - Kwazulu-Natal; LIM - Limpopo; MP - Mpumalanga; NC - Northern Cape; NW - North West; WC - Western Cape

At the other end of the scale, 35 of the 97 municipalities achieved efficiency scores greater than 1, indicating that 36% of municipalities are relatively inefficient in providing the set of basic services. Third, over half of the 59 super-efficient DMUs are municipalities classified as small towns. At the bottom end of the rankings, the results indicate that Category B3 municipalities account for almost 55% of municipalities rated as inefficient in providing basic services. Finally, the Western Cape is the only province where all municipalities are super-efficient. From Table 5, 8 of the top 10 highly efficient DMUs are located in the Western Cape with Saldanha Bay municipality achieving the best score of 0.95. Also, half of the top performing DMUs in the Western Cape are category B3 municipalities characterised by the presence of commercial farms and local economies that are largely agriculturally

based. In contrast to the Western Cape, the Free State province accounts for the highest number of inefficient municipalities with 25% of its 35 municipalities attaining efficiency scores greater than 1 over the sample period.

Figure 5 is the spatial map of municipal efficiency scores and provides visual evidence of clustering by municipalities on the basis of respective levels of efficiency. The map shows that efficient municipalities, highlighted by areas in light red color on the map, are mainly concentrated in the western province (i.e. the Western Cape) of South Africa. For the case of inefficient municipalities highlighted by areas with darker red color, the map shows a noticeable clustering of municipalities within the central region that is largely covered by the provinces of Free State and Gauteng.

Figure 5 : Spatial distribution of Efficient municipalities averaged over the data period (2007-2018)

