Efficiency of South African Local Government: A Comparative Study of Determinants Using Subjective Satisfaction and Conventional Measures

A Research Report submitted in partial fulfilment of the Degree of

Master of Commerce (Economics)

in the School of Economic and Business Sciences,

University of the Witwatersrand

by

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Word Count:

Excluding appendices: 18 564

Including appendices: 23 301

28/09/2018

Declaration

I declare that this study has been composed solely by myself and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where states otherwise by reference or acknowledgment, the work presented is entirely my own.

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Jolandi Swanepoel

Acknowledgements

I would like to thank both my supervisor, Prof Kollamparambil, and the Public Affairs Research Institute for their inputs into this paper.

This degree was made possible by the funding provided to me by the Public Affairs Research Institute, but I would like to thank the staff and fellows there for so much more than that. The guidance given to me by an excellent set of researchers was invaluable in producing this work, but also in shaping me as a researcher. I received many opportunities to present and discuss my progress with incredibly useful insights being provided, which helped me refine my work. I was also included in a supportive and encouraging research space that inspired me to produce my best, most rigorous work. I place great value on my time spent at the Public Affairs Research Institute and thank them for helping to make me a better researcher, thinker, and person.

I would like to extend my thanks to Prof Kollamparambil who, despite her huge workload, made time to give me the guidance and advice I needed. She is an absolute expert in her field, as well as a phenomenal researcher. Her experience and insight made a significant contribution to this work and my approach to the field and I would like to thank her for that.

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Abstract

Efficiency analyses of local government structures are well researched and have provided important insights into local governance. Most of the existing literature uses observable and tangible output measures to calculate whether municipalities are efficient – this study broadens the literature by using residents' subjective satisfaction levels with service delivery as the main output measure, using local municipal data from South Africa. This analysis uses Data Envelopment Analysis to establish how relatively efficient municipalities are to one another. In addition to this, this study assesses which municipal characteristics contribute to the efficiency of these municipalities using bootstrapped DEA and Tobit analysis. These relationships are also found for conventional models and a comparison is done to establish that using subjective satisfaction adds additional information that conventional models do not exhibit. This study shows that a number of municipal characteristics are correlated with efficient municipalities and the models using subjective satisfaction are correlated either with different characteristics, or in some cases, with the same characteristics, but in different ways. From this comparison, we found that efficiency with respect to satisfaction includes elements of quality of service provision and differing perceptions amongst people, while the conventional model only provided insight into access.

1. Introduction

Efficiency analyses of local government structures are well researched and have provided important insights into local governance. Most of the existing literature uses observable and tangible output measures to calculate whether municipalities are efficient – this study broadens the literature by using residents' subjective satisfaction levels with service delivery as the main output measure. In addition to determining how efficient municipalities are, this study will endeavour to assess which municipal characteristics contribute to the efficiency of these municipalities.

There are a number of reasons that the analysis in this study is important, ranging from practical to theoretical concerns. Practically, it is important to know which municipalities are performing well, and possible reasons for their success so that policy changes can be made to improve all municipalities. Theoretically, subjective satisfaction allows us to measure the true success of service delivery, as the purpose of a service is not the provision of the service itself as an end, but rather the improvement of the lives of citizens, as is discussed below.

The policy implications of this study are fairly clear: municipalities that are performing badly need to be investigated and assisted by provincial or national government and the characteristics that are correlated with increased efficiency should undergo further analysis to test for causality, and should that prove true, other municipalities should be altered to exhibit these characteristics, where possible. Conversely, characteristics that are negatively correlated with efficiency should be investigated and reduced where possible. As part of a broader policy discussion, this study contributes to the literature on centralisation. As further discussed below, there has been a drive towards decentralising government functions in South Africa, placing more responsibility on local government structures. For this approach to be feasible, the local government must be capable of providing basic services that are of a reasonable quality and are accessible by all residents; this can best be achieved by more efficient municipalities. Inefficient municipalities either provide the required services to their residents, but at a greater cost, or fail to provide services adequately and in both cases, the state should consider whether service provision could be improved by a more centralised system. This study does not aim to answer that question but is made important and relevant by the extent of decentralisation that has happened in South African local government structures.

Given that an obligation on the government to provide services exists, we must establish that subjective satisfaction is a desirable way to measure the success of this service delivery. The South African Constitution states in its preamble the following:

> "We, therefore, through our freely elected representatives, adopt this Constitution as the supreme law of the Republic so as to - heal the divisions of the past and establish a society based on democratic values, social justice and fundamental human rights; lay the foundations for a democratic and open society in which government is based on the will of the people and every citizen is equally protected by law; improve the quality of life of all citizens and free the potential of each person …" (Republic of South Africa, 1996)

This highlights two important elements: firstly, that human rights, including access to some basic services, as well as broader rights such as dignity, which arguably cannot exist without the provision of basic services, must be respected. This respect for human rights can, in part, be measured in tangible outcomes, however, the second important element is the reference to the quality of life of all citizens, which speaks to a larger question than simply whether a household has access to a service. Quality of life is inherently a subjective understanding of a person's own life, as discussed below, and thus tangible measures could include access to services, and even the quality of services, but cannot incorporate the value citizens attach to services and how these services impact their quality of life. Thus, in order to evaluate if municipalities adhere to the mandate given in the Constitution, one must incorporate subjective satisfaction as a measure.

Lastly, this study is of importance based on empirical evidence: 99% of South Africans feel that living conditions (e.g. access to piped water in their dwelling, access to a safe and reliable toilet facility, access to electricity, access to adequate housing) are either very important or important for maintaining or improving the standards of living of their household (Statistics South Africa, n.d.). Thus, the efficiency with which local government provides these services is important to the citizenry and warrants further research.

The research questions for this paper are: using both subjective satisfaction and conventional measures, how relatively efficient are South African municipalities, which factors correlate with that efficiency, and how do the subjective and conventional analyses compare? The DEA provides efficiency scores to address the first question, which allows us to find that a variety of characteristics are correlated with efficiency, with municipal income per capita,

gross value added, whether the municipality is urban, wealth of residents, and the education levels of residents contributing to most of the municipal services provided. Most importantly, this study found discrepancies between the conventional model and the subjective satisfaction model, showing that different characteristics contribute to efficiency in different ways depending on the model. This shows that the use of subjective measures provides additional information, such as the quality of services or the perceptions of service provision, which cannot be gleaned from conventional models alone.

This paper proceeds with a literature review in section 2, a discussion on methodology in section 3, data and descriptive statistics in section 4, the presentation of the results in section 5, a conclusion in section 6, and four appendices.

2. Literature Review

Conceptually, this study combines two main frameworks: efficiency and subjective satisfaction. Both are situated in a well-analysed body of literature and this study aims to combine these using a two-stage analysis. In addition, this analysis will also be done using conventional measures as a contrast to subjective satisfaction. As such, each of these elements is discussed below, as well as the history and context of South African municipalities, which is the main vehicle for this amalgamation of concepts.

2.1 South African Municipalities

South African municipalities have struggled to provide adequate services to their constituents. The Auditor General found that the lack of accountability measures remained the root cause of delivery problems and that municipalities had not acted to improve their systems. This is dire, given that only 19% of municipal audits were declared clean in the 2015-2016 financial year (Auditor General, 2016a). It is important to understand how the local government structures work in South Africa, as well as the history of their creation.

The Apartheid government of South Africa had a complex process of (de)centralisation, with the gradual centralisation of all structures in areas they deemed to be valuable, but allowing the homelands to act as independent areas. This combination of central control in some areas, as well as complete decentralisation in others, created a complex system of local government that the democratically-elected government inherited (Wittenberg, 2003).

The new government opted to decentralise the Apartheid system (Padayachee, 2006). This occurred for a variety of reasons, some of which included an international trend towards

decentralisation, a focus on a developmental local government, and the improved accountability mechanisms local government provides (Padayachee, 2006; Republic of South Africa, 2000). The theory of why decentralisation of government improves the capacity of government to fulfil their mandate is a well-explored concept in economics. Starting with the basic concepts such as the Theory of Clubs (Buchanan, 1965) and the Tiebout Model (Tiebout, 1956), economists have established that structures that can more closely align themselves with people's revealed preferences are better able to provide services. This, in conjunction with a developmental focus, led to the system of governance in South Africa that created the Integrated Development Plan (IDP), which emphasised the developmental role of local government (Padayachee, 2006). The international movement towards decentralisation also encouraged this shift in the new South African government, as it contributed to the aim of integrating South Africa back into the global markets, which was one of the main focuses of the then current economic policy, the Growth, Employment, and Redistribution (GEAR) plan (Padayachee, 2006).

Given this increased decentralisation, the new government became comprised of three levels: national, provincial, and local; this study focuses on local service delivery and will examine local municipalities, as defined by the 2011 census boundaries. Local government is divided into metropolitan, local, and district municipalities (Republic of South Africa, 1996); the focus here is on metropolitan and local municipalities as they provide the services which form the basis of the study. The National government is responsible for policy development which is then implemented at a sub-national level: provincial government is responsible for services such as education and health, whereas local government takes care of water, sanitation, electricity and refuse removal (Mahabir, 2014).

This study will use the contextual and historical relevance of decentralisation to emphasise its importance, rather than attempt to cast judgement of the success of the decentralisation, as is done elsewhere in the literature (Beall, 2004; Cousins & Kepe, 2004; De Visser, 2005; Kauzya, 2007; Mogale, 2003). Despite the drive towards decentralisation, local government still faces significant influence from provincial and central governments. The Constitution of the Republic of South Africa (1996) stipulates in Chapter 7 that "A municipality has the right to govern, on its own initiative, the local government affairs of its community, subject to national and provincial legislation, as provided for in the Constitution," which legally allows for higher levels of government to become involved in local affairs. Financially, this is also spurred on by the provision of intragovernmental grants, as discussed below. This results in

local government technically having the capacity to self-govern, but being subject to, and in some cases, dependent on higher levels of government. The Constitution adds an additional caveat, that "The national or provincial government may not compromise or impede a municipality's ability or right to exercise its powers or perform its functions," which affords local government a higher degree of decentralisation legally but may enforce intra-governmental dependence by encouraging the provision of intra-governmental grants. In addition to this, the national management of state-owned enterprises (SOEs) also limits local government. One of the four main services provided by the local government is electricity, which is currently supplied by the SOE, Eskom. Competition is negligible, and prices and policies are set at the national level. This control over electricity provision essentially ties the hands of local government, as it is dependent on national action to provide electricity (Muller, 2017). These elements contribute to blur the distinctions between the different levels of government and complicate any analysis that seeks to separate a level of government from other.

However, this dependence can quite reasonably be justified by the historically charged spatial inequality in South Africa. While some municipalities rely on local rates and taxes to provide the majority of their income, others depend entirely on intragovernmental transfers to finance their service delivery, as their constituents are not able to pay the required rates (Mahabir, 2014). This is an indication that results from this study may vary significantly depending on the circumstances in which the municipality operates. Transfers are made up of national, provincial, and horizontal local government transfers and consist of both conditional and unconditional grants[1] (South Africa National Treasury, 2008). In the table below, the number of municipalities that receive the indicated percentage of their total income from transfers is shown. From this, we see that 166 out of the 278 municipalities for which data is available receive at least 50% of their total income from transfers. This significant reliance on other parts of government, mostly the national government, shows how complicated the system of decentralisation has become.

[1] A variety of conditional grants are made available to municipalities by national government. These grants range from relief grants, like the municipal disaster grants, to developmental grants, such as the municipal infrastructure grant. Each of these grants have specific requirements and necessary outputs, which limit municipalities in the ways that they can spend this grant (Republic of South Africa, 2016). The more dependent a municipality becomes on conditional grants, the less autonomous it becomes, which, in theory, reduces the benefits of local government service delivery.

Table 1: Percentage of total income attributed to grants

Percentage of Total Income Attributed to Grants	**Number of Municipalities**
0% - 9%	8
10% - 19%	15
20% - 29%	31
30% - 39%	27
40% - 49%	31
50% - 59%	36
60% - 69%	41
70% - 79%	49
80% - 90%	29
90% - 100%	11

The complex environment in which South African municipalities[2] exist, as well as the importance of service delivery, as discussed below, make the study of local government and its ability to enact what it is mandated to provide relevant and important. While the context discussed above makes the analysis more difficult to isolate, a critical appraisal of its performance may indicate the success or failure of the current system and could lead to an improved over-arching structure.

2.2 Role of (Local) Government

Given that this paper focuses on the current South African government, the backdrop of a constitutional democracy is assumed and is used as a benchmark for good governance. In doing so, this paper places emphasis on the duties outlined in the South African Constitution and thus focuses on one of the more intuitive and widely accepted assumptions about governments: that they exist to improve the welfare of their citizens (Helliwell & Huang, 2008). While a variety of indicators that quantify tangible effects exist, these measures are simply instruments for what governments aim to evaluate: welfare. This paper will attempt to bridge the gap between objective indicators and the government's fulfilment of its mandate

[2] This complex environment of decentralisation and local government dependency, as well as the horizontal inequalities between municipalities is not unique to South Africa. Situations similar to these are seen throughout the developing world (Ebel & Yilmaz, 2002), and thus research that seeks to clarify how these interactions take place is valuable.

by using a direct measure of welfare: subjective well-being. This important and hitherto unexplored link is what makes this paper a valuable contribution to the literature.

The South African government has been defined as a developmental state (Koma, 2010), which has used local government as a privileged space for this development, as it is the level of government closest to the people (Thornhill, 2008; Van der Waldt, 2006). When looking at local government, the Constitution of the Republic of South Africa (1996) emphasises the provision of basic services; in Sections 152 and 153 it states that "The objects of local government are… to ensure the provision of services to communities in a sustainable manner…" and that "A municipality must… structure and manage its administration and budgeting and planning processes to give priority to the basic needs of the community, and to promote the social and economic development of the community…" This mandate places local government at the heart of service delivery, and because that service delivery speaks to the provision of the basic requirements to lead a decent life, local government is placed at the heart of poverty alleviation (Mogale, 2003).

2.3 Efficiency

To establish a definition of efficiency, Cooper, Seiford, & Tone (2006) use the Pareto-Koopmans definition, which is Pareto efficiency adjusted for production economics. The definition of the former reads, "A Pareto optimum is a welfare maximum defined as a position from which it is impossible to improve anyone's welfare by altering production or exchange without impairing someone else's welfare" (Pearce, 1986). This was then extended by Koopmans (1951) by adding efficiency prices, or multipliers, to create the Pareto-Koopmans definition of efficiency: "The performance of a DMU [decision-making unit] is efficient if and only if it is not possible to improve any input or output without worsening any other input or output". This implies the following definition of inefficiency, relevant to DEA analysis: "The performance of a DMU is inefficient if and only if it is possible to improve some input or output without worsening some other input and output." This defines the efficiency frontier, as only DMUs that subscribe to this definition can be efficient (Cooper et al., 2006).

The easiest way to understand the measurement of productive efficiency is to consider a ratio of input to outputs. If a process has one input and one output it is easy to calculate how efficient the process is, however, seeing as municipal services require a variety of inputs and produce multiple outputs, some thought must be given so that an index of inputs and outputs

can be created. Often market prices are used to assign weights to inputs and outputs, but the fact that public outputs often do not have prices complicates the analysis (Fried, Schmidt, & Lovell, 1993). This was overcome using national cost weights in a Norwegian study (Borge, Falch, & Tovmo, 2008) but the analysis would still be served better if a subjective weighting was not needed.