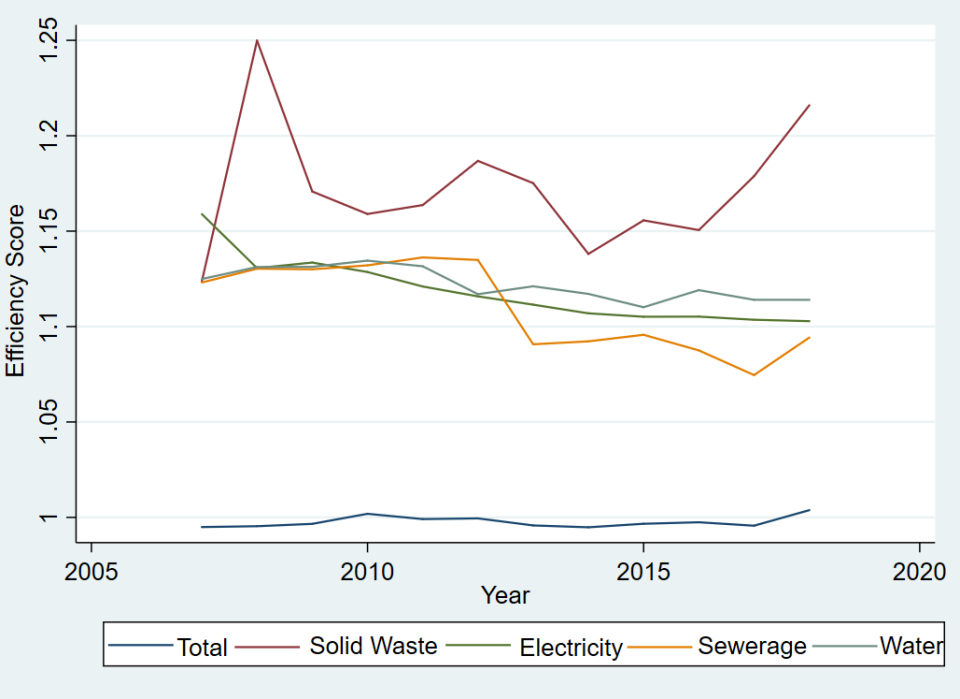


Source: Authors' Calculations. 97 Municipalities in Sample

In preceding analysis, the assessment of efficiency is based on municipal provision of the four main basic services. Given the delegated responsibilities of services across different categories of municipalities, we conduct an analysis of municipal efficiency in the provision of each of the four basic services. In this case, a 'one input/one output' approach is used to derive estimates of $\hat{eScore}_{L,mi}$, which measures-for a given output level L of a specific basic service, the service provision efficiency of the ith municipality relative to the m municipalities in its peer group. For this exercise, total (net) expenditures by the municipality in the provision of L is the main input variable, while the output is the level of service provision derived from Eq.(4). We estimate individual basic services efficiency scores for municipalities mandated to provide a specific basic service and for which relevant information over the sample period is available. Figure 6 shows the average efficiency score for each basic service over the sample period. Overall, efficiency scores averaged above 1, indicating general inefficiency by municipalities in delivering the identified services. Despite this general trend, Figure 6 also indicates that with the exception of solid waste, average efficiency scores for sewerage, electricity and water

have trended lower since 2012. This suggests that over the sample period, while municipalities were increasingly inefficient in delivering solid waste services, the provision of sewerage, electricity and water benefited from some improvements in municipal efficiency.

Figure 6 :Averaged Service Efficiency score (2007 - 2018)



Source: Authors' Calculations.

Insights regarding the drivers of trends observed in Figure 6 can be gleaned from efficiency scores for each service within municipalities mandated to provide a specific service. Table 6 compares and summarizes the ranking of municipal efficiency performance, while Figure 7 is a spatial map showing the distribution of efficiency scores, averaged over the sample period, for each individual basic service across South Africa's municipalities (light shaded areas correspond to higher efficiency, and vice versa for darker areas).[9]

For the 151 individual municipalities mandated to provide electricity and for which data is available, the estimates of efficiency scores indicate that only 47 can be considered efficient given their efficiency scores of one. Category B3 municipalities make up 61% of efficient electricity service providers, with the highest concentration in the Western Cape (11) and Northern Cape (8) provinces, respectively (See top left map in Figure 7). With efficiency scores less than one, six municipalities can be classified as highly efficient in electricity provision over the sample period. Similar to the case of efficient municipalities, highly efficient DMUs are mainly category B3 municipalities (5 out of 6) concentrated in the Western Cape province. Over the sample period, estimates indicate that despite their status, four of South Africa's metropolitan municipalities - Nelson Mandela Bay, the cities of Tshwane and Ekurhuleni as well as eThekwini, are inefficient providers of electricity services. Of the 98 inefficient electricity providing DMUs, 55% are category B3 municipalities mainly located in the largely rural provinces of Kwazulu-Natal (17), the Eastern Cape (15) and Mpumalanga (14).

[9]For comparative purposes, Figure A2 in the Appendix provides a spatial map of the distribution of efficiency scores in the last year - 2018, of the sample period.

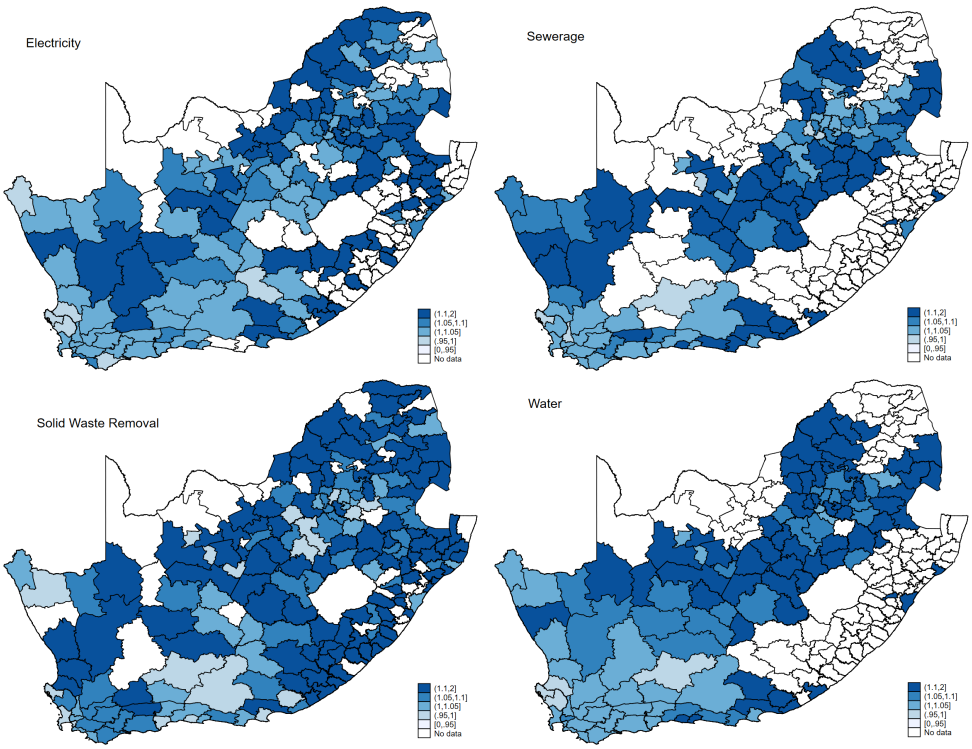
Table 6 : Municipal rankings by service level efficiency scores

Electricity	Sewerage	Waste Removal	Water
Top 5			
Richtersveld (0.964) - B3; NC	Saldanha Bay (0.975) - B2; WC	City of Johannesburg (0.964) - A; GP	Bergrivier (0.990) - B3; WC
Swartland (0.982) - B3; WC	Kgatelopele (0.989) - B3; NC	Saldanha Bay (0.967) - B2; WC	Swartland (0.997) - B3; WC
Bergrivier (0.988) - B3; WC	Beaufort West (0.991) - B3; WC	Makana (0.969) - B2; EC	Saldanha Bay (0.998) - B2; WC
Saldanha Bay (0.992) - B2; WC	Emfuleni (0.994) - B1; GP	City of Cape Town (0.976) - A; WC	Beaufort West (0.999) - B3; WC
Cape Agulhas (0.994) - B3; WC	Drakenstein (0.997) - B4; WC	Dipaleseng (0.980) - B3; MP	Kgatelopele (1.00) - B3; NC
Bottom 5			
Elundini (1.873) - B4; EC	Tokologo (1.609) - B3; FS	Ga-Segonyana (1.834) - B3; NC	Bushbuckridge (1.640) - B3; MP
Matatiele (1.851) - B3; EC	Ga-Segonyana (1.417) - B3; NC	Sakhisizwe (1.705) - B3; EC	Ga-Segonyana (1.460) - B3; NC
Nquthu (1.645)-B4; KZN	!Kheis (1.350) - B3; NC	Senqu (1.703) - B4; EC	Moretele (1.434) - B4; NW
Umvoti (1.493) - B3; KZN	Setsoto (1.334) - B3; FS	Emalahleni (1.684) - B4; EC	Nkomazi (1.423) - B4; MP
eDumbe (1.465) - B3; KZN	Nketoana (1.319) - B3; FS	Greater Tzaneen (1.679) - B4; LIM	Mogalakwena (1.406) - B2; LIM

Source: The figures in parentheses indicate the efficiency scores averaged over the 2007 - 2018 sample period. Municipal categories - A and B1-B4, and abbreviation for provinces are as previously defined

Efficiency scores for the provision of sewerage services are estimated for a sample of 112 municipalities. For scores equal to or less than 1, only 32 municipalities (or 28.6% of the sample) are efficient in the delivery of sanitation services. In terms of geographical distribution, 15 of the efficient DMUs (or 47%) are located in the Western Cape (see regions with light blue shading on the map in top right quadrant of Figure 7). Category wise, local municipalities with mainly small towns at their core account for almost half (15) of efficient DMUs.