The decision around which inputs and outputs to include in an analysis is not a new consideration, stemming from a discussion by Knight (2013) originally published in 1933, which looked at including too many inputs and outputs and concluded that only relevant factors should be considered. Conversely, Stigler (1976) looked at including too few factors and found that this too was detrimental. Including too many or too few inputs or outputs clouds the analysis, and thus it is important to include only the relevant ones (Fried et al., 1993). This paper simplifies this process by using expenditure and satisfaction as inputs and outputs. Using monetary expenditure, ideally, necessarily includes only the relevant inputs, as anything that was paid for by the municipality was deemed to be required for the functioning of the municipality. This, however, rests on the assumption that municipalities spend their resources ethically and correctly. Given that it is unlikely that all municipalities spend their income perfectly, this is a problematic assumption. However, if one approaches the topic pragmatically, one will assume that some mismanagement of funds, whether malicious or negligent, is likely, and given that (especially with South Africa's municipal record (Auditor General, 2016a)), it becomes reasonable to include misspending as a necessary, if undesirable, input. Thus, expenditure is a catch-all variable for both the legitimate items value is attached to, as well as the unjustifiable but existing items that form part of the inputs required to provide municipal services. Using a satisfaction measure as the output also incorporates all the necessary outputs, as for how satisfied a resident feels will depend on the quality and quantity of a service and necessarily any other relevant factors. While expenditure may include irrelevant factors, a person's satisfaction level is only going to include important factors: if a characteristic of a service is not important to a person it will not affect their satisfaction with the service. As an example, if one measures the quality of refuse removal by what happens to the refuse after collection (landfill, recycled, etc.) then a person who is concerned about the environment will include this in their feeling of satisfaction with the service, but if a person does not care about the environment, what happens to the refuse will be irrelevant to them and thus will not form part of what makes up their satisfaction level. In this way, each person includes only the relevant factors, optimizing the output measure. This

is a particularly useful characteristic, as any conventional measure is unlikely to be all-encompassing without including unnecessary facets. As an example, the conventional analysis in this paper uses the distance between a household and its water source as a measure of service delivery, which includes the category of households whose water source is less than 200m from their dwelling. While this is an objective measure of delivery, it does not include external factors, such as the ease with which people may be able to access this water source. A household with a tap inside their dwelling would be grouped with a household that needs to transport water for 200m, possibly without sufficient manpower to facilitate this. While the former situation is likely to satisfy residents, the later would probably not. Using conventional measures, all these external factors would need to be accounted for, e.g. does the household own enough buckets to carry the water, are there enough able-bodied household members to transport sufficient water, etc. Without including these external factors, the conventional measure does not allow for an accurate input-output comparison, as discussed above. The use of a subjective measure eliminates the need for painstakingly accurate data, as a person's satisfaction will automatically include all the relevant, and only the relevant, external factors. This claim places a lot of emphasis on satisfaction being very important. This importance is shown by government's mandate, which focuses on welfare and stipulates that service delivery is the vehicle for that welfare. Satisfaction with service delivery combines these elements as it provides a measurable interpretation of welfare in terms of service delivery, justifying its importance in this context. Thus, the use of subjective satisfaction creates a 'black box' effect, as we cannot be sure what exactly influences satisfaction levels, but as long as the factors that are at play within the satisfaction decision-making process are relevant, we obtain more accurate results than with conventional measures that require a judgment to be made about which external factors are relevant.

2.4 Subjective Satisfaction

Subjectivity plays a philosophical role in well-being: subjectivists would argue that one can only derive well-being from something if there was a want for it in the first place (Heathwood, 2014). This manner of thinking can be adjusted to this paper by looking at the subjectivity of satisfaction: not whether a person wants a service, but rather how much they value it, which can be investigated by looking at satisfaction level. The use of a subjective measure is intuitively persuasive: a good can only be valuable insofar that it improves people's lives according to those people (Heathwood, 2014). This idea becomes particularly relevant when considering the public element of service provision: objective measures may be descriptive

but may not speak to the needs of the community in question and in that case, the public sector fails its intrinsic governmental mandate, which speaks to the role of the state, as discussed above.

Alternative forms of measuring the progress of government are well used. Measures such as the Human Development Index ('Human Development Index (HDI) | Human Development Reports', n.d.) provide an alternative way of measuring a government's progress, beyond the standard economic variables, such as gross domestic product. The literature focuses on a composite index often referred to as 'quality of life' or subjective well-being and these indices include a variety of factors; most include a material element, like income, and a subjective element which looks at how a person perceives their quality of life (White, 2009). While this paper will not focus on overall well-being, the nature of the responses being inherently subjective allows for an overlap in the theoretical approach and methodological considerations and thus subjective well-being literature will be discussed.

Subjectivity has been avoided in quantitative research in the past with good reason and some cautions suggested by the literature are discussed here. The first concern is that of variability: one person's perception of a satisfactory life (or in this paper, outcome) could be starkly different from another's. This is particularly relevant in a country such as South Africa, as these differences in opinions may be rooted in the lived experiences of poverty. Adaptation refers to the changes in people's perception of their own circumstances based on external factors; this adaptation can happen both in a downwards direction, as well as upwards. The former is more commonly discussed: people who live in poverty suppress their wants and desires to be commensurate with their circumstances and in adapting downwards they provide a biased opinion of their experiences (Clark, 2009). With regards to upward adaptation, people's subjective well-being has been shown to be related more significantly to their rank in their society rather than their absolute position (Kuziemko, Buell, Reich, & Norton, 2014). Considering South Africa's staggering inequality ('GINI index (World Bank estimate) | Data', n.d.), people may be less satisfied than they would have been had they not had a more affluent group in society to compare themselves with. Thus, downward adaptation could bias results upward as people perceive their situation more positively, while upward adaptation could have the opposite effect if people feel they are worse off, particularly in comparison to others in their society. Another concern is that of the relative importance of factors that contribute to well-being. An element in a person's life may contribute to a diminished state of well-being, but this may not necessitate government action, thus if that

factor significantly skews the person's well-being, inappropriate policy actions may be taken. This is less likely to be a problem in this study as specific opinions about certain services are looked at, but it could bias the implied relationship between spending, services and overall well-being: a community may not be best served by public funds in the form of basic services (White, 2009). The above-mentioned concerns can become problematic when subjective responses are used as indicators against which governments measure their progress, as this study attempts to do.

Incorporating subjective measures has become more common, with Diener & Suh establishing the importance of using subjective measures in 1997. They found that not only do subjective measures add substantial value to the more commonly used tangible measures but they include information that is not contained in other measures. This is due to the composition of a subjective evaluation, which is made up of two parts: the affective and cognitive parts. The latter is the objective and information based evaluation of circumstances, while the affective part is based on emotions, feelings, and perceptions (Diener, 1994). While the cognitive elements of service delivery could be investigated using conventional measures, this affective element is the additional information that only a subjective measure can determine.

Since then, studies have made use of subjective measures, particularly in relation to quality of life (Costanza et al., 2007; Diener & Suh, 2000; Priebe, Huxley, Knight, & Evans, 1999; WHOQOL Group, 1995). Thus, this study will attempt to capitalise on the specific benefits that subjective measures provide but will have to consider how these results have been affected by known drawbacks to using this kind of data.

Subjective measures are particularly valuable in the study of public goods. A fundamental characteristic of money is its ability to ascribe value to an item or service, which forms a basis for the effective functioning of markets. When goods are provided by the government, it is often done free of charge, and even when tax revenue is used to deliver these goods and services, they are not paid for directly, e.g. a taxpayer may fund the provision of street lights but does not pay for the use of a specific street light at a specific time. These dynamics distort the use of money in establishing supply and demand for government-provided services, which means alternative measures must be sought to evaluate them. Subjective satisfaction with a service does this well, as a person's satisfaction with it includes their own understanding of the demand and supply of the service, as well as factors such as its quality.

This paper is inspired by the sparse but existing literature that sought to do similar work. A broad study based in contemporary Britain examined the effects of public policy on citizens' well-being and found that policy changes affected the micro level (individual) well-being of people and was exhibited in both cognitive and affective changes in opinion (Whiteley, Clarke, Sanders, & Stewart, 2010). Another study found that subjective well-being was more closely aligned with the quality of government than GDP was (Helliwell & Huang, 2008). These studies provide comparable examples in favour of the hypothesis that government spending is directly related to citizens' well-being. Diener, Lucas, Schimmack, & Helliwell (2009) analyse the specific pitfalls of using subjective well-being data in the policy realm and conclude that it remains a valuable and important evaluative tool for governmental policies, further confirming the value of this research.

3. Methodology

This study will make use of DEA, which uses input-output analysis to evaluate the efficiency of a decision-making unit. Each DMU, in this case, each municipality, will receive an efficiency score between zero and unity indicating the degree of efficiency. The score is based on a reference DMU, the 'efficiency frontier', which represents the most efficient DMU and all efficiency scores are calculated in reference to that DMU. The DEA analysis will produce a multiplier for each input and output, allowing one to see how the efficiency of a DMU will be affected by a change in one of the factors; this can also assist in doing sensitivity analysis to see how easily a change in factors can affect the efficiency of a DMU (Cooper et al., 2006).

A benefit gained from using DEA is the compilation of inputs and outputs without the need for assigning weights, as one would in a standard index; DEA also does not require a known functional form, as many statistical analyses do. While the use of weights can be very useful, it necessitates assumptions and subjective decisions, as one would have to decide, for example, the importance of an input compared to another input; as mentioned above, this is particularly difficult in the absence of prices. DEA eliminates the need for these subjective decisions to be made by creating optimal weights for each DMU, that is, it uses a set of weights for each DMU that maximises the output-input ratio (Cooper et al., 2006).

There are two main approaches to DEA: evaluating a single output, in this case, a specific service, such as water provision, and evaluating the global efficiency of a DMU, here, combining all outputs to determine how efficient a municipality is overall. Both of these

approaches have been widely tested[3] and this study will make use of the former. Despite the extensive number of studies completed, none have used subjective satisfaction as the main output measure, which is the main contribution of this study to the literature (Cooper et al., 2006).

Once efficiency figures have been calculated for municipalities, this study will endeavour to investigate which factors may play a role in explaining why some municipalities are more efficient than others. As was described above, municipalities in South Africa vary greatly in the environments in which they operate. A series of papers have found that the following factors increase efficiency: high local taxes, educational levels of the population (De Borger & Kerstens, 1996a; Vanden Eeckaut, Tulkens, & Jamar, 1993), larger populations, levels of commercial activity (Balaguer-Coll, Prior-Jimenez, & Vela-Bargues, 2002), high share of fees in municipal income, high investment share in expenditure (Athanassopoulos & Triantis, 1998), a larger share of municipal workers aged 35-49, and dense urban structure (Loikkanen & Susiluoto, 2006). Conversely, the same studies found that the following factors have a negative effect on efficiency: higher per capita income and wealth of citizens, per capita grants, the number of coalition parties in power, higher tax revenue, population density, parties affiliated with the central government, peripheral location, larger populations, high unemployment, diverse service structure, and a larger share of services bought from other municipalities (Afonso & Fernandes, 2005). Given the diversity of these results and the fact that some results are contradictory, this study will investigate a broad variety of factors and will include factors that may be specifically relevant to South Africa, for example, the race composition of a municipality's residents.

There are three prominent South African examples of DEA being used to evaluate municipalities. The first is by Monkam (2014) who uses a similar methodology and concludes that some municipalities are significantly inefficient and that fiscal autonomy and the number and skill levels of the top management of a municipality's administration influenced the efficiency levels in municipalities. The second study was done by Van der Westhuizen & Dollery (2009) and also using DEA, found that most municipalities either

[3] The following studies examined single output cases Bouckaert (1992); Burgat & Jeanrenaud (1994); Davis & Hayes (1993); and Kalseth & Rattsø (1995) while these studies looked at a global output measure: Vanden Eeckaut, Tulkens, & Jamar (1993), Borger, Kerstens, Moesen, & Vanneste (1994), De Borger & Kerstens (1996a), De Borger & Kerstens (1996b), Athanassopoulos & Triantis (1998), Worthington (2000), Prieto & Zofio (2001), Balaguer-Coll, Prior-Jimenez, & Vela-Bargues (2002), and Loikkanen & Susiluoto (2006) (Afonso & Fernandes, 2005).

exhibited increasing or decreasing returns to scale, indicating that they were not operating at the optimal scale. Lastly, Brettenny & Sharp (2016) use DEA to examine the efficiency of local municipalities in terms of the provision of water in order to establish which municipalities are in need of additional interventions. Internationally, a number of studies have used this approach to evaluate efficiency in the public sector, but as in the South African case, conventional measures are used as outputs and not subjective satisfaction. Afonso & Fernandes (2005) provide an excellent summary of a number of papers that have completed this analysis, as well as presenting their own analysis for the Portuguese government.

4. Data and Descriptive Statistics

4.1 Data

A series of datasets were used to compile this analysis. The Community Survey is a survey performed by Statistics South Africa every ten years, coinciding with the midpoint between the preceding and proceeding census years. The survey happens at the local municipal level and the data that will be used in this study will be the 2016 survey (Statistics South Africa, n.d.). Primarily, the specific questions in the survey that are used include individual satisfaction with a variety of municipal services, namely electricity, refuse removal, sanitation and water provision. The data is accessed through Easy Data (EasyData, n.d.).This, in addition to the Municipal Finance Management Act data supplied by the National Treasury for the 2015/2016 financial year (South Africa National Treasury, n.d.). This data was chosen as it is disaggregated into the different services and is available at the local government level.

This analysis using more standard measures from South African data has been done by Monkam (2014) and it was repeated here with updated data. It should be noted that the original paper used the Non-Financial Census as a data source, but this source had a significant number of missing values in 2016 and thus the Community Survey was used here instead. The conventional analysis will use the number of consumer units provided for each service as defined as follows. For water provision, the number of households that had a water source that was inside their dwelling or less than 200m away was used as the output variable. Electricity output was measured as how many households had access to electricity billed by their municipality, or prepaid meters installed by their municipality. Sanitation was defined as households that had access to a flushing toilet that was connected either to a sewerage system or to a septic tank. Lastly, refuse removal output was measured as the number of households whose refuse was removed by a local authority, private company, or community members.

While the standard approach to testing relationships is to use Ordinary Least Squares, this study will make use of Tobit models and the bootstrapped DEA model instead. In terms of the Tobit model, this is because of the way that DEA limits the score it assigns a municipality. Municipalities are rated in terms of efficiency relative to one another, which creates upper and lower limits; in this case, the lower limit is 0 and the upper limit is 1. Given that the data is inherently confined between 0 and 1, a Tobit model is ideal, as it is a regression method formulated to deal with data bounded between 0 and 1. The bootstrapped DEA model was first used by Simar & Wilson (2007); it was developed as through using the bootstrap technique, it produces a data generating process, unlike the naïve two stage DEA analysis, which includes variables that are serially correlated. The second stage analyses makes use of several datasets, most accessed through EasyData. Further information from the Community Survey was used, as well as demographic, income and production, and labour data collected by Quantec as part of their Regional Service Indicators, and the non-financial census of municipalities. Additionally, information about political parties was sourced from the Electoral Commission of South Africa's website ('Electoral Commission : Municipal election results', n.d.), and audit outcomes were obtained from the Auditor General website (Auditor General, 2016a). In all the datasets, the 2011 demarcations were used and data was gathered at the person level and not the household level.

Given that a number of datasets were combined to perform the analysis, some municipalities had missing values in some variables and were dropped from the analysis. Additionally, all national, provincial, and district observations were removed from the analysis as this study looks at satisfaction with services provided by local municipalities. Some municipalities also had slightly different names and spellings in different datasets and these details are also noted. Seeing as the Auditor General audits municipalities and other state-owned organisations, the latter were excluded from the analysis. These details can be found in Appendix 1.

It should be noted that the extent of the analysis in this study was hampered by the availability of data. Ideally, panel data would have been preferred as it would have allowed for the differencing out of individual, time-invariant characteristics, but the Community Survey did not include questions on service satisfaction in their 2007 survey. The General Household Survey did include questions about satisfaction with water and electricity provision over many years, but the data is not available at the municipal level, making it insufficient for this analysis.

4.2 Statistical Approach

As discussed in detail above, a DEA is used. A series of analyses are completed and in each, there is a single input: expenditure. An analysis for each service is done and these are single-input-single-output analyses. It is valuable to note that the DEA method does not have any assumptions regarding endogeneity, making it a particularly useful method of analysis.

Mathematically, the study assumes that outputs (Y_i) are a function of inputs (X_i) and should the output value be smaller than the input value, an inefficiency exists:

Equation 1

$$Y_i = f(X_i)$$

where i indicates the municipality and runs from 1 to 228. Thus, if $Y_i < f(X_i)$ municipality i is inefficient and the degree of inefficiency can be calculated by the distance to the theoretical efficiency frontier (Afonso & Fernandes, 2005). The bootstrapped model uses the original data sample and resamples from that set of data many times to create the data generating process.

The data is provided at a municipal level and six possible levels of satisfaction could be chosen. The six levels are: good, average, poor, no access, do not use, and unspecified. Using each of these categories unnecessarily complicates the analysis, as a natural split exists between a good rating and a bad rating; in this case, the first two categories will be counted as ‘good’, while the other four will be considered ‘bad’. The last two categories together make up just over 1% of the population and thus will be considered negligible and will be included in the ‘bad’ category. The value that forms the output in the DEA is the proportion of residents who rated the service as either good or average.

Expenditure per capita will be used to make municipalities of different sizes comparable. Given that municipal spending in South Africa generally only covers water, sanitation, electricity and refuse removal, these services are focused on and the satisfaction levels of each service are the single output. The DEA results range from 0 to 1 and are relative; this means that a municipality that receives a score of 1 is the most efficient municipality in the dataset and any deviation from 1 indicates the percentage improvement that is possible; examples of the interpretation are provided with the summary statistics.

Two specifications must be chosen when doing a DEA. The first is whether the focus is on maximising output for a given input or minimising input for a given output (Cooper et al.,

2006). In this study the methods provide quite disparate results for the subjective measures, but similar results when using conventional outputs:

Table 2: Correlation between input and output method DEA scores

Service	**Correlation Between Input and Output Methods**
Electricity using subjective satisfaction	0.3012
Electricity using conventional measures	0.9924
Sanitation using subjective satisfaction	0.4006
Sanitation using conventional measures	0.9233
Refuse Removal using subjective satisfaction	0.5456
Refuse removal using conventional measures	0.9210
Water using subjective satisfaction	0.4120
Water using conventional measures	0.7980

Theoretically, the output method may be more applicable in this context, as government's mandate is to provide basic services, as is established in the Constitution and thus the satisfaction with those services should be maximised. Additionally, the input in this study, expenditure, may be exogenous: rates and taxes do not change frequently and a municipality may not be able to control the income it receives from other levels of government, thus it would be futile to try and minimise expenditure in this study.

The second specification is what returns to scale should be used. If constant returns to scale are assumed, the input and output methods would yield the same results, but DEA does not force us to make this assumption, as variable returns to scale can be used (Afonso & Fernandes, 2005). In terms of subjective satisfaction, there is no evidence that municipalities exhibit constant returns to scale, as can be seen in the summary statistics below as well as the vastly different results from the input and output models. even though the conventional methods exhibit higher levels of correlation, there is not sufficient justification for using constant returns to scale and thus, this study makes use of variable returns to scale.

Once the DEA was completed, the efficiency scores are included in either the bootstrapped DEA or the Tobit regression analysis to investigate which municipal characteristics are correlated with (in)efficient municipalities as follows:

Equation 2

$$\delta_i = \alpha_i + \beta W + \varepsilon_i$$

where: δ_i is the efficiency score calculated through the DEA for municipality i

α_i is the constant

W[4] is a vector of explanatory variables

β is the coefficient vector associated with W

ε_i is the error term

The benefit of the Tobit model is that $\delta_i \varepsilon [0,1]$. The bootstrapped DEA was used in the models based on subjective satisfaction and Tobit models were used for the conventional measures; the latter was because the bootstrapped DEA did not converge in the conventional model. Two additional models were considered: a standard ordinary least squares (OLS) model and a truncated regression. The latter differs from the former by the imposition of lower and upper bounds on the dependent variable (0 and 1 in the case of the DEA scores). In order to test the robustness of the models the bootstrapped DEA models were also run as Tobit models and the Tobit models were also run as truncated regression models. When the truncated regression models did not converge, OLS models were run. In all cases the results were similar and we find that the results are robust to different techniques. These results can be seen in Appendix 4.

Given that the data is made up of three levels that form subsets of each other (provincial, district and local municipalities), each of these levels needs to be investigated as this causes the data to become hierarchical. The lowest level, local municipalities, form the basis of the analysis and the provincial level is accounted for by adding provincial dummies into the second stage models. To address the middle level, district municipalities, we cluster the variance in the Tobit, OLS, and truncated regression models by the district municipality. This approach ensures that all hierarchical effects are accounted for.

[4] Each of these variables is noted and its theoretical reason for being included is discussed in the result section.

4.3 Summary Statistics

4.3.1 Subjective Satisfaction

As a preliminary attempt to investigate the nature of the data, below are simple scatter plots showing the relationship between expenditure per capita for each service and the proportion of residents who rated the specific service as either good or average.

The graphs below indicate a generally positive relationship between satisfaction and spending, with water and reuse removal exhibiting quadratic relationships. This indicates that in all cases besides for electricity, increased spending tends to correlate with increased satisfaction, but this effect only applies up to a certain point in the cases of water and refuse removal, as the quadratic relationship shows. Electricity has an almost horizonal slope, indicating that satisfaction levels are not correlated very much with spending; this may be because Eskom is the national energy provider and municipalities may be dependent on the parastatal. An example may be the national Load Shedding programme by Eskom[5], which would reduce satisfaction levels, but is outside of the control of municipalities. The other services are not centrally controlled and thus exhibit some more variation.

Table 3: Descriptive statistics for satisfaction levels by services

Proportion of People Who Rated the Service as Good or Average	**Number of municipalities**	**Mean**	**Std. Dev.**	**Min**	**Max**
Electricity	228	0.8323	0.1063	0.2266	0.9681
Refuse Removal	228	0.6214	0.2365	0.2009	0.9767
Sanitation	228	0.7357	0.1269	0.3647	0.9648
Water	228	0.7421	0.1610	0.2091	0.9743

Refuse removal has lower levels of satisfaction and a higher variance, whereas the other services are similar in satisfaction levels and have a smaller variance.

[5] Load Shedding is an approach that Eskom uses to limit electricity usage in times of high demand. When the power grid is under sufficient strain, certain areas are not supplied with electricity for a set period of time in order to reduce the demand on the entire system and to prevent a "blackout", which is a situation in which the electricity stores are depleted (Eskom, n.d.).

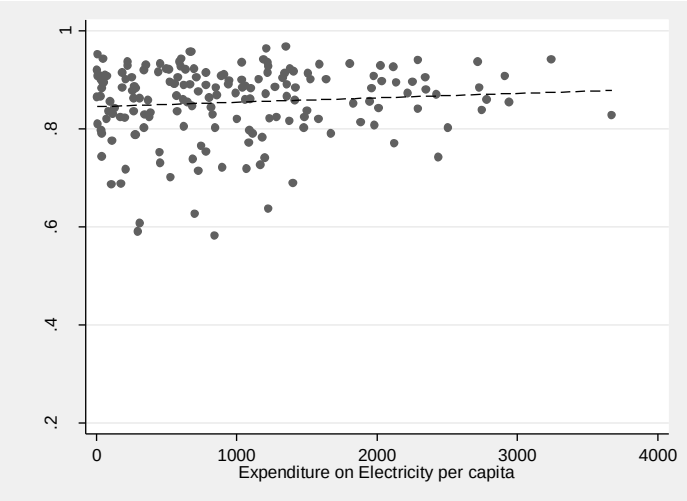

Figure 1: *Scatter plot for satisfaction levels for electricity provision against electricity expenditure per capita in 2016*

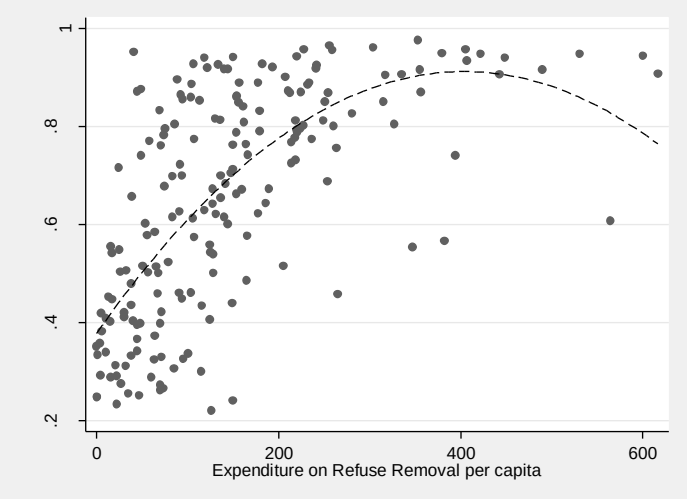

Figure 2*: Scatter plot for satisfaction levels for refuse removal against refuse removal expenditure per capita in 2016*

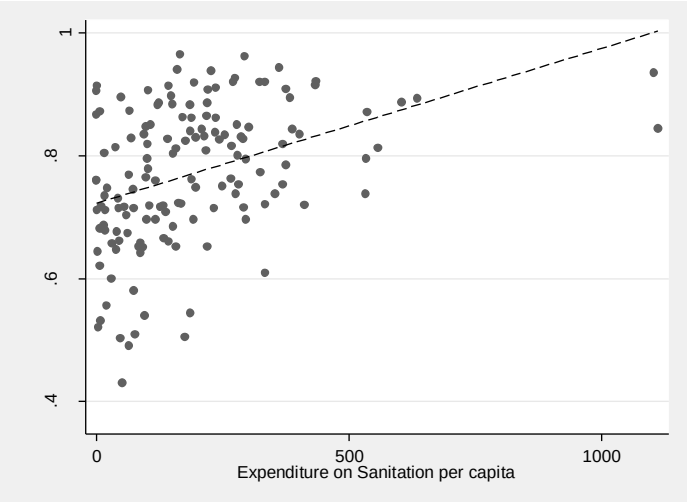

Figure 3: *Scatter plot for satisfaction levels for sanitation provision against total sanitation expenditure per capita in 2016*

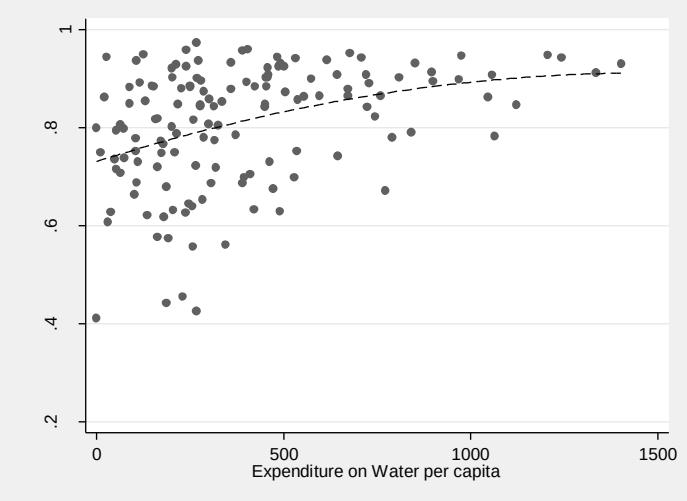

Figure 4: *Scatter plot for satisfaction levels for water provision against total water expenditure per capita in 2016*

Looking next at the results of the first stage of the analysis, the DEA results, we find the following:

Table 4: DEA results by service[6]

DEA Score	**Number of Municipalities**	**Mean**	**Std. Dev.**	**Min**	**Max**
Electricity using subjective satisfaction	176	.8898297	.07947	.6048082	1
Electricity using conventional measures	176	.0999208	.1517172	.0027506	1
Sanitation using subjective satisfaction	146	.812719	.1168348	.4633235	1
Sanitation using conventional measures	146	.1017477	.1972139	.0010761	1
Refuse removal using subjective satisfaction	192	.718155	.2131236	.2300345	1
Refuse removal using conventional measures	192	.0833513	.1523502	.0009309	1
Water using subjective satisfaction	140	.8396876	.1227907	.4381763	1
Water using conventional measures	140	.1074595	.2014153	.0001586	1

[6] The scores can be interpreted as follows: an input efficiency score of, for example, 0.5769 means that the municipality could achieve the same levels of satisfaction with roughly 42.31% fewer resources, while an output efficiency score of 0.9012 means that a municipality could achieve satisfaction levels 9.87% higher with the same expenditure.

It is immediately apparent that the DEA scores generated from the conventional measures are much lower than the DEA scores from subjective satisfaction ratings. Whether this is a level effect, or whether the datasets exhibit completely different patterns is of interest and discussed next.

4.3.2 Comparison to Conventional Measures

Having looked at the summary statistics based on subjective satisfaction, we compare these directly to a conventional model which uses tangible measures as the outputs in the DEA. The tangible outputs are the number of consumer units that a municipality is able to provide, i.e. how many households are provided with electricity, water, sanitation, and refuse removal. The comparison provides an interesting insight into the use of subjective satisfaction as another measure of municipal efficiency, as there are significant differences, as can be seen in the T-Tests performed below. The mean and standard error refer to the difference in the DEA scores, that is, the DEA score using the conventional method subtracted from the DEA scores using subjective satisfaction.

Table 5: T-Test results comparing conventional and subjective DEA scores

Service	**Mean**	**Standard Error**
Electricity	.789909***	.12663
Sanitation	.7109713***	.0174003
Refuse removal	.6348037***	.0173225
Water	.7322281***	.0209081

Significance indicated at the following levels: * 10%, ** 5%, and *** 1%

In all cases there is a significant positive difference, indicating that the DEA scores using subjective satisfaction are generally higher than those using the conventional data. It is important to note that there is limited correlation between the subjective DEA scores and their conventional counterparts:

Table 6: Correlation between subjective and conventional DEA scores

Service	**Pearson Correlation**	**Spearman Rank Correlation (p-value)**
Electricity	0.0461	-0.1131 (0.1351)
Sanitation	0.1810	0.0839 (0.3140)
Refuse Removal	0.1697	0.0879 (0.2256)
Water	-0.1123	-0.2151 (0.0107)

The full results of the DEA can be found in Appendix 2. Table 6 and 7 show significant differences, both in terms of level effects and in the rank, indicated by the Spearman Rank Correlation. For the latter, the p-value is in reference to the null hypothesis that the satisfaction and conventional DEA scores are independent. The p-values for all the services besides for water are higher than 0.1, indicating that the subjective satisfaction measures are independent of the conventional measures. There is significant rank correlation when looking at water provision, but the correlation is negative, indicating that the more efficient municipalities based on subjective satisfaction are some of the less efficient municipalities when using conventional measures. This along with the Pearson correlations indicate that we are likely to get very different results from the two models.

This result confirms that using subjective measures could provide additional information that cannot be gleaned from standard measures and is thus worth investigating. This additional information is in the context of quantity and demand. When using the conventional measure, the only information we have is how many consumer units were provided – this does not include whether this amount was in excess or not enough, or of what quality this provision was. A satisfaction rating necessarily includes these elements, as a resident will only be satisfied if they received a service they wanted, in the correct quantity, and of an acceptable quality.

5. Results

The available literature on municipal efficiency, as well as the persistent characteristics of the South African society, provide us with a wealth of options to investigate. The results presented below present a refined model born from a process of testing and eliminating a series of variables that theoretically could have been significant. The eliminated variables are discussed after the main results are presented as their complete or limited lack of significance also provides interesting insights. All continuous variables were included both linearly and as squared values to account for non-linear relationships and where the squared variable is not reported, it was not significant.

5.1 Results: Electricity

Table 7: Results for electricity provision models

	Bootstrapped DEA Scores using Satisfaction for Electricity using Tobit	DEA Scores using Conventional Measures for Electricity using Tobit

Gross Value Added Per Capita	-1189.6*	-460.6
	(-2.39)	(-1.90)
Proportion of Households with a Female Head	-18.10	-20.85**
	(-1.41)	(-3.16)
Proportion of Households with a Female Head Squared	19.26	21.78**
	(1.51)	(3.26)
Number of Unemployed People (thousands)	-0.000185	0.00185***
	(-1.07)	(9.38)
Wealth Score	0.0307***	0.00150
	(5.23)	(0.62)
Constant	5.181	5.040**
	(1.59)	(3.08)
sigma	0.0891***	
	(11.20)	
N	172	176

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Looking first at the models for electricity provision, we see that the models are much opaquer than the other services. This is not unexpected, as when examining the descriptive statistics, one can see that electricity has a smaller variance than the other services. As has been mentioned before, this could be because of the centralisation of electricity provision in the form of Eskom, the parastatal responsible for electrifying the country. It is likely that factors affecting efficiency lie within Eskom, rather than with the municipalities that are dependent on the parastatal.

In the subjective satisfaction model two variables are significant: gross value added per capita and the wealth score. Balaguer-Coll et al. (2002) found that the level of commercial activity in a municipality is correlated with efficiency and in this study, the gross value added (GVA) is used to measure that. The GVA per capita is significant but the GVA is not, indicating that the relationship is proportion and does not only become relevant at a specific threshold. Balaguer-Coll et al. (2002) suggest that this may be because businesses place more pressure on local government representatives to provide good services to their businesses, as it could affect their profit-making ability, and this is likely to benefit the entire community, not only the businesses. In this study, GVA per capita is only significant in the satisfaction model and not the conventional model, which matches the explanation given, but the effect is negative, which indicates that business activity decreases satisfaction. This could be because local government prioritises businesses over households. Alternatively, a higher GVA may attract those seeking opportunities, which could create an influx of migrants (von Fintel & Moses, 2017), placing more pressure on municipalities and lowering levels of satisfaction. This variable is not significant in the conventional model, indicating that the reduced efficiency is

related to perceptions, rather than tangible effects. This may be because residents perceive their services to be crowded out by businesses or migrants, rather than consumer units being provided less efficiently. As discussed before, this may be because residents are comparing themselves to others who appear better off and this reduces subjective satisfaction.

In terms of the wealth score, we see a significant, positive correlation between residents' wealth and efficiency of electricity provision in terms of satisfaction. This may be because many assets (including the assets used to compile the wealth score) require electricity and communities with limited access to reliable electricity are unlikely to own these types of assets. Beyond this correlation, a driving factor may be the community's influence on the municipality: if many residents own assets that require electricity, it is likely that they will place pressure on the governing structures to provide electricity efficiently. It should be noted that the latter effect would be in the form of quality of service, as the conventional model does not have wealth as a significant variable. This means that wealth is not correlated with *more* electrified dwellings, but rather with better *quality* provision.