Figure 7 : Spatial mapping of average municipal efficiency scores for electricity, sewerage, solid waste & water services, 2007-2018



Source: Authors' Calculations. Average scores are for the 2007-2018 period. Number of Municipalities in sample: Electricity-183, Sewerage-112, Waste removal-183, Water-119

Over the period reviewed, 74 municipalities are ranked inefficient in delivering sewerage (and sanitation) services. Of this figure, 48 municipalities (or 65%) are Category B3 municipalities mainly located in the provinces of the Northern Cape (15) and the Free State (14), respectively. A notable finding is that inefficiency is not solely a function of municipal size as over the sample period, 3 metropolitan municipalities (Buffalo City in the Eastern Cape, eThekwini in Kwazulu-Natal and Mangaung in the Free State) and 10 B1 municipalities - Matjhabeng in the Free State; Newcastle, Msunduzi and City of uMhlatuze in Kwazulu-Natal; Polokwane City in Limpopo; City of Mbombela and Emalahleni in Mpumalanga; and JB Marks, Madibeng and Rsustenburg in the North-West province, averaged efficiency scores greater than 1. A seemingly consistent observation is the efficiency with which municipalities made up of smaller towns provide both electricity and sewerage services. This may be attributed to the advantage such municipalities gain from servicing areas with smaller populations, with lesser strain on municipal capacity and infrastructure than is the case for municipalities

that administer more densely populated locations.

With most municipalities mandated to provide solid waste management, efficiency scores are estimated for a sample of 183 municipalities. The results indicate that 23 municipalities are on the best practice frontier having obtained efficiency scores of one. 18 municipalities are located beyond the estimated production-possibility frontier as over the sample period, they exhibit output-oriented efficiency less than one. As the bottom left map in Figure 7 indicates, these highly efficient and efficient DMus (or 22% of the sample) are distributed across South Africa's nine provinces, with the Western Cape accounting for the highest number of 5 highly efficient and 7 efficient municipalities, respectively. With 142 (78%) of the 183 municipalities examined recording efficiency scores greater than one, the provision of waste management services is the most inefficient function carried out by the local government sphere during the period reviewed. 114 (80%) of the 142 inefficient DMUs are either B3 (76) or B4 (38) municipalities mainly located in the provinces of the Eastern Cape (24), Kwazulu-Natal (22) and Limpopo (15).

Efficiency scores in the provision of water services are computed for a sample of 119 municipalities. In a water-scarce country that is ranked as one of the 40 driest countries in the world, only 27 (23% of the sample) municipalities are efficient while 4 are highly efficient water service providers during the review period (see Table 6). The efficient municipalities are mainly comprised of 17 B3 municipalities, with 10 (59%) of these local governments located in the Western Cape. The remainder of efficient municipalities are spread over 2 metropolitan municipalities/large cities (Nelson Mandela Bay in the Eastern Cape and City of Cape Town in the Western Cape), 2 secondary cities (Emfuleni in Gauteng and Mestsimaholo in the province of the Free State), and 4 municipalities with a large town as its core (Emakhazeni in Mpumalanga, and the local municipalities of Breede Valley, Overstrand, Mossel Bay and Outdshoorn all located in the Western Cape). Interestingly, despite its status as one of South Africa's most arid provinces, the Western Cape is the most efficient region with 20 of its 24 (83%) local municipalities efficient or highly efficient DMUs in delivering water services to their residents.

Given their efficiency scores, 88 municipalities (or 74% of the sample) can be classified as inefficient in the provision of water services during the review period. The number of inefficient DMUs includes 6 metropolitan municipalities - the cities of Ekhurhuleni, Johannesburg and Tshwane in Gauteng; Mangaung in the Free State; eThekwini in Kwazulu-Natala and Buffalo City in the Eastern Cape. The bulk of the 88 inefficient municipalities are B3 local governments (55) mainly located in the provinces of the water-scarce Northern Cape (17 municipalities) and the Free State (13 municipalities), respectively (see areas in dark blue shading in the lower right map of Figure 7). One problematic issue with the inefficiencies in the provision of water, especially in the metropolitan municipalities, is that quite often, delivery shortfalls are characterised by significant water losses stemming from poorly maintained and depreciating infrastructure (South African Institution of Civil Engineering, 2017). Such infrastructure related inefficiencies impose additional costs on the water delivery functions in metropolitan and secondary cities (Wall, 2021).