Looking at the influence of gender, we see that the proportion of women in the municipality is insignificant. This variable was included initially because of the general pervasiveness of gender discrimination, particularly with regards to poverty, to which South Africa is not an exception (Kehler, 2013). This variable often is not significant because the aggregation across an entire municipality is likely to yield a 50% female ratio unless a community has a specific history, for example, areas that men travelled to for work under the Apartheid regime. A better indication of gender in this study is the gender of the household head, which is significant. The latter offers a better idea of gender discrimination as households headed by women experience the brunt of the discrimination and these households tend to be worse off (Flatø, Muttarak, & Pelser, 2017). Female headed households are no more or less satisfied, but communities that have a concentration of female headed households tend to have more efficient provision of consumer units in terms of electricity. This effect is matched closely by the negative, significant linear variable. This difference may be driven by specific programmes aimed at assisting female headed households and it is reasonable then that this effect is only observed in communities where this is very prevalent and such initiatives are more widespread. The negative linear variable shows that female headed households tend to receive less efficient electricity provision, indicating that municipalities need to improve service delivery to all female headed households and not just doing so in communities where there is a concentration of female headed households.

Loikkanen & Susiluoto (2006) found high levels of unemployment to be significant to municipal efficiency. This study tested for the employment rate, the percentage of unemployed people in a population, and the number of unemployed people. Only the last

variable was found to be significant, indicating that there is an absolute threshold at which unemployment becomes relevant, as opposed to a relative effect of the proportion of unemployed people, as Loikkanen & Susiluoto (2006) suggest. This increased level of efficiency associated with unemployment may be due to the pressure a community with more unemployed people place on a municipality. Unemployed people can purchase less electricity and thus these municipalities are forced to provide services with less income. Unemployed people may have more time available to them to place pressure on municipalities and that could be the vehicle for this increased pressure.

In both the cases of female headed households and unemployment prevalence, we do not see significance in the satisfaction model. This may be because expectations tend to be driven downwards for people who live in less favourable circumstances, which would be true for both female headed households and unemployed people. These people may simply be accustomed to harsher living standards and thus their satisfaction is not affected, even though they tend to receive less efficient service provision.

While electricity provision may be least affected by municipalities, the analysis above clearly shows that the factors that municipalities do control have very different effects in the two contrasted models. This affirms that considering subjective satisfaction adds information that the convention model would not have considered.

5.2 Results: Refuse Removal

Table 8: Results for refuse removal models

	Bootstrapped DEA Scores using Satisfaction for Refuse Removal using Tobit	DEA Scores using Conventional Measures for Refuse Removal using Tobit
Proportion of residents who stay on farms	0.511	-0.527***
	(0.93)	(-3.49)
Proportion of residents who stay on farms, squared	-0.489	1.330***
	(-0.39)	(4.21)
Proportion of residents whose household head is between the ages of 20 and 59, squared	-61.23**	14.01
	(-2.80)	(1.00)
Proportion of residents whose	-119.7**	27.45

household head is older than 60		
	(-2.78)	(0.98)
Proportion of residents whose household head is older than 60, squared	58.93**	-13.34
	(2.73)	(-0.93)
Proportion of residents whose household head is younger than 19	-84.60**	23.58
	(-2.73)	(1.04)
Proportion of residents who stay in an urban area	-0.633*	0.162
	(-2.39)	(1.27)
Proportion of residents who stay in an urban area, squared	1.067***	-0.124
	(4.30)	(-1.14)
Provincial Dummy: Eastern Cape	-0.720***	-0.0143
	(-4.51)	(-0.63)
Provincial Dummy: Free State	-0.739***	0.00463
	(-4.54)	(0.34)
Provincial Dummy: Gauteng	-0.538**	0.0493**
	(-2.88)	(2.63)
Provincial Dummy: KwaZulu Natal	-0.675***	0.0108
	(-4.19)	(0.64)
Provincial Dummy: Limpopo	-0.661***	0.0399
	(-4.02)	(1.31)
Provincial Dummy: Mpumalanga	-0.679***	0.0481***
	(-4.26)	(3.85)
Provincial Dummy: Northern Cape	-0.705***	0.00303
	(-4.46)	(0.23)
Provincial Dummy: North West	-0.635***	0.0284
	(-3.94)	(1.56)
Total income for the municipality	1.70e-08	6.03e-08***
	(0.98)	(15.64)

Constant	61.87** (2.85)	-13.92 (-0.99)
sigma	0.168*** (14.05)	
N	188	192

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

The refuse removal models provide more detail than the electricity model, as is expected due to its bigger variance.

Being a developing country with a history of HIV/AIDS, South Africa has a presence of child-headed households (Richter & Desmond, 2008), but also many households headed by elderly people, as grandparents raise children with the parents working away from home in order to earn more money (Pose, Fairburn, & Lund, 2006). In this context, this study investigates whether the age of the household head was correlated with efficiency and found the following. Each category of household head age (under 19, 20-59, and over 60 years) had a different size effect, although all were negative. Households with a household head in the 20-59 years age category had the smallest negative coefficient, followed by the category of those younger than 19 years. The category of household heads over 60 has the largest negative coefficient, however this is tempered by the opposing quadratic effect, which reduces the negative effect in municipalities with very many or very few household heads over 60 years. This increased dissatisfaction among more vulnerable groups may be due to the increased dependence they may have on municipal services. If refuse is not disposed of properly, less vulnerable groups may be able to remove it themselves, whereas more vulnerable household may not be able to do that and may be exposed to the health risks of refuse that is not disposed of. This would make these groups comparatively less satisfied. The conventional model does not include the age of the household head as a significant variable, indicating that the different age groups do not receive more or less efficient services, but their perception of that efficiency is affected by their vulnerability.

Loikkanen & Susiluoto (2006) suggest that whether a municipality is more urban or rural may be correlated with efficiency and this is found to be true in this study. The squared proportion of residents who live in an urban area has a positive correlation with efficiency in terms of satisfaction. This means that municipalities that are almost exclusively urban or rural tend to be more efficient at refuse removal, with a reduced effect in more mixed

municipalities. This may be because services can be tailored to the communities – very urban areas may have more regular collections or central collection points, whereas rural areas may have less cumulative waste and thus require less frequent removal of that waste. This effect is tempered by the negative coefficient for the linear variable in areas with a combination of rural and urban areas. The conventional model does not include the proportion of urban residents as a significant variable, but the proportion of residents living on farms behaves in a very similar way. This shows that both models are affected by how rural or urban a municipality is, but satisfaction is more closely correlated with cities and the conventional model is correlated more closely to farms, which simple represents the opposite end of the same spectrum.

Lastly, we see that the provincial dummies are significant. The comparison is to the Western Cape, and we see that efficiency with respect to satisfaction for refuse removal is negative in each case, indicating that the Western Cape is significantly more efficient. Given that it is the only province not governed by the ANC, there may be a system implemented by the provincial government to support refuse removal in all municipalities. It would be worth further investigation to see how this manifests and to adopt similar strategies in the other provinces. The comparison to the conventional model is very interesting in the cases of Gauteng and Mpumalanga, as these variables have positive significant coefficients, contradicting the satisfaction model. As in the Western Cape, further research should be done to see which processes at a provincial level improve the efficiency of refuse removal in Gauteng and Mpumalanga and special attention should be paid to why this does not translate into perceptions of efficiency.

The total municipal income is significant and positive in the conventional model which indicates that municipalities with higher income levels are more efficient. This result is inconsistent with other results: Moore, Nolan, & Segal (2005) found that richer municipalities are less efficient. Moore et al. (2005) suggest that this may be because when resources are scarcer, municipalities are under more pressure to be efficient. Because this variable is included as an absolute value, it indicates that this effect is seen after a threshold of income and is not necessarily proportional to the size of the municipality. This result indicates that there is a minimum threshold at which efficiency is likely to occur when using consumer units as a measure. This may be because of economies of scale or the fact that these richer municipalities have more buying power, but their efficiency at providing more consumer units does not translate into higher satisfaction levels for residents. This may be because

managing the large numbers of services that are provided is logistically difficult and even if people receive more services, they may be less satisfied if these services are provided badly or not maintained well. This is an important variable, as it shows that large budgets may lead to more services, but not necessarily better services, pointing to the value of using subjective satisfaction as a measure.

As with the electricity models, we see that the difference between the subjective satisfaction model and the conventional measures model indicates that there is additional information included in subjective satisfaction measures. The models for refuse removal have more overlap in terms of how urban municipalities are but indicate disparate results for the effects of different provinces, again providing insight that the conventional model by itself would not.

5.3 Results: Sanitation

Table 9: Results for sanitation models

	Bootstrapped DEA Scores using Satisfaction for for Sanitation using Tobit	DEA Scores using Conventional Measures for Sanitation using tobit
Population size	-0.126	1.360***
	(-0.62)	(3.89)
Population size squared	1.70e-13	5.94e-13***
	(1.19)	(4.30)
Gross value added, squared	-0.0000227	-0.0000636***
	(-1.46)	(-4.07)
IDP submitted	-0.0347	0.129**
	(-1.06)	(2.75)
The municipality monitors water quality	0.00837	-0.142**
	(0.34)	(-2.69)
Nominal Compensation Per	10.37	28.31***

Capita Squared		
	(0.86)	(3.50)
Proportion of Employed People	-1.829***	0.855
	(-4.14)	(1.38)
Proportion of Employed People Squared	1.525***	-0.740
	(3.67)	(-1.38)
Proportion of residents whose household head is between the ages of 20 and 59	-0.543**	0.0579
	(-2.60)	(0.30)
Proportion of Households that are of Size 6-10 People	3.089**	-0.507
	(2.95)	(-0.42)
Proportion of Households that are of Size 6-10 People, squared	-5.953***	0.954
	(-3.40)	(0.43)
Proportion of residents who have no formal education	0.708*	0.565
	(2.03)	(1.83)
Proportion of residents whose highest qualification is completed secondary education, squared	0.827	-1.827*
	(1.09)	(-2.03)
Proportion of resents who live	0.167***	0.181**

in urban areas, squared		
	(4.35)	(3.22)
Total municipal income	4.41e-08	-0.000000160**
	(1.22)	(-2.77)
Audit dummy: Adverse with findings	-0.421***	-0.0248
	(-4.50)	(-0.46)
Audit dummy: Audit not finalised at legislated date	-0.140***	-0.0262
	(-3.45)	(-0.53)
Audit dummy: Qualified with findings	-0.151***	-0.0388
	(-4.70)	(-0.78)
Audit dummy: Disclaimed with findings	-0.134***	0.0655
	(-3.61)	(1.05)
Audit dummy: Unqualified with findings	-0.0849**	-0.0626
	(-2.75)	(-1.48)
Number of unemployed residents	0.000505	-0.00524**
	(0.39)	(-3.33)
Percentage of unemployed residents	-0.00902***	0.00352
	(-4.68)	(1.85)
Constant	1.454***	-0.431
	(6.63)	(-1.40)

sigma	0.0779***	
	(14.70)	
N	141	146

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

When analysing the provision of sanitation, a wealth of variables is found to be significant. Looking first at the proportion of people who are employed in the municipality, we see a negative correlation in the satisfaction model, with a positive squared proportion to temper the correlation in municipalities with very high or low employment rates. This is similar to what was seen in the model for electricity, but in this model the rates are significant for employed people and not the absolute number of unemployed people, which is closer in line with the finds of Loikkanen & Susiluoto (2006). The negative linear relationship may be explained by a lack of pressure on these municipalities. This could be driven by the fact that employed people are more likely to pay their rates and taxes and thus the municipality has more income available and thus less drive to be efficient. The effect of the squared variable is to reduce the negative relationship in municipalities with very high or very low employment rates. In municipalities with very low rates of employment, less income will be generated from rates and taxes and municipalities will be forced to be more efficient due to their limited funds. Conversely in communities with high employment rates, we may see residents placing pressure on municipalities to perform as they are likely spending more of their income on rates and taxes. Seeing as this variable is only significant in the satisfaction model, these inefficiencies are only experienced through perception and not in terms of consumer units and is likely to be a reflection of the quality of the service provision. When looking at a related variable, that of the percentage of unemployed people, we see that it has a negative relationship in the satisfaction model, but this effect is much smaller than the effect seen from the percentage pf employed people, and so the percentage of unemployed people simply diminished the effect of the proportion of employed people, rather than contributing in a distinctly different way. The conventional model, however, is correlated with the number of unemployed people, indicating that the negative correlation between unemployment and service provision only becomes relevant at a certain level of unemployment.

In terms of the composition of households, we see that households headed by a person who is of working age see sanitation as being less efficient in terms of satisfaction. This may be because this is a relatively privileged group – they are more likely to be better off than households headed by children or the elderly, as discussed above. These more vulnerable groups may have adjusted their expectations downwards to be in line with their circumstances, while households with working age heads would not have done so and have a negative perception of service delivery of sanitation. We also see that household size is important: communities where there is a very high or very low concentration of households with 6-10 residents are negatively correlated with efficiency in terms of satisfaction. This effect is tempered by the smaller, positive coefficient for the linear variable. As discussed by Anjou & Ravallion (1995), the relationship between poverty and household size is not clear and because other poverty measures were tested, we can assume that household size variables indicate something other than poverty. This is also not an indication of whether the household is in a rural or urban environment, as that was included as a separate variable. Household size does not have an influence in the conventional model, which is expected, as the conventional model would consider providing sanitation to a household with one person the same as providing the exact same service to a household with 10 residents. While these two consumer units are counted equally, the household in which 10 people need to share a service will probably be less satisfied with that service, as additional connection points or more frequent maintenance would be required for the same level of satisfaction as smaller households. This may simply be a size indication not picked up by the population size variable. As an example, two municipalities with the same number of residents could have different household compositions: one may have more households with fewer people in each household, while the other may have fewer, bigger households. In terms of consumer units, municipalities would have to provide more units of service to the former municipality but could be doing it at the same level of satisfaction in both municipalities. This indicates the importance of using satisfaction as a measure, as municipalities that provide many consumer units may be deemed to be more efficient when in truth they are servicing fewer people and thus not contributing to satisfaction more than other municipalities.

The education levels of residents were found to be positively related to municipal efficiency (De Borger & Kerstens, 1996a; Loikkanen & Susiluoto, 2006; Vanden Eeckaut et al., 1993). In this satisfaction model, municipalities with higher concentrations of people with no formal education perceived their sanitation to be more efficient; this effect is likely because their

expectations are driven downwards by their circumstances or they may be less informed that formally educated people and thus may not be aware of the quality of service they are entitled to. The conventional model includes a negative coeffect for the squared proportion of residents' who have completed their secondly education. This means that communities where a very large or very small part of the population has completed high school (or an equivalent) receive less efficient consumer units. Municipalities may have a pro-poor focus and may spend additional time or resources on poorer areas, which are the areas likely to be dominated by people who have very little formal education. This would exclude those with completed secondary education, but these people may only be slightly better off than people with less education but could be receiving a lot less attention in terms of targeted programmes. This effect diminishes as people become more educated, as people with tertiary qualifications are more likely to be able to afford sanitation services and would reduce the pressure for efficiency.

Both models indicate that a higher concentration of urban residents is correlated positively with higher levels of efficiency. This is likely related to the infrastructural outlays required for sanitation: each water source and its associated plumbing will service more people in cities than in rural areas, driving up efficiency in terms of consumer units that are provided, as well as in terms of satisfaction, as this increased ease of provision could lead to higher quality service delivery. As in previous models we see the squared proportion as being significant: this shows that only municipalities that have very similar compositions of households in terms of the rural/urban split see these benefits, as it allows for specialisation in a certain approach to service delivery.

A tool used by the South African government to monitor municipalities is the annual municipal audit performed by the Auditor General. A summary of the findings is given to each municipality by indicating the extent to which the audit findings were qualified with one of five descriptions. These were included as dummy variables, with an audit described as "unqualified with no findings", which is essentially a clean audit, acting as the comparison. As is expected, all audit results that are not a 'clean audit' are negatively correlated with satisfaction of service delivery. Interestingly, this is not seen in the conventional model, indicating that a badly administered municipality affects the quality of service delivery rather than the quantity of consumer units provided. This could be because corruption could lead to substandard quality of the infrastructure, or a reduced focus on maintenance, as the budget allocated to these items may be funnelled away from communities. This is an important

distinction between the two models, as this provides important information about municipal administration that would not become apparent if only conventional models were being analysed.

When focusing on the conventional model, we see that while personal characteristics of the resents drive the satisfaction model, municipal characteristics drive the conventional model, as would be expected. Balaguer-Coll et al. (2002) and Loikkanen & Susiluoto (2006) found population size to be significant and we see this in the conventional model here too. Population size and its squared variable are significant and positive; this means that municipalities with more residents are more efficient at providing services. The positive effect could be explained by economies of scale, and additionally, the significance of population size could be related to metropolitan municipalities. A dummy variable for metropolitan municipalities was tested, but its lack of significance shows that the only statistical difference between metros and other municipality are their size. The significance in only the conventional model indicates that while larger municipalities provide consumer units more efficiently, this does not translate into satisfaction, which may indicate that larger populations place pressure on the quality of sanitation provide by municipalities.

In terms of gross value added, similar to the electricity provision model, we see a negative correlation, however this is in terms of the conventional model and not the satisfaction model, as with electricity. In the case of sanitation, the crowding out effect is seen tangibly, but perception is not affected, indicating that businesses may be driving the quality of service provision up.