5 Conclusion

In South Africa, the local government sphere is a strategic feature within the 1996 Constitution. This is effected by mandating municipalities to play a "developmental role" by fulfilling the "basic needs" of

their communities. This study, with knowledge of the systemic challenges and observed service delivery failures in South Africa, explores whether the local government sphere can be classified as inefficient in fulfilling its core mandate. To achieve this, this study explores the public expenditure efficiency of South African municipalities and provides a comparative perspective of the results. For this purpose, this paper constructed a composite index of municipal performance, across dimensions of quality and access, in the delivery of the four main mandated basic services. Using these composite indicators as output measures and municipal spending on service delivery functions as the input measure, the partial frontier efficiency analysis (PFEA) methodology was then applied to the data set. This, on its own, is a major contribution of the paper, with the application of the PFEA methodology to municipal performance a first of its kind for decentralized governance systems in an African country setting.

The study finds that, of South Africa's 213 local municipalities, only 97 are constitutionally mandated to provide all four main basic services of electricity, Water, sewerage and solid waste removal. The results indicate that municipal size and location do not necessarily translate into relatively efficient service delivery. From estimated efficiency scores, 61% of municipalities are highly efficient in providing all four basic services, with the bulk of these been municipalities administering small towns. The Western Cape, where the foundations for the system of local government in South Africa was laid in 1836, is the province where all municipalities are highly efficient in delivering basic services. In terms of each of the main basic services and over the sample period, inefficiency was high, with the share of municipalities unable to provide their citizens with an efficient level of electricity, water, sewerage and water services ranging between 65% - 78%. In this aspect, we find that the number of efficient municipalities is highest in the delivery of electricity services (at 35%) and lowest in the provision of waste services (at 22%).

Lastly, on average, service delivery efficiency of South African municipalities declined over the sample period. For example, the average efficiency score across all South African municipalities was 0.995 in 2007, in comparison to 1.003 in 2018. While municipal efficiency in the provision of water, electricity, and sewerage services showed some improvements over the same period, the local sphere's performance in delivering solid waste removal was characterised by a consistent decline.

In the pre-2000 political dispensation, South Africa's local government sphere comprised 843 municipalities, with each municipality responsible for, on average, three of the country's 2,345 cities and towns. This average increased to eight following successive consolidation and re-demarcation processes that reduced the number of municipalities to 284 in 1999/2000, 283 in 2006, 278 in 2011, and finally 257 in 2016. A key driver of most amalgamations is the assumption that economies of scale and financial viability can be achieved in larger municipalities. Given the the persistently poor state of service delivery across municipalities, there is a view that consolidation of municipalities improves their effectiveness and efficiency. Our results suggest that smaller municipalities are relatively more efficient in providing basic services. Very often, municipalities are faced with the challenge of allocating small budgets to providing public services to towns and cities spread over vast areas. Outside of the main metropolitan areas and secondary cities, the capacity of mainly rural municipalities is further stretched by the need to provide services to jurisdictions with low population densities.

As part of comprehensive efforts to enhance municipal service delivery functions, consideration should be given to creating more, and smaller municipalities complemented by a pragmatic approach

which places an emphasis on ensuring municipalities are able to focus on those services for which they are most efficient in providing. In this regard, finalizing the practicalities of implementing a differentiated approach to service delivery, especially in a manner that takes into account the varied capacities at the local sphere when assigning expenditure (and revenue) functions to municipalities, will enhance reform agenda to improve municipal service delivery efficiency.

Concerning future work avenues, the work in this paper can be extended to investigate the issue of *why* municipalities are efficient or inefficient in their service delivery functions . Given the structure and framework of the local government sphere, is the extent of efficiency driven by administrative and financial capacities to develop, implement and manage budgets? Is efficiency a function of socio-economic characteristics of a municipality or is it due to stability in political and administrative structures that manage municipal functions? Whereas historical elements might be significant in explaining the differences observed in efficiency outcomes. Future research could explore the application of multivariate regression techniques to analyze how the efficiency indicators obtained relate to municipal variables of control and thereby, provide insights on the determinants of efficiency. Understanding how variables across a range of municipal characteristics impact efficiency may point to different and far-reaching policy implications for ongoing refinements to South Africa's intergovernmental fiscal framework.

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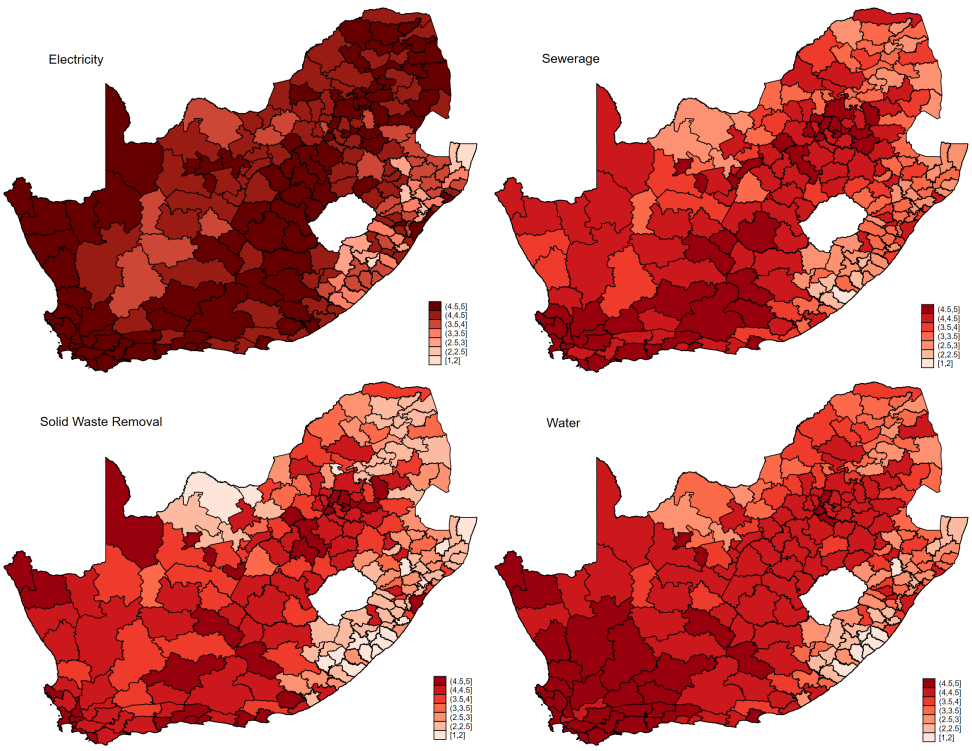
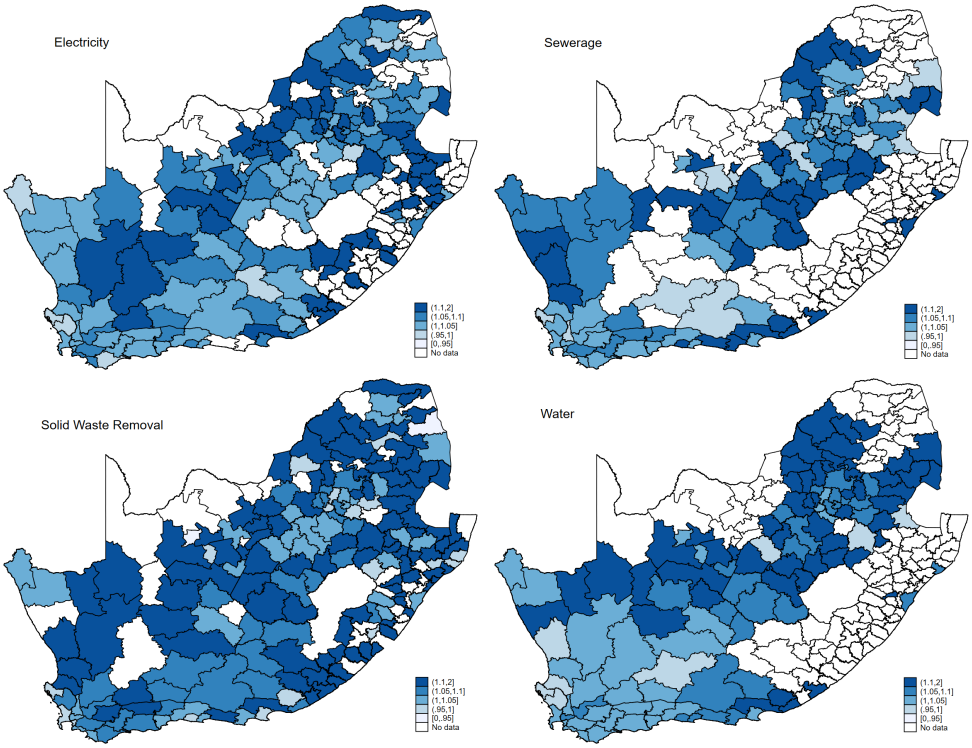
A Appendix