The non-financial municipal census includes a list of agreements or plans that a municipality could have, some of which refer to service provision. The full list includes: whether the municipality has a funding agreement with Eskom, whether the municipality monitors effluent discharges, whether the municipality monitors water quality, whether the municipality submitted a Water Services Development Plan (WSDP), whether the municipality submitted an Integrated Development Plan, and whether the municipality has an HIV/AIDS policy. Only two of these which remain significant here is whether a municipality has an IDP and whether they test for water quality. The provision of an IDP is also only significant in the conventional model, indicating that an IDP is positively correlated with more efficient service delivery, but not with the satisfaction of residents. Unexpectedly, the monitoring of water quality is negatively correlated with efficiency of sanitation services.

This could be because such analyses move the focus away from quantity and towards quality but given that there is no positive correlation in the satisfaction models, this benefit is not being realised. There is a policy implication from this finding: the agreements and policies that are required of municipalities at the moment do not seem to improve service delivery as efficiency levels are not higher in municipalities that have adhered to these guidelines. This could imply that these agreements and policies should be re-examined or the extent to which they are implemented must be investigated. These effects are also more meaningful if a satisfaction comparison is available, as it allows us to see whether the quality of services is improved by these policies, which it seems not to be.

The significance of compensation and municipal income in the conventional model can be interpreted together. Compensation refers to the incomes that residents receive, but this affects municipalities by residents being able to afford more rates, taxes and services, which has an effect on municipal income. In terms of municipal income, we see that in generally richer municipalities are less efficient at providing consumer units, but in municipalities where very many or very few residents earn more money, the coefficient is positive. This could be because municipalities with many poorer people are forced to be more efficient as they have less income, and municipalities with many richer people could face more pressure from these residents as they feel they deserve more efficient services as they contribute more to these services. These pressures (or lack thereof) only affect the number of consumer units produced and not the satisfaction of residents.

Again, we see that the satisfaction model provides additional information that would be lost had only the conventional measures been considered.

5.4 Results: Water

Table 10: Results for water provision models

	Bootstrapped DEA Scores using Satisfaction for Water using Tobit	DEA Scores using Conventional Measures for Water using Tobit
Number of councillors per capita	-197.3	177.3*
	(-1.36)	(2.39)
Density squared	0.000000208	-0.000000266***
	(0.86)	(-5.96)

Population size	-0.255	1.340***
	(-0.87)	(7.24)
Population size, squared	-1.72e-13	6.64e-13***
	(-0.64)	(4.97)
Gross Value Added squared	0.0000101	-0.0000887***
	(0.39)	(-5.70)
Nominal Compensation Per Capita	13.73**	5.223
	(2.87)	(1.48)
Nominal Compensation Per Capita Squared	-126.2*	-20.39
	(-2.34)	(-0.60)
Total municipal income	0.000000103	-0.000000339***
	(1.23)	(-6.14)
Total municipal income, squared	-4.58e-17	1.40e-14***
	(-0.01)	(6.68)
Proportion of Employed People Squared	-0.484**	-0.00635
	(-2.97)	(-0.09)
Proportion of residents whose household head is between the ages of 20 and 59	-558.0**	183.5*
	(-3.22)	(2.13)
Proportion of residents whose household head is between the ages of 20 and 59, squared	62.87**	36.86*

	(2.75)	(2.31)
Proportion of residents whose household head is older than 60	-433.4*	257.0**
	(-2.56)	(3.36)
Proportion of residents whose household head is older than 60, squared	-62.82**	-37.64*
	(-2.70)	(-2.39)
Proportion of residents whose household head is younger than 19	-461.2**	240.6**
	(-2.73)	(3.10)
Proportion of Households that are of Size 6-10 People	0.0975	-0.330**
	(0.33)	(-2.68)
Proportion of residents whose highest level of education is completed primary school, squared	29.07*	1.492
	(2.15)	(0.34)
Proportion of residents whose highest level of education is some secondary school	5.289	5.182**
	(1.22)	(2.80)
Proportion of resents whose highest level of education is some secondary school, squared	-10.95	-7.838**

	(-1.56)	(-2.72)
Proportion of resents who are black Africans	0.397	-2.797***
	(0.21)	(-6.91)
Proportion of residents who are coloured	0.578	-2.899***
	(0.31)	(-7.14)
Proportion of residents who are white	0.617	-2.583***
	(0.32)	(-6.97)
Proportion of residents who live in urban areas	0.108	-0.127***
	(1.61)	(-4.34)
Provincial Dummy: Eastern Cape	-0.166**	-0.0377
	(-2.80)	(-1.64)
Provincial Dummy: Free State	-0.127	-0.0848**
	(-1.86)	(-3.02)
Provincial Dummy: Gauteng	0.110	-0.110**
	(1.01)	(-3.35)
Provincial Dummy: KwaZulu Natal	-0.0601	-0.297***
	(-0.53)	(-5.51)
Provincial Dummy: Limpopo	-0.182*	-0.0471
	(-2.56)	(-1.43)
Provincial Dummy:	-0.164*	-0.119***

Mpumalanga		
	(-2.49)	(-4.32)
Provincial Dummy: Northern Cape	-0.197***	0.0142
	(-3.66)	(0.81)
Provincial Dummy: North West	-0.233***	-0.00189
	(-3.41)	(-0.05)
Wealth score	-0.0120	-0.0362***
	(-0.97)	(-3.56)
Wealth score squared	0.00100	0.00330**
	(0.58)	(2.66)
Constant	495.1**	-218.2**
	(2.92)	(-2.74)
sigma	0.0970***	
	(13.57)	
N	136	140

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Loikkanen & Susiluoto (2006) found that the age of municipal workers was relevant to efficiency, but that data is not available for South Africa. The only data that is available is from the non-financial municipal census which provides data on the number of management positions in each municipality. The number of positions tested was: the number of legislative managerial positions, the number of managerial positions on the municipality's organogram, and the number of councillors. Only the last variable had a significant positive effect in the conventional model. The fact that this does not translate into higher levels of efficiency in terms of satisfaction calls into question the value added by this additional efficiency in terms of consumer units. This provision of water may be of a reduced quality or may be provided in

excess by these additional councillors and their impacts should be analysed further to ensure that municipalities do not employ unnecessary staff members.

Population density measured as the number of households per square kilometre was found to be relevant by Athanassopoulos & Triantis (1998) but when the density in terms of people per square kilometre was included in this study, it has not been significant thus far. This may be because of the difference between the measures used (people rather than households) as household size can be correlated, if not always, with poverty (Lanjouw & Ravallion, 1995) and this may have changed the results, as very poor areas may have a high density in terms of people but a moderate density in terms of households; this is relevant as poverty and household size have been shown to be relevant to municipal efficiency in some cases, as discussed above. Alternatively, the density may simply act as an imperfect proxy for whether an area is more urban or rural, and when this variable is included directly, it becomes significant instead, such as in the preceding models. However, density squared is significant in the conventional water provision model and the coefficient is negative, indicating that very sparsely populated or very dense municipalities are less efficient. This is a reasonable conclusion as water provision requires infrastructure and providing that to very sparely populated areas is more expensive and would lead to reduced efficiency, and in areas where density is very high, municipalities may be overburdened, and the infrastructure may not be able to cope with the large demands.

Nominal compensation per capita squared is negatively correlated with efficiency in terms of satisfaction. And this effect is tempered by a smaller positive coefficient for the linear variable. This shows that municipalities with more people who earn higher wages and salaries are less able to meet expectations efficiently. Seeing as this does not translate into the conventional model, this reduced satisfaction may be caused by inflated expectations: richer people are accustomed to better service delivery and may be disproportionately dissatisfied with municipal water provision. When residents earn enough for it to translate into increased municipal income, we see a reduction in efficiency in terms of the conventional model. This effect is tempered in municipalities with very high municipal income, indicating a tapering off of the negative effect. This reduction in efficiency may be because of a reduced sense of pressure, as richer municipalities are not under as much pressure to provide consumer units with limited funds. The fact that this does not translate into the satisfaction model indicates that residents are not affected to a large extent by this reduction in inefficiency and thus it

may be less imperative for municipalities to curtail inefficiencies in this regard, when compared to other avenues of improvement.

In terms of employment proportions, we see that communities with very high or low employment rates see less efficient provision of water services in the satisfaction model but not in the conventional model. This implies that this effect is one of perception, rather than of tangible consequence. Communities with low employment rates may be more dependent on reliable water provision and are thus very dissatisfied when there are disruptions, while communities with very high employment rates are likely richer and have higher expectations of service delivery.

In terms of the age of the household head, the satisfaction model can be interpreted in a similar way to the satisfaction model for refuse removal. The conventional model here adds an interesting element, with each group seeing the opposite effect, compared to the satisfaction model. This implies that more vulnerable groups like the elderly and child headed households are provided for less efficiently in terms of satisfaction, but more efficiently in terms of consumer units. This may be explained by the fact that fewer consumer units are provided to these vulnerable groups, as they are less likely to be able to afford them, but that this limited provision is done very efficiently. Because the provision is limited, satisfaction would remain low, despite provision being tangibly more efficient. This is simply one possible explanation and further research should be done to investigate this relationship; this is a clear example of models relating to satisfaction adding important information that cannot be gained from conventional models.

In terms of household size, we see that the conventional models exhibit a negative relationship but that the variable is not significant in the satisfaction model. This implies that water provision is less efficient in larger households, but that this reduced efficiency does not affect efficiency in terms of satisfaction. This is interesting, as the sanitation models show the opposite effect. Given that water and sanitation service are closely linked and use similar infrastructure, this relationship should be studied further. While this study does not strive to uncover this level of detail, it does make it apparent that the use of subjective satisfaction is useful in understanding how municipalities provide services.

Given the racially charged history of Apartheid, race was considered in this study but was not found to be significantly correlated with municipal efficiency in all models, besides for the conventional model for water provision. Higher proportions of black African, coloured, and

white people all had a negative coefficient. The coefficient for coloured people was the largest, followed by that of black African people, followed by white people. This implies that service delivery is most inefficient for coloured people and the least infect for white people, as is expected given South Africa's apartheid history. Historically white areas were better equipped and have remained well maintained since the onset of democracy because of the privilege that comes with white people, their influence, and their inherited wealth. These variables may not be significant in the satisfaction model either because service quality does not differ based on the racial makeup of a municipality, but rather because different races have become accustomed to certain living standards and have adjusted their expectations accordingly.

Contrary to previous models, higher concentrations of urban residents receive less efficient water provision. This may be because demand is higher in urban areas and municipalities are not able to cope with this level of demand, even when it should be easier to provide services to people in closer proximity to one another. This does not translate into inefficiencies in the satisfaction model, however, and thus this analysis allows us to see that this inefficiency needs to be addressed less urgently than the ones that affect satisfaction and conventional models.

As before, the provincial dummy variables are in comparison to the Western Cape. In most provinces there is not an overlap between the conventional and satisfaction models, however all significant variables have negative coefficients. This result points to the necessity for further study of each province's individual policies in order to see why tangible efficiency is not translating into efficiency in terms of satisfaction, or how increased efficiency in satisfaction can be achieved without an increase in tangible efficiency. Water provision efficiency clearly illustrates the differences between the conventional and satisfaction models and highlights the value looking at satisfaction brings.

Lastly, the wealth score is negatively correlated with efficiency in the conventional model. This means that municipalities with wealthier residents provide less efficient services in terms of consumer units, but that satisfaction with water provision is not affected. Given resource constrains within a municipality, the availability of satisfaction data in this case indicates that municipalities should prioritise correcting other inefficiencies before addressing this one, as it does not translate into reduced satisfaction. In addition, government's focus

should always be on the most vulnerable people in society, which wealthier citizens generally do not form part of.

Population size, gross value added, and education levels can be interpreted in the same was as in the sanitation models.

Again, the water provision models show quite clearly that satisfaction with services has a different pattern to the quantity of services provided and should be considered in order to understand the situation fully.

5.5 Findings

5.5.1 Variables with no significance

Firstly, the South African municipal structure has an interesting anomaly in the form of eight metropolitan municipalities. These are municipalities that were formed by looking at where people lived and worked and how they commuted, rather than at established municipal borders, thus some municipalities were amalgamated into one and some had their borders changed in the process (Cameron, 2005). Services are still provided in these municipalities as in other local municipalities (Monkam, 2014), but because of their size and history of amalgamation, could have different results. This was tested by including a dummy variable, but it was not significant in the analysis, thus indicating that metropolitan municipalities are not likely to be significantly more or less efficient than other local municipalities.

Athanassopoulos & Triantis (1998) found that whether a municipality was part of the ruling party of the country was relevant to municipal efficiency. This is a likely relationship, as South African municipalities get a significant proportion of their income from national government (22.7% based on own calculations) and political affiliations may be able to influence the provision of national grants. Whether the municipality's council had a majority of African National Council (ANC), the ruling party, members were included as a dummy variable. The result found by Athanassopoulos & Triantis (1998) suggest that central government interference may have negative effects on efficiency. Furthermore, given that only a small number of municipalities are not controlled by the ANC (25% based on own calculations), there may be some complacency and a lack of efficiency in ANC controlled municipalities. However, the ANC dummy was not significant in any of the models.

Two measures of poverty were used: whether a household ran out of money to buy food at least once in the past year and whether they ran out of money to buy food at least five times

in the past month, with the latter being an indicator of more severe poverty. Neither indicator was significant, indicating that compensation is a better indicator of efficiency than poverty, as it was significant in some of the models.

5.5.2 Reflections

The purpose of evaluating the results as they have been set out above was to provide a direct comparison between the conventional model based on the quantity of services provided and a model based on subjective satisfaction with services. As suggested by Diener & Suh (1997), the subjective information provides insights that cannot be gained from conventional, tangible measures, which is what we have seen in the analysis. In the cases where a variable was significant in the satisfaction model, but not in the conventional model, we could establish that additional information was being provided by the subjective measures. Often this additional information may be based on ill-informed perceptions, but irrespective of the objective truth of the information, it is a real perspective held by residents who expect to be protected and led by the Constitution of South Africa, which emphasises the value of welfare, not consumer units. This additional information may also make conclusions more ambiguous and create the need for additional research, but without including this measure, government officials would not be aware of a possible area where research needs to take place. A subjective rating also allows us to measure more than just the quantity of a service: inherent in someone's satisfaction with a service is their individual weigh-up of the demand and supply of that service, as well as the quality of it. Thus, this subjective measure allows us to see whether the right number of consumer units were provided to the right people and at a reasonable quality. This provides data that is richer than simply knowing in what quantities services have been provided. Additionally, by using a person's subjective satisfaction, the optimal weightings between access and quality have already been determined by the person themselves and researcher-assigned weights and judgements need not be included. By using subjective satisfaction, we get a more holistic picture of municipal efficiency which allows municipalities to cater to the needs of residents more efficiently in future.

Additionally, we see that the in some cases the same variable provides different information in the two models. This serves to show that the same variable can have very different effects, or different reasons for an effect in the different models, further entrenching the proposition that subjective satisfaction adds an additional dimension of information.

6 Conclusion

Subjective satisfaction allows us to measure the true success of service delivery, as the purpose of a service is not the provision of the service itself as an end, but rather the improvement of the lives of citizens. This study aimed to measure this, and to establish three things: firstly, how efficient municipalities are, relative to one another, secondly, which factors are correlated with efficiency, and lastly, whether subjective satisfaction provided any information other than what could be established when using a more conventional model.

The first question was answered using an output orientated DEA and these results formed the basis of the second stage analysis, which regressed a series of municipal characterises on the DEA scores. This analysis was run for electricity provision, refuse removal, sanitation, and water provision. Some of the characteristics that were relevant to a number of models included municipal income per capita, gross value added, whether the municipality is urban, wealth of residents, and the education levels of residents. This analysis was run for two models: one using subjective satisfaction, and the other using the number of consumer units provided. The results showed that there were significant differences in which characteristics were relevant to each model, and in the cases where the characteristics were the same, the relationships they exhibited with the dependent variable were quite different in some cases. This proves the value of using subjective measures in evaluating the success of a system, particularly governmental systems, as they are very closely related to welfare, which is more accurately established through subjective measures.

This study allows government to establish which municipalities are least efficient, which common traits these municipalities exhibit, and areas for future research that have hitherto been neglected by conventional methods. Theoretically, it also bolsters the existing subjective well-being literature by proving quantitatively that subjective data includes additional data that objective data does not.

References

Afonso, A., & Fernandes, S. (2005). *Assessing and Explaining the Relative Efficiency of Local Government: Evidence for Portuguese Municipalities* (SSRN Scholarly Paper No. ID 849247). Rochester, NY: Social Science Research Network. Retrieved from https://papers.ssrn.com/abstract=849247

Athanassopoulos, A. D., & Triantis, K. P. (1998). Assessing Aggregate Cost Efficiency and the Related Policy Implications for Greek Local Municipalities. *INFOR*, *36*(3), 66–83.