Figure A1 : Service Access Index Scores Across Municipalities, 2018



Source: Authors' Calculations.

Figure A2 : Spatial mapping of municipal efficiency scores for electricity, sewerage, solid waste & water services, 2018



Source: Authors' Calculations.

Table A1 : Municipal rankings by output-oriented efficiency scores, Average for 2007-2018

Rank	Municipality	Score	Rank	Municipality	Score
1	Saldanha Bay	.9501305	50	Bela-Bela	.9989867
2	City of Cape Town	.9602227	51	Mbombela/Umjindi	.999344
3	City of Johannesburg	.96525	52	Emakhazeni	.9994733
4	Drakenstein	.9741501	53	Thaba Chweu	.9995273
5	Mossel Bay	.9741958	54	Tswelopele	.9997058
6	Richtersveld	.9744554	55	Kannaland	.9997391
7	Swartland	.9746723	56	Sundays River Valley	.9998251
8	Cape Agulhas	.9750753	57	Mogalakwena	.9999521
9	Beaufort West	.9754255	58	Dr Pixley Ka Isaka Seme	.9999887
10	Nama Khoi	.9779561	59	New	.9999921
11	City of Matlosana	.9779859	61	Chief Albert Luthuli	1
12	Stellenbosch	.9780076	61	Mkhondo	1
13	Nelson Mandela Bay	.9781628	61	Nkomazi	1
14	Gamagara	.9790011	63	Thabazimbi	1.000193
15	Emfuleni	.9793545	64	Phumelela	1.000285
16	Sol Plaatjie	.9799507	65	Hantam	1.00083
17	Govan Mbeki	.9813425	66	Polokwane	1.001021
18	Matjhabeng	.983636	67	Ga-Segonyana	1.001437
19	Makana	.9837745	68	Msukaligwa	1.001853
20	Hessequa	.9850854	69	Masilonyana	1.001995
21	Knysna	.9855957	70	Metsimaholo	1.002066
22	Swellendam	.9856002	71	The Msunduzi	1.002177
23	George	.9861698	72	Victor Khanye	1.002287
24	Witzenberg	.9863055	73	Thembelihle	1.002355
25	Langeberg	.9863347	74	Kai !Garib	1.003283
26	Overstrand	.9873062	75	Ndlambe	1.003519
27	Emthanjeni	.9875308	76	Mangaung	1.004049
28	Bergrivier	.9877135	77	Maluti a Phofung	1.004593
29	Kgatelopele	.9885929	78	Mogale City	1.006437
30	Ekurhuleni	.9895606	79	Letsemeng	1.007776
31	Lesedi	.9899167	80	Maquassi Hills	1.007911
32	Merafong City	.9899502	81	Siyancuma	1.008698
33	Bitou	.9901662	82	Municipality of Madibeng	1.00887
34	Steve Tshwete	.9902228	83	City of Tshwane	1.009354
35	Cederberg	.9905475	84	Dikgatlong	1.011621
36	Oudtshoorn	.991618	85	Setsoto	1.013781
37	Umsobomvu	.9930815	86	uMhlathuze	1.015569
38	Ngwathe	.9936169	87	Ventersdorp/Tlokwe	1.016621
39	eThekwini	.9938135	88	Tokologo	1.020648
40	Camdeboo/Ikwezi/Baviaans	.9945894	89	Blue Crane Route	1.021265
41	Breede Valley	.9949374	90	Newcastle	1.024182
42	Nala	.9952027	91	Modimolle/Mookgophong	1.025198
43	Theewaterskloof	.9953866	92	Emalahleni	1.027626
44	Mantsopa	.9954098	93	Dihlabeng	1.028016
45	Dipaleseng	.9957407	94	Lephalale	1.033073
46	Matzikama	.9974229	95	Midvaal	1.055129
47	Magareng	.9977068	96	Rustenburg	1.059208
48	Laingsburg	.9982968	97	Buffalo City	1.076024
49	Khâi-Ma	.9986258			