Auditor General. (2016a). *Consolidated General Report on the Local Government Audit Outcomes*.

Auditor General. (2016b). *Municipal Finance Management Act Report (MFMA) 2015-2016*. Retrieved from https://www.agsa.co.za/Documents/Auditreports/MFMA20152016.aspx

Balaguer-Coll, M., Prior-Jimenez, D., & Vela-Bargues, J. (2002). *Efficiency and Quality in Local Government Management. The Case of Spanish Local Authorities* (No. WP 2002/2). Universitat Autonoma de Barcelona.

Beall, J. (2004). *Decentralisation and engendering democracy: lessons from local government reform in South Africa* (Crisis States Research Centre working papers series No. 54). Retrieved from http://www.crisisstates.com/Publications/publications.htm

Borge, L.-E., Falch, T., & Tovmo, P. (2008). Public sector efficiency: the roles of political and budgetary institutions, fiscal capacity, and democratic participation. *Public Choice*, *136*(3–4), 475–495. https://doi.org/10.1007/s11127-008-9309-7

Borger, B. de, Kerstens, K., Moesen, W., & Vanneste, J. (1994). Explaining differences in productive efficiency: An application to Belgian municipalities. *Public Choice*, *80*(3–4), 339–358. https://doi.org/10.1007/BF01053225

Bouckaert, G. (1992). Productivity Analysis in the Public Sector: The case of Fire Service. *International Review of Administrative Sciences*, *58*(2), 175–200.

Brettenny, W., & Sharp, G. (2016). Efficiency evaluation of urban and rural municipal water service authorities in South Africa: A data envelopment analysis approach. *Water SA*, *42*(1), 11–19. https://doi.org/10.4314/wsa.v42i1.02

Buchanan, J. M. (1965). An Economic Theory of Clubs. *Economica*, *32*(125), 1–14. https://doi.org/10.2307/2552442

Burgat, P., & Jeanrenaud, C. (1994). Technical Efficiency and Institutional Variables. *Swiss Journal of Economics and Statistics*, *130*(4), 709–717.

Cameron, R. (2005). Metropolitan restructuring (and more restructuring) in South Africa. *Public Administration and Development*, *25*(4), 329–339. https://doi.org/10.1002/pad.383

Clark, D. A. (2009). Adaptation, Poverty and Well-Being: Some Issues and Observations with Special Reference to the Capability Approach and Development Studies. *Journal of Human Development and Capabilities*, *10*(1), 21–42.

Cooper, W. W., Seiford, L. M., & Tone, K. (2006). *Introduction to data envelopment analysis and its uses with DEA-solver software and references /*. New York: Springer.

Costanza, R., Fisher, B., Ali, S., Beer, C., Bond, L., Boumans, R., … Snapp, R. (2007). Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecological Economics*, *61*(2), 267–276. https://doi.org/10.1016/j.ecolecon.2006.02.023

Cousins, B., & Kepe, T. (2004). Decentralisation when land and resource rights are deeply contested: A case study of the Mkambati eco-tourism project on the wild coast of South Africa. *The European Journal of Development Research*, *16*(1), 41–54. https://doi.org/10.1080/09578810410001688725

Davis, M., & Hayes, K. (1993). The Demand For Good Government. *Review of Economics and Statistics*, *75*, 148–152.

De Borger, B., & Kerstens, K. (1996a). Cost efficiency of Belgian local governments: A comparative analysis of FDH, DEA, and econometric approaches. *Regional Science and Urban Economics*, *26*(2), 145–170. https://doi.org/10.1016/0166-0462(95)02127-2

De Borger, B., & Kerstens, K. (1996b). Radial and Nonradial Measures of Technical Efficiency: An Empirical Illustration for Belgian Local Governments Using an FDH Reference Technology. *Journal of Productivity Analysis*, *7*(1), 41–62.

De Visser, J. (2005). *Developmental Local Government: A Case Study of South Africa*. Intersentia nv.

Diener, E. (1994). Assessing Subjective Well-Being: Progress and Opportunities. *Social Indicators Research*, *31*(2), 103–157.

Diener, E., Lucas, R., Schimmack, U., & Helliwell, J. (2009). *Well-Being for Public Policy*. Oxford, New York: Oxford University Press.

Diener, E., & Suh, E. (1997). Measuring Quality of Life: Economic, Social, and Subjective Indicators. *Social Indicators Research*, *40*(1–2), 189–216. https://doi.org/10.1023/A:1006859511756

Diener, E., & Suh, E. M. (2000). *Culture and Subjective Well-being*. MIT Press.

EasyData. (n.d.). Beyond 20/20 WDS - Extract view - CS 2016 Persons - Custom table (**still awaiting labour and income variables**). Retrieved 10 July 2017, from http://quanis1.easydata.co.za/ExtractViewer/extractView.aspx

Ebel, R. D., & Yilmaz, S. (2002). *On the Measurement and Impact of Fiscal Decentralization*. World Bank Publications.

Electoral Commission : Municipal election results. (n.d.). Retrieved 28 December 2017, from http://www.elections.org.za/content/Elections/Municipal-elections-results/

Eskom. (n.d.). Eskom Load Shedding. Retrieved 15 September 2018, from http://loadshedding.eskom.co.za/LoadShedding/Description

Flatø, M., Muttarak, R., & Pelser, A. (2017). Women, Weather, and Woes: The Triangular Dynamics of Female-Headed Households, Economic Vulnerability, and Climate Variability in South Africa. *World Development*, *90*(Supplement C), 41–62. https://doi.org/10.1016/j.worlddev.2016.08.015

Fried, H. O., Schmidt, S. S., & Lovell, C. A. K. (1993). *The Measurement of Productive Efficiency: Techniques and Applications*. Oxford University Press.

GINI index (World Bank estimate) | Data. (n.d.). Retrieved 13 March 2017, from http://data.worldbank.org/indicator/SI.POV.GINI?locations=ZA

Heathwood, C. (2014). Subjective Theories of Well-Being. In B. Eggleston & D. Miller (Eds.), *The Cambridge Companion to Utilitarianism* (pp. 199–219). Cambridge University Press.

Helliwell, J. F., & Huang, H. (2008). How's Your Government? International Evidence Linking Good Government and Well-Being. *British Journal of Political Science*, *38*(4), 595–619.

Human Development Index (HDI) | Human Development Reports. (n.d.). Retrieved 14 January 2018, from http://hdr.undp.org/en/content/human-development-index-hdi

Kalseth, J., & Rattsø, J. (1995). Spending and overspending in local government administration: A minimum requirement approach applied to Norway. *European Journal of Political Economy*, *11*, 229–251.

Kauzya, J.-M. (2007). Political Decentralization in Africa: Experiences of Uganda, Rwanda and South Africa. UNDESA.

Kehler, J. (2013). Women and Poverty: The South African Experience. *Journal of International Women's Studies*, *3*(1), 41–53.

Knight, F. (2013). *The Economic Organization* (1 edition). New Brunswick, New Jersey: Routledge.

Koma, S. B. (2010). The state of local government in South Africa : issues, trends and options. *Journal of Public Administration*, *45*(Special issue 1), 111–120.

Koopmans, T. C. (1951). *'Analysis of Production as an Efficient Combination of Activities' in Activity Analysis of Production and Allocation*. New York: John Wiley & Sons.

Kuziemko, I., Buell, R. W., Reich, T., & Norton, M. I. (2014). "Last-Place Aversion": Evidence and Redistributive Implications. *The Quarterly Journal of Economics*, *129*(1), 105–149. https://doi.org/10.1093/qje/qjt035

Lanjouw, P., & Ravallion, M. (1995). Poverty and Household Size. *The Economic Journal*, *105*(433), 1415–1434. https://doi.org/10.2307/2235108

Loikkanen, H. A., & Susiluoto, I. (2006). *Cost Efficiency of Finnish Municipalities in Basic Service Provision 1994-2002* (Discussion Paper No. No. 96). Helsinki Center of Economic Research.

Mahabir, J. (2014). Quantifying Inefficient Expenditure in Local Government: A Free Disposable ... *South African Journal of Economics*, *82*(4).

Mogale, T. M. (2003). *Developmental Local Government and Decentralised Service Delivery in the Democratic South Africa in Governance in the New South Africa: The Challenges of Globalisation*. (G. C. Z. Mhone & O. Edigheji, Eds.). Juta and Company Ltd.

Monkam, N. F. (2014). Local municipality productive efficiency and its determinants in South Africa. *Development Southern Africa*, *31*(2), 275–298. https://doi.org/10.1080/0376835X.2013.875888

Moore, A., Nolan, J., & Segal, G. F. (2005). Putting Out The Trash: Measuring Municipal Service Efficiency in U.S. Cities. *Urban Affairs Review*, *41*(2), 237–259. https://doi.org/10.1177/1078087405279466

Muller, J. (2017). ESKOM: Electricity and Technopolitics in South Africa. *Politikon*, *44*(3), 466–468. https://doi.org/10.1080/02589346.2017.1354998

Padayachee, V. (2006). *The Development Decade?: Economic and Social Change in South Africa, 1994-2004*. HSRC Press.

Pearce, D. W. (1986). *The MIT Dictionary of Modern Economics* (3rd ed). Cambridge, Mass MIT Press. Retrieved from http://trove.nla.gov.au/work/18693429

Posel, D., Fairburn, J. A., & Lund, F. (2006). Labour migration and households: A reconsideration of the effects of the social pension on labour supply in South Africa. *Economic Modelling*, *23*(5), 836–853.

Priebe, S., Huxley, P., Knight, S., & Evans, S. (1999). Application and Results of the Manchester Short Assessment of Quality of Life (Mansa). *International Journal of Social Psychiatry*, *45*(1), 7–12. https://doi.org/10.1177/002076409904500102

Prieto, A., & Zofio, J. (2001). Evaluating Effectiveness in Public Provision of Infrastructure and Equipment: The Case of Spanish Municipalities. *Journal of Productivity Analysis*, *15*(1), 41–58.

Republic of South Africa. (1996). *The Constitution of the Republic of South Africa*. Pretoria: Government Printer.

Republic of South Africa. Municipal Systems Act (2000).

Republic of South Africa. Division of Revenue Bill (2016).

Richter, L. M., & Desmond, C. (2008). Targeting AIDS orphans and child-headed households? A perspective from national surveys in South Africa, 1995–2005. *AIDS Care*, *20*(9), 1019–1028.

Simar, L., & Wilson, P. W. (2007). Estimation and inference in two-stage, semi-parametric models of production processes. *Journal of Econometrics*, *136*(1), 31–64. https://doi.org/10.1016/j.jeconom.2005.07.009

South Africa National Treasury. (2008). *Chapter 5 - Intergovernmental transfers in Local Government Budgets and Expenditure Review : 2003/04 - 2009/10*. Retrieved from http://www.treasury.gov.za/publications/igfr/2008/lg/default.aspx

South Africa National Treasury. (n.d.). MFMA Reports. Retrieved 27 September 2018, from http://mfma.treasury.gov.za/Media_Releases/s71/1516/4th_1516/Pages/default.aspx

Statistics South Africa. (n.d.). Community Survey 2016 | Statistics South Africa. Retrieved 10 July 2017, from http://www.statssa.gov.za/?page_id=6283

Stigler, G. J. (1976). The Xistence of X-Efficiency. *The American Economic Review*, *66*(1), 213–216.

Thornhill, C. (2008). The transformed local government system: some lessons. *Journal of Public Administration*, *43*(3.2).

Tiebout, C. M. (1956). A Pure Theory of Local Expenditures. *Journal of Political Economy*, *64*(5), 416–424. https://doi.org/10.1086/257839

Van der Waldt, G. (2006). Managing local government performance: key considerations and challenges. *Journal of Public Administration*, *41*(2).

Van der Westhuizen, G., & Dollery, B. (2009). Efficiency measurement of basic service delivery at South African district and local municipalities. Retrieved from https://repository.nwu.ac.za:443/handle/10394/3947

Vanden Eeckaut, P., Tulkens, H., & Jamar, M.-A. (1993). Cost Efficiency in Belgian Municipalities. In H. O. Fried, S. S. Schmidt, & C. A. K. Lovell (Eds.), *The Measurement of Productive Efficiency: Techniques and Applications*. Oxford University Press.

von Fintel, D., & Moses, E. (2017). Migration and gender in South Africa: Following bright lights and the fortunes of others? *Regional Science Policy & Practice*, *9*(4), 251–268. https://doi.org/10.1111/rsp3.12106

White, S. C. (2009). *Bringing Wellbeing into Development Practice* (WeD Working Papers No. 09/50). Wellbeing in Developing Countries.

Whiteley, P., Clarke, H. D., Sanders, D., & Stewart, M. C. (2010). Government Performance and Life Satisfaction in Contemporary Britain. *The Journal of Politics*, *72*(3), 733–746. https://doi.org/10.1017/S0022381610000137

WHOQOL Group. (1995). The World Health Organization quality of life assessment (WHOQOL): Position paper from the World Health Organization. *Social Science & Medicine*, *41*(10), 1403–1409. https://doi.org/10.1016/0277-9536(95)00112-K

Wittenberg, M. (2003). *Decentralisation in South Africa*. Economic Research Southern Africa.

Worthington, A. C. (2000). Cost efficiency in Australian local government: A comparative analysis of mathematical programming and econometric approaches. *Financial Accountability and Management*, *16*(3), 201–224.

Appendices

Appendix 1 - Details of Data Changes and Discrepancies between Datasets

The following variables had negative values for expenditure and were changed to 0 in order to avoid skewing the data:

- Emalahleni (EC) for water and sanitation
- Inxuba Yethemba for water
- Umsobomvu for refuse removal

Table 11: Local municipalities with missing values

Municipality	Found In	Missing From
Breede River/Winelands	Community Survey	Regional Service Indicators; Election Results; Non-Financial Census; Audit Outcomes
Bushbuckridge in Limpopo	Non-Financial Census	Community Survey
Delmas	Election Results	Community Survey
Ephraim Mogale	Community Survey	Election Results
Greater Marble Hall	Election Results	Community Survey
Kagisano/Molopo	Community Survey	Election Results
Kungwini	Non-Financial Census	Community Survey ; Financial data
Langeberg	Regional Service Indicators; Election Results; Non-Financial Census; Audit Outcomes	Community Survey
Matatiele in KwaZulu-Natal	Non-Financial Census	Community Survey
Merafong City in the North West	Non-Financial Census;	Community Survey ; Financial data
Molopo	Non-Financial Census	Community Survey ; Financial data
Moshaweng	Non-Financial Census	Community Survey ; Financial data

Nokeng Tsa Taemane	Non-Financial Census	Community Survey ; Financial data
NW397 Local Municipality [Ganyesa/Pomfret]	Election Results	Community Survey
Umzimkhulu in Eastern Cape	Non-Financial Census	Community Survey
Victor Khanye Metsweding Motheo	Community Survey Community Survey Community Survey	Election Results Financial data Financial data

List of Variations in Spelling and Specification of Municipalities

!Kai !Garib - Kai !Garib

Amahlati – Amahlathi

Amatole - Amathole

Bela-Bela - Bela Bela

Bergriver - Bergrivier

Bojanala – Bojanala Platinum

Buffalo City Metropolitan Municipality - Buffalo City

Cacadu Development Agency - Cacadu

Cape Town – City of Cape Town

Chief Albert Luthuli - Albert Luthuli

City of uMhlathuze - uMhlathuze

Dr JS Moroka - Dr J.S. Moroka

Dr Pixley Ka Isaka Seme - Pixley Ka Seme – MP

Dr Ruth S Mompati - Dr Ruth Segomotsi Mompati

Ekurhuleni – Ekurhuleni Metro

eThekwini - eThekwini Metropolitan

Ezinqoleni - Ezingoleni

Ingquza Hill - Ngquza Hill

Kagisano - Kagisano/Molopo

Kagisano/Molopo - Kagisano-Molopo

Kgetlengriver – Kgetlengrivier

Khâi-Ma - Khai-Ma

Khara Hais - //Khara Hais

Lepelle-Nkumpi - Lepele-Nkumpi

Lukhanji - Lukanji

Makhudutamaga – Makhuduthamaga

Maluti a Phofung - Maluti-a-Phofung

Mangaung Metropolitan Municipality - Mangaung

Matlosana - City of Matlosana

Mooi Mpofana - Mpofana

Mookgophong - Mookgopong

Msunduzi - The Msunduzi

Msunduzi - The Msunduzi

Nquthu – Nqutu

Ngquza Hills - Ngquza Hill

Ntambana - Ntambanana

Sekhukhune - Greater Sekhukhune

Sol Plaatje - Sol Plaatjie

Thabo Mofutsanyana - Thabo Mofutsanyane

The Big Five False Bay - The Big 5 False Bay

Thembisile Hani – Thembisile

Tlokwe - Tlokwe City Council – Potchefstroom

Tshwane Metro - City of Tshwane

Tubatse - Greater Tubatse

Appendix 2: DEA Results

The full set of DEA results are presented in table 13.

Table 12: DEA results

Municipality	Province	District	DEA Score: Electricity using Output method for Satisfaction	DEA Score: Electricity using Output method for Conventional Measures	DEA Score: Refuse Removal using Output method for Satisfaction	DEA Score: Refuse Removal using Output method for Conventional Measures	DEA Score: Sanitation using Output method for Satisfaction	DEA Score: Sanitation using Output method for Conventional Measures	DEA Score: Water using Output method for Satisfaction	DEA Score: Water using Output method for Conventional Measures
Buffalo City	EC	Alfred Nzo	0.7951986	0.246337	0.5800791	0.1471608	0.8251626	0.1637431	0.9015762	0.5097422
Matatiele	EC	Alfred Nzo	0.6193441	0.1118413	1	1				
Mbizana	EC	Alfred Nzo	0.7208603	0.1034527	0.2940001	0.0076365				
Nelson Mandela Bay	EC	Alfred Nzo	0.9129182	0.3985994	0.9192214	0.4584119	0.8661479	0.314718	0.9233441	0.1796556
Ntabankulu	EC	Alfred Nzo								
Umzimvubu	EC	Alfred Nzo			0.3403124	0.0114215				
Amahlathi	EC	Amathole	0.9439529	0.035941	0.4807979	0.0402365				
Great Kei	EC	Amathole	0.752328	0.0372112	0.4568454	0.0054298				
Mbhashe	EC	Amathole			0.3656429	0.0536662	0.7448676	0.0389083		
Mnquma	EC	Amathole								
Ngqushwa	EC	Amathole	0.9114859	0.0521929	0.3207379	0.0058528				
Nkonkobe	EC	Amathole	0.9042748	0.0717268	0.4813017	0.0374525				
Nxuba	EC	Amathole	0.9968407	0.0339007	0.6819891	0.0137251				
Baviaans	EC	Cacadu	0.7436784	0.0170336	0.8308043	0.006172	0.8458844	0.0048996	0.9260806	0.0023201
Blue Crane Route	EC	Cacadu	0.9250289	0.0096709	0.9578661	0.0092828	0.8485956	0.0090207	0.950495	0.0061454
Camdeboo	EC	Cacadu	0.9539291	0.0257984	0.9550916	0.0332279	0.9538568	0.0148797	0.9015551	0.0002823

Ikwezi	EC	Cacadu	0.7822607	0.163834	0.7110176	0.0107989	0.7527665	0.0046718	0.6973701	0.0001586
Kouga	EC	Cacadu	0.8813952	0.0360906	0.9294676	0.0308081	0.7809603	0.0274774	0.925982	0.0456063
Kou-Kamma	EC	Cacadu	0.9531174	0.2008744	0.8919042	0.03043	0.8605402	0.0130861	0.6629656	0.0082042
Makana	EC	Cacadu	0.9439241	0.0116709	0.9247692	0.0447989	0.7784954	0.0216832	0.6936176	0.0102517
Ndlambe	EC	Cacadu	0.9036158	0.0097836	0.9006853	0.0237356	0.7801936	0.0128479	0.7721844	0.0162698
Sundays River Valley	EC	Cacadu	0.8710078	0.0283208	0.6321921	0.0703794	0.5429155	0.0315124	0.7055513	0.0359681
Emalahleni - EC	EC	Chris Hani	0.8757964	0.047426	0.5262564	0.0357171				
Engcobo	EC	Chris Hani								
Inkwanca	EC	Chris Hani								
Intsika Yethu	EC	Chris Hani								
Inxuba Yethemba	EC	Chris Hani	0.9419268	0.054283			1	1		
Lukanji	EC	Chris Hani	0.8505026	0.1030768	0.6567885	0.0824158				
Sakhisizwe	EC	Chris Hani	0.974338	0.010924	0.3144449	0.0036163			1	0.216925
Tsolwana	EC	Chris Hani	0.9598337	0.0566454	0.5821375	0.0067193	0.7395055	0.0248748	0.9541764	0.0813379
King Sabata Dalindyebo	EC	O.R.Tambo	0.7314128	0.2582272	0.3530383	0.0691414	0.6775132	0.5508975		
Mhlontlo	EC	O.R.Tambo			0.41778	0.0038604				
Ngquza Hill	EC	O.R.Tambo			0.2300345	0.0082865				
Nyandeni	EC	O.R.Tambo	0.8672981	0.2324029	0.4664324	0.0166498	1	1	1	1
Port St Johns	EC	O.R.Tambo			0.6839606	0.0156027	0.5690568	0.0141951		
Elundini	EC	Ukhahlamba	0.6364403	0.0657776	0.3403426	0.0276077				
Gariep	EC	Ukhahlamba	0.8624076	0.0591661	0.9265689	0.028723	1	0.5056242		
Maletswai	EC	Ukhahlamba	0.9120311	0.0458505	0.9333394	0.0204744				
Senqu	EC	Ukhahlamba	0.8636929	0.0256515	0.4690099	0.0157224	0.7744634	0.0580223		
Mafube	FS	Fezile Dabi	0.9398859	0.4121161					0.8513809	0.0227904
Mangaung	FS	Fezile Dabi	0.937235	0.1875351	0.8270422	0.1989473	0.746326	0.1336136	0.9224702	0.1425387
Metsimaholo	FS	Fezile Dabi	0.8436636	0.0846695	0.8406957	0.0560132	0.7761424	0.0399607	0.9736416	0.0127628
Moqhaka	FS	Fezile Dabi	0.9477795	0.0753019	0.9042585	0.0615389	0.8741962	0.0459988	0.4381763	0.0193333

Ngwathe	FS	Fezile Dabi	0.8968725	0.1681254	0.8989617	0.0940941	0.8432294	0.0372387	0.7043704	0.0249867
Masilonyana	FS	Lejweleputswa	0.9750519	0.0158897	0.8207569	0.0658121	0.8869678	0.0367671	0.852267	0.0223325
Matjhabeng	FS	Lejweleputswa	0.9639086	0.2294102	0.6460952	0.184503	0.8643725	0.1590013	0.8877108	0.0413348
Nala	FS	Lejweleputswa	0.9149437	0.0379269	0.8384389	0.025825	0.8614765	0.0204089	0.9331288	0.0179597
Tokologo	FS	Lejweleputswa	0.9605598	0.0151505	0.7291324	0.0097037	0.5645458	0.003167	0.841706	0.0094534
Tswelopele	FS	Lejweleputswa	0.944077	0.005243	0.9233142	0.0218597	0.8303804	0.0119668	0.9537314	0.011667
Dihlabeng	FS	Thabo Mofutsanyane	0.9278125	0.0364253	0.8966318	0.0694063	0.8986228	0.0643557	0.9834905	0.0580739
Maluti a Phofung	FS	Thabo Mofutsanyane	0.8917879	0.4486429	0.4245338	0.0568434			0.8073106	0.1600584
Mantsopa	FS	Thabo Mofutsanyane	0.9782385	0.0073414	0.6995173	0.0218986	0.7890627	0.0153664	0.644924	0.0128817
Nketoana	FS	Thabo Mofutsanyane	0.9334498	0.0161826	0.7591242	0.0161221	0.7657645	0.0142941	0.8446351	0.0083314
Phumelela	FS	Thabo Mofutsanyane	0.8252255	0.0412941	0.6895698	0.021362	0.7134017	0.0142595	0.8772472	0.0173527
Setsoto	FS	Thabo Mofutsanyane	0.9345378	0.0149227	0.7121553	0.0468875	0.7482609	0.0289603	0.7941889	0.029406
Kopanong	FS	Xhariep			0.8337601	0.0497561	0.9286671	0.0227969	0.8887997	0.0061971
Letsemeng	FS	Xhariep	0.9690704	0.0227525	0.8074873	0.0378737	0.9356417	0.0299356	0.8698307	0.0079584
Mohokare	FS	Xhariep	0.9909261	0.1707931	0.9599202	0.0221778	0.8934808	0.0110439	0.9080724	0.0041399
Naledi - FS	FS	Xhariep	0.9268963	0.4115664	0.5379425	0.0145408	0.7596194	0.012614	0.7168701	0.0058309
Emfuleni	GP	Sedibeng	0.9242181	0.1133269	0.8834723	0.4006757	0.9547335	0.2947181	0.9724388	0.04355
Lesedi	GP	Sedibeng	0.8844658	0.04654	0.8983102	0.0575304	0.9213983	0.041766	0.9575905	0.0184624
Midvaal	GP	Sedibeng	0.8890953	0.0151835	0.9382964	0.0283232	0.8137729	0.0250694	0.9680184	0.033662
Ekurhuleni	GP	West Rand	0.8546578	0.6290642	0.9283376	0.8220289	0.9158038	1	0.955788	0.6798628
Merafong City	GP	West Rand	0.7681417	0.0860624	0.793184	0.0826611	0.8868513	0.1431048	0.8696907	0.0471737
Mogale City	GP	West Rand	0.8408182	0.0673984	0.8914424	0.0994814	0.8931351	0.1047665	0.9382355	0.1112843
Randfontein	GP	West Rand	0.7679927	0.0478939	0.8274335	0.0446202	0.8543685	0.048221	0.8800676	0.033129
Westonaria	GP	West Rand	0.7126555	0.0257446	0.9151179	0.1912359	0.9318353	0.0356313	0.9565084	0.0830569
Dannhauser	KZ	Amajuba								
Newcastle	KZ	Amajuba	0.9334698	0.0412909	0.7513443	0.1107245	0.7633368	0.199865	0.9365857	0.0421897
KwaDukuza	KZ	iLembe	0.8692269	0.0971399	0.7105982	0.0614294				
Mandeni	KZ	iLembe	0.8839436	0.0356486	0.5405779	0.0572869				
Maphumulo	KZ	iLembe								

Ndwedwe	KZ	iLembe								
eThekwini Metropolitan	KZ	Sisonke	0.8829464	1	0.850941	1	0.8011305	0.7402318	0.8862754	1
Greater Kokstad	KZ	Sisonke	0.9034038	0.0483046	0.8089229	0.0540758				
Ingwe	KZ	Sisonke								
Kwa Sani	KZ	Sisonke			0.5057895	0.0038386				
Ubuhlebezwe	KZ	Sisonke			0.3028817	0.0134022				
Umzimkhulu	KZ	Sisonke			0.7038518	0.2101624				
Ezingoleni	KZ	Ugu								
Hibiscus Coast	KZ	Ugu	0.9485085	0.1254819	0.5682368	0.0244182				
Umdoni	KZ	Ugu			0.5631908	0.0191532				
Umzumbe	KZ	Ugu								
Vulamehlo	KZ	Ugu								
Impendle	KZ	UMgungundlovu								
Mkhambathini	KZ	UMgungundlovu								
Mpofana	KZ	UMgungundlovu	0.6048082	0.0243315	0.5270098	0.0615392				
Richmond	KZ	UMgungundlovu			0.4314624	0.0167508				
The Msunduzi	KZ	UMgungundlovu	0.908742	0.1250942	0.6681305	0.1643934	0.7656727	0.1015424	0.9267921	0.1036424
uMngeni	KZ	UMgungundlovu	0.9060637	0.0502708	0.7930163	0.0464	0.8131485	0.1903049		
uMshwathi	KZ	UMgungundlovu			0.8843926	0.1358693				
Hlabisa	KZ	Umkhanyakude			0.8155752	0.0064029				
Jozini	KZ	Umkhanyakude			0.6613654	0.0487752				
Mtubatuba	KZ	Umkhanyakude			0.3456275	0.0124342				
The Big 5 False Bay	KZ	Umkhanyakude								
Umhlabuyalingana	KZ	Umkhanyakude								
Endumeni	KZ	Umzinyathi	0.800006	0.0480919	0.6988078	0.0264241	0.8754416	0.1778096		
Msinga	KZ	Umzinyathi			0.8803644	0.0077041				
Nqutu	KZ	Umzinyathi	0.8719512	0.1932327	1	0.0376492	0.9523143	0.0427211		
Umvoti	KZ	Umzinyathi	0.8198738	0.0150475	0.5332496	0.0094232				

Emnambithi/Ladysmith	KZ	Uthukela	0.8833079	0.0980012	0.7021806	0.0885565				
Imbabazane	KZ	Uthukela								
Indaka	KZ	Uthukela			0.6761965	0.443187				
Okhahlamba	KZ	Uthukela								
Umtshezi	KZ	Uthukela	0.817853	0.026031	0.5990355	0.035595				
Mfolozi	KZ	Uthungulu								
Mthonjaneni	KZ	Uthungulu	0.7641457	0.0183594	0.529919	0.0214022				
Nkandla	KZ	Uthungulu	0.8305139	0.1580866						
Ntambanana	KZ	Uthungulu								
uMhlathuze	KZ	Uthungulu	0.9733365	0.0562509	0.7998943	0.0590163	0.9030606	0.0436827	0.9311853	0.0435097
uMlalazi	KZ	Uthungulu	0.8258188	0.0849848	0.4422845	0.0387012	0.7048429	0.2363115		
Abaqulusi	KZ	Zululand	0.7843775	0.130911	0.4823855	0.0818817	0.689728	0.0374879	0.6006533	0.1669078
eDumbe	KZ	Zululand	0.7204733	0.1273507						
Nongoma	KZ	Zululand			0.264052	0.0032661				
Ulundi	KZ	Zululand	0.8623539	0.1426766	0.4187969	0.0326284				
Aganang	LP	Capricorn								
Blouberg	LP	Capricorn	0.9264392	0.2131659	0.977734	0.3179012				
Lepele-Nkumpi	LP	Capricorn	0.8779694	0.086562	0.3674574	0.130783				
Molemole	LP	Capricorn	0.9547798	0.2013734					0.7549089	0.1773178
Polokwane	LP	Capricorn	0.9328821	0.2047938	0.6445827	0.317239	0.824552	0.1595622	0.8263009	0.3616801
Elias Motsoaledi	LP	Greater Sekhukhune	0.9030432	0.021163	0.2858522	0.0357361				
Fetakgomo	LP	Greater Sekhukhune								
Greater Tubatse	LP	Greater Sekhukhune			0.4919801	0.1466559				
Makhuduthamaga	LP	Greater Sekhukhune	0.9453589	0.2467899	0.3422788	0.0125233				
Ba-Phalaborwa	LP	Mopani	0.9839987	0.0411988	0.6788049	0.2195328				
Greater Giyani	LP	Mopani	0.9379111	0.1943225	0.3732425	0.0742168				
Greater Letaba	LP	Mopani	0.9557018	0.1150582	0.7436119	0.0885569	0.7821616	0.1787299		
Greater Tzaneen	LP	Mopani	0.9195766	0.0340425	0.4529848	0.042696	0.8008169	0.1744087		

Maruleng	LP	Mopani	1	0.2710115	0.8965451	0.0189604				
Makhado	LP	Vhembe	0.9636493	0.2315646	0.5159236	0.1090445	0.8374241	0.8296268	0.643822	1
Musina	LP	Vhembe	0.8960834	0.0477214	0.9052857	0.0766353				
Mutale	LP	Vhembe								
Thulamela	LP	Vhembe			0.3909868	0.1252919				
Bela-Bela	LP	Waterberg	0.8935378	0.0446401	0.8473026	0.0374039			0.8663136	0.0247962
Lephalale	LP	Waterberg	0.927868	0.0326337	0.7967362	0.0700315	0.8984625	0.0362509	0.838896	0.1738801
Modimolle	LP	Waterberg	0.8524399	0.0442132	0.8207667	0.0265098	0.8100807	0.0323083	0.723411	0.0253306
Mogalakwena	LP	Waterberg	0.9190723	0.1828436	0.6019086	0.2916551	0.7482837	0.269456	0.6428295	0.3009701
Mookgopong	LP	Waterberg	0.8107228	0.0064424	0.7307594	0.0309694	0.7412428	0.007429	0.7457318	0.017012
Thabazimbi	LP	Waterberg	0.769547	0.0335529	0.5240874	0.0627864	0.7118806	0.1247756	0.595555	0.0678479
Bushbuckridge	MP	Ehlanzeni	0.9526264	0.1939233	0.9072399	0.522101	0.5811334	0.1963617	0.6453326	0.3293724
Mbombela	MP	Ehlanzeni	0.9253629	0.0435551	0.4718116	0.0526376	0.6825356	0.1032256	0.6580018	0.4871582
Nkomazi	MP	Ehlanzeni	0.9831947	0.058004	0.4810544	0.0771028	0.7706807	0.0311951	0.6707876	0.3032148
Thaba Chweu	MP	Ehlanzeni	0.8263286	0.0530214	0.7336968	0.0387226	0.8431471	0.0402861	0.7959213	0.04696
Umjindi	MP	Ehlanzeni	0.9202024	0.0423442	0.8417666	0.0293479	0.7708089	0.0565385	0.8768631	0.0821761
Albert Luthuli	MP	Gert Sibande	0.928717	0.1110157	0.7057425	0.1382496	0.7832028	0.1527629	0.6538187	0.1354096
Dipaleseng	MP	Gert Sibande	0.7459531	0.0140105	0.7306949	0.0338104	0.722196	0.0329773	0.7495507	0.0315104
Govan Mbeki	MP	Gert Sibande	0.8513479	0.1791864	0.8743231	0.1695754	0.8936747	0.1147554	0.9679471	0.0266131
Lekwa	MP	Gert Sibande	0.8465677	0.0554583	0.7559209	0.0830536	0.8798487	0.1568337	0.8157976	0.0510271
Mkhondo	MP	Gert Sibande	0.7968755	0.1153946	0.5469796	0.0773777	0.604046	0.1844293	0.8144423	0.181359
Msukaligwa	MP	Gert Sibande	0.7533514	0.0909889	0.7419271	0.0619592	0.7968091	0.0968534	0.7655293	0.0815445
Pixley Ka Seme - MP	MP	Gert Sibande	0.8719491	0.0694128	0.6225809	0.0128795	0.8235873	0.0491297	0.9244211	0.0139124
Dr JS Moroka	MP	Nkangala	1	1	0.38381	0.0541073	0.5723516	0.025071	0.7379308	0.1346225
Emakhazeni	MP	Nkangala	0.7506686	0.0320012	0.59913	0.0156536	0.7520055	0.0182646	0.7209558	0.0190808
Emalahleni - MP	MP	Nkangala	0.6586263	0.2620363	0.5671719	0.2484818	0.741448	0.1560366	0.5726855	0.1704366
Steve Tshwete	MP	Nkangala	0.8646852	0.1402919	0.8744717	0.0718465	0.8236659	0.0660547	0.8816261	0.160143
Thembisile	MP	Nkangala	0.954428	0.5693009	0.4229891	0.1401595	0.4633235	0.0321183	0.6492006	0.062061

Dikgatlong	NC	Frances Baard	0.8381439	0.4365343	0.2735834	0.0259971	0.7546719	0.0392412	0.9339266	0.0270551
Magareng	NC	Frances Baard	0.9240671	0.0221786	0.6414047	0.0107256	0.6308979	0.0057901	0.4697403	0.0063633
Phokwane	NC	Frances Baard	0.8993707	0.0226682	0.6263779	0.0266356	0.7222435	0.0144937	0.7043499	0.0234655
Sol Plaatjie	NC	Frances Baard	0.8350899	0.1067005	0.8638793	0.1136925	0.8686856	0.0703234	0.8650883	0.0466093
Gamagara	NC	John Taolo Gaetsewe	0.9312848	0.0183387	0.9153357	0.0183879	0.918465	0.015317	0.8644468	0.0180755
Ga-Segonyana	NC	John Taolo Gaetsewe	0.8622823	0.0288022	0.250938	0.0079949	0.5228892	0.0082221	0.7164664	0.1374812
Joe Morolong	NC	John Taolo Gaetsewe	0.8990117	0.0830145	0.8077397	0.0186335	0.7440247	0.0167397	0.8010309	0.1481558
Hantam	NC	Namakwa	0.970736	0.0027506			0.9546649	0.0051437	0.8295257	0.0036238
Kamiesberg	NC	Namakwa	0.9137782	0.0045691	0.8212324	0.003637	0.6973014	0.0025133	0.908458	0.00074
Karoo Hoogland	NC	Namakwa	0.8793665	0.0048975	0.8508325	0.0062886	0.722568	0.0026476	0.8309905	0.0002481
Khâi-Ma	NC	Namakwa	0.9253253	0.0081521	0.6405635	0.0100718	0.73427	0.0054198	0.7499809	0.0002094
Nama Khoi	NC	Namakwa	0.9441497	0.021242	0.9564613	0.0171687	0.862321	0.0124592	0.8892032	0.0021945
Richtersveld	NC	Namakwa	0.8925633	0.004224	0.895202	0.0115929	0.746877	0.0029114	0.8034694	0.0014597
Emthanjeni	NC	Pixley ka Seme	0.8873541	0.0255573	0.7794672	0.0134713	0.8560631	0.0133428	0.9101133	0.0036173
Kareeberg	NC	Pixley ka Seme	0.9526153	0.0056635	0.9900978	0.0045568	0.9531885	0.0030202	0.993154	0.0039887
Renosterberg	NC	Pixley ka Seme	0.9063233	0.0044004	0.7122427	0.015078	0.8374039	0.0033789	0.8509032	0.0014846
Siyancuma	NC	Pixley ka Seme	0.9205275	0.0184406	0.7780734	0.0511284	0.7499804	0.0091016	0.893632	0.032094
Siyathemba	NC	Pixley ka Seme	0.9604688	0.0030068	0.9563356	0.0133535	0.8826507	0.0055195	0.9873922	0.0018967
Thembelihle	NC	Pixley ka Seme	0.8143816	0.0409987	0.6542917	0.0108443	0.6996225	0.0081747	0.865281	0.0086984
Ubuntu	NC	Pixley ka Seme	0.8409418	0.026316	0.7945246	0.007046	0.7906966	0.0051233	0.7767235	0.0047363
Umsobomvu	NC	Pixley ka Seme	0.961241	0.0082614			0.7656012	0.0070991	0.8037471	0.0066036
!Kheis	NC	Siyanda					0.6908549	0.0050128	0.8975171	0.0100101
//Khara Hais	NC	Siyanda	0.9377047	0.0422221	0.979327	0.0545511	0.8647069	0.0224209	0.9476063	0.0290279
Kai !Garib	NC	Siyanda	0.7856458	0.078611	0.6694357	0.033505	0.6933663	0.0357632	0.7424232	0.0357228
Kgatelopele	NC	Siyanda	0.9740902	0.0478601	1	0.0425347	0.96954	0.0052829	1	0.001669
Mier	NC	Siyanda			0.8160468	0.0009309	0.6758505	0.0010761	0.8717327	0.0028748
Tsantsabane	NC	Siyanda	0.9310787	0.0038369	0.8243921	0.0106284	0.8965103	0.0103342	0.8963472	0.013466
Kgetlengrivier	NW	Bojanala	0.8398622	0.0126019	0.3595046	0.0352111	0.7380637	0.0264509	0.6482351	0.0270302
Madibeng	NW	Bojanala	0.8349833	0.1293289	0.5216519	0.1532195	0.5416121	0.2205912	0.5764342	0.4608741

Moretele	NW	Bojanala	1	0.3652102	0.7714967	0.0803714			0.4591577	0.3535206
Moses Kotane	NW	Bojanala			0.8040109	0.0861209	0.7302978	0.0489183	0.6896593	0.1876651
Rustenburg	NW	Bojanala	0.8291467	0.0762184	0.8206139	0.2945161	0.74095	0.1160231	0.7631542	0.1986346
Maquassi Hills	NW	Dr Kenneth Kaunda	0.9582753	0.0104266	0.6119615	0.0573075	0.8667167	0.0435565	0.888261	0.0111997
Tlokwe City Council	NW	Dr Kenneth Kaunda	0.8997065	0.0605328	0.8978787	0.0553155	0.8574576	0.0471732	0.9174914	0.0458249
Ventersdorp	NW	Dr Kenneth Kaunda	0.6521576	0.0628391	0.9473988	0.1566066	0.6501702	0.0640861	0.6634753	0.0586167
Greater Taung	NW	Dr Ruth Segomotsi Mompati	0.8604871	0.0373861	0.2784744	0.0115854	0.6993294	0.0209247	0.8855312	0.7763276
Lekwa-Teemane	NW	Dr Ruth Segomotsi Mompati	0.9475585	0.0076584	0.9297075	0.0138513	1	0.5846897	0.8119707	0.0050691
Mamusa	NW	Dr Ruth Segomotsi Mompati	0.9309599	0.0073811	0.8720396	0.0679524	0.6777796	0.0178944	0.7778305	0.0891284
Naledi - NW	NW	Dr Ruth Segomotsi Mompati	0.8501818	0.015618	0.7582771	0.0217228	0.7996671	0.0274175	0.801928	0.0435988
Ditsobotla	NW	Ngaka Modiri Molema	0.9326931	0.0256871	0.6063864	0.1187834	0.7887825	0.1347611	0.7884931	0.2182964
Mafikeng	NW	Ngaka Modiri Molema			0.6470931	0.1334144	0.712579	0.1117811	0.7756282	0.4247857
Ramotshere Moiloa	NW	Ngaka Modiri Molema	0.8673826	0.065874	0.7553737	0.1028442	0.6202115	0.0315547	0.7783716	0.2429647
Ratlou	NW	Ngaka Modiri Molema								
Tswaing	NW	Ngaka Modiri Molema	0.8993922	0.031639	0.4143211	0.0763892	0.5263368	0.0467513	0.8389726	0.2275786
Breede Valley	WC	Cape Winelands	0.9638287	0.0706061	0.9502264	0.0610977	0.9600314	0.0495542	0.95328	0.0454134
Drakenstein	WC	Cape Winelands	0.9716043	0.106177	1	0.0805864	0.9538884	0.0765903	1	0.032402
Stellenbosch	WC	Cape Winelands	0.8699268	0.0610509	0.8786188	0.0524905	0.8422115	0.0450331	0.9497544	0.1280555
Witzenberg	WC	Cape Winelands	0.947696	0.0634708	0.9632339	0.0608584	0.9525031	0.0416051	0.9208408	0.0393292
Beaufort West	WC	Central Karoo	0.93097	0.0282644	0.9963828	0.0178171	0.8710233	0.0165294	0.9081266	0.0022438
City of Cape Town	WC	Central Karoo	0.9350516	0.7666068	0.9628224	1	0.9277342	1	0.9633393	1
Laingsburg	WC	Central Karoo	0.9445487	0.0045709	0.9667006	0.0055574	0.9442713	0.0026987	0.9335221	0.0003089
Prince Albert	WC	Central Karoo	0.9975336	0.0141113	0.936722	0.0137931	0.9368255	0.005583	0.8935103	0.0011425
Bitou	WC	Eden	0.9119272	0.0223896	0.966297	0.0144615	0.9265773	0.0151315	0.9663985	0.0196014
George	WC	Eden	0.9612743	0.0841559	0.9863331	0.0733189	0.9412638	0.0526053	0.9697688	0.0190193
Hessequa	WC	Eden	0.9649341	0.0234745	0.9288925	0.0134938	0.978694	0.0143845	0.9334925	0.0046721

Kannaland	WC	Eden	0.9175339	0.0119202	0.8430598	0.0208611	0.8761551	0.0053644	0.9233027	0.004999
Knysna	WC	Eden	0.9028676	0.0257257	0.9724467	0.020935	0.8778741	0.019898	0.9142905	0.0131531
Mossel Bay	WC	Eden	0.9691962	0.0307528	0.9712891	0.024042	0.9486969	0.0241734	0.9766352	0.0079824
Oudtshoorn	WC	Eden	0.8291511	0.0545042	0.900471	0.0382839	0.836188	0.0346396	0.919392	0.023111
Cape Agulhas	WC	Overberg	0.9582652	0.0113447	0.9796332	0.0092858	0.97259	0.0105357	0.9855831	0.0095777
Overstrand	WC	Overberg	0.8663292	0.0273977	0.9706755	0.0237885	0.9205233	0.0244996	0.932723	0.0210332
Swellendam	WC	Overberg	0.9975017	0.0262018	0.9812158	0.0281001	0.9773333	0.014939	0.9075628	0.0033861
Theewaterskloof	WC	Overberg	0.9623411	0.0538216	0.9762623	0.0432333	0.9403291	0.0351602	0.9582966	0.048949
Bergrivier	WC	West Coast	0.9748693	0.0376574	0.9881052	0.0187646	1	0.0243613	0.9622215	0.0051642
Cederberg	WC	West Coast	0.9155118	0.0272247	0.9192247	0.0769868	0.9648909	0.0581853	0.9271626	0.0058117
Matzikama	WC	West Coast	0.9691719	0.0437926	0.9694983	0.0567775	0.958917	0.0393456	0.9615136	0.0038053
Saldanha Bay	WC	West Coast	0.9262723	0.0397324	0.938017	0.0277092	0.8751642	0.026766	0.9183349	0.0287071
Swartland	WC	West Coast	1	0.0576154	0.9556376	0.055963	0.9963902	0.0376512	0.9821106	0.013651

Appendix 3: Variable Descriptions

This study makes use of many variables from a series of sources and it is important to understand exactly what each of these variables means, its source, and how it was adjusted to aid this study. As such, each variable will be discussed below. All variables were sourced from the 2016 dataset of their source.

Total population size: this was sourced from the Community Survey and when this variable is presented in the results each unit represents 1 000 000 people, however, when this variable was used to create per capita variables for other characteristics the original amount was used.

Total municipal income: sourced directly from the Financial Census with each unit representing R1000.

Total municipal income per capita: the total municipal income was divided by the total population size resulting in a unit representing R1000 per person.

Gross value added: sourced from Quantec's Regional Indicators and presented in R millions and in nominal terms. This was divided by 1000 in order to be presented as R1 000 000 000 per unit.

Gross value added per capita: the gross value added was divided by the total population size, resulting in a unit representing R1 000 000 000 per person.

Wealth score: Principal Component Analysis was used to generate a wealth index for each municipality based on the number of household items a person owned. These household items consisted of air conditioner, car, cell phone, DVD player, fridge, geyser, home theatre system, internet, landline telephone, microwave, PC, radio, satellite television, stove, tablet, television, vacuum cleaner, and washing machine. This data was sourced from the Community Survey.

Proportion of households that are of a certain size: this was sourced from the Community Survey, which presented it as the number of households in each municipality that had the specific number of people living in that household. These amounts were divided by the total number of households in order to get a proportion for each municipality.

Provincial dummies: these are simply dummy variables indicating which province a municipality is in and was sourced from the Community Survey.

The proportion of households that are in urban areas: this was sourced from the Community Survey and it included the number of households that were urban, farms, or traditional land. These absolute figures were then divided by the total number of households to get a proportion for each.

Proportion of highest education level: the Community Survey presented the number of people in each municipality who had obtained a specific level of education. Very specific information was provided

here, with the education level broken down into grades and specific post-school qualifications. These were combined into six categories: no schooling, some primary education (grade 6 and below), complete primary education (grade 7), some secondary education (grade 8 – 11, as well as incomplete school-level equivalent qualifications), complete secondary education (grade 12 and complete school-level equivalent qualifications), and tertiary education (all post-school qualifications). Each of these categories was divided by the total population size to get a proportion.

Unemployed people: this was sourced from the Quantec Regional Indicators and the number of people who were unemployed, as well as the simple percentage these people represent, was provided. The percentage was simply the number of unemployed people divided by the total population size multiplied by 100 and was not the unemployment rate.

Employed people: this was sourced from the Quantec Regional Indicators and is the number of employed people divided by the total working age population, which was also provided, in each municipality to get a proportion.

Proportion of female-headed households: the total number of households that were headed by a woman were presented in the Community Survey and these amounts were divided by the total number of households to obtain a proportion.

Audit outcomes: this was sourced from the Auditor General database for the Municipal Finance Management Act Report (MFMA) and this dataset was used to create dummy variables. The following section quotes the definitions from the report (Auditor General, 2016b)

- Auditees that received a financially unqualified opinion with no findings are those that were able to:
    - produce financial statements free of material misstatements (material misstatements mean errors or omissions that are so significant that they affect the credibility and reliability of the financial statements)
    - measure and report on their performance in line with the predetermined objectives in their integrated development plans and/or service delivery and budget implementation plans in a manner that is useful and reliable
    - comply with key legislation.
    - This audit outcome is also commonly referred to as a clean audit.
- Auditees that received a financially unqualified opinion with findings are those that were able to produce financial statements without material misstatements, but are struggling to:
    - align their performance reports to the predetermined objectives to which they had committed in their integrated development plans and/or service delivery and budget implementation plans

    - set clear performance indicators and targets to measure their performance against their predetermined objectives General report on the local government audit outcomes for 2015-16 179
    - report reliably on whether they had achieved their performance targets
    - determine which legislation they should comply with, and implement the required policies, procedures and controls to ensure that they comply.
- Auditees that received a financially qualified opinion with findings face the same challenges as those that were financially unqualified with findings in the areas of reporting on performance and compliance with key legislation. In addition, they were unable to produce credible and reliable financial statements. Their financial statements contained misstatements which they could not correct before the financial statements were published.
- The financial statements of auditees that received an adverse opinion with findings included so many material misstatements that we disagreed with virtually all the amounts and disclosures in the financial statements.
- Those auditees with a disclaimed opinion with findings could not provide us with evidence for most of the amounts and disclosures in the financial statements. We were unable to conclude or express an opinion on the credibility of their financial statements. Auditees with adverse and disclaimed opinions are typically also:
    - unable to provide sufficient supporting documentation for the achievements they report in their performance reports
    - not complying with key legislation.

Nominal compensation: this was gathered by Quantec in their Regional Indicators dataset and represents the total nominal compensation that residents in that municipality received in 2016 and it was presented in R million. This