Table A2 : Municipal rankings by output-oriented efficiency scores, 2018

Rank	Municipality	Score	Rank	Municipality	Score
1	Drakenstein	.9760942	50	Setsoto	.9997037
2	Richtersveld	.977684	51	Thaba Chweu	.9997465
3	Nama Khoi	.9790103	52	Cederberg	.9999269
4	Mossel Bay	.9803503	53	Saldanha Bay	0.959942
5	Bitou	.9827039	54	City of Cape Town	0.9698114
6	Knysna	.9836376	55	City of Johannesburg	0.9711843
7	Swartland	.984059	56	Beaufort West	0.9755017
8	Overstrand	.9845055	57	Tswelopele	1
9	Cape Agulhas	.984605	58	Maluti-A-Phofung	1
10	Govan Mbeki	.9852848	59	Phumelela	1
11	Emfuleni	.985451	60	Thabazimbi	1
12	Ndlambe	.9863957	61	Mogalakwena	1
13	Kannaland	.9865006	62	Chief Albert Luthuli	1
14	Hessequa	.9877802	63	Mkhondo	1
15	Stellenbosch	.988258	64	Dr Pixley Ka Isaka Seme	1
16	City of Matlosana	.9883747	65	Nkomazi	1
17	Bergrivier	.9896904	66	Dikgatlong	1
18	Rand West City	.9902194	67	Gamagara	1
19	Emthanjeni	.991266	68	Madibeng	1
20	Nala Local	.9919435	69	Matzikama	1
21	Mantsopa	.9920263	70	Metsimaholo	1.002001
22	Dr Beyers Naudé	.99212	71	Lesedi	1.003277
23	Makana	.992918	72	Ga-Segonyana	1.003421
24	Theewaterskloof	.9935258	73	Mangaung	1.005927
25	Umsobomvu	.9935746	74	City of Ekurhuleni	1.008988
26	Bela-Bela	.9940593	75	Steve Tshwete	1.009198
27	Msukaligwa	.9943585	76	Khai-Ma	1.009468
28	Witzenberg	.9945003	77	Maquassi Hills	1.009863
29	Kgatelopele	.9948251	78	Mogale City	1.012148
30	Swellendam	.9949819	79	City of Tshwane	1.016873
31	Langeberg	.9951488	80	City of uMhlathuze	1.017394
32	Letsemeng	.9952579	81	Laingsburg	1.017404
33	Msunduzi	.9954222	82	Polokwane	1.020427
34	Magareng	.9955463	83	Oudtshoorn	1.020551
35	Kai !Garib	.9956107	84	Lephalale	1.025958
36	Emakhazeni	.9959736	85	Sol Plaatje	1.027315
37	Ngwathe	.9963	86	JB Marks	1.030722
38	Matjhabeng	.9966601	87	Merafong City	1.030804
39	Thembelihle	.9966902	88	Breede Valley	1.032386
40	Nelson Mandela Bay	.9973425	89	Victor Khanye	1.037336
41	Modimolle-Mookgophong	.9974465	90	Dihlabeng	1.038606
42	Blue Crane Route	.9974474	91	Newcastle	1.044466
43	eThekwini	.9977664	92	Midvaal	1.050285
44	Dipaleseng	.9978537	93	Rustenburg	1.073809
45	George	.9982666	94	Siyancuma	1.082631
46	Hantam	.9983612	95	Buffalo City	1.089748
47	Sundays River Valley	.9985042	96	Tokologo	1.092819
48	City of Mbombela	.9993525	97	Emalahleni	1.09321
49	Masilonyana	.9995643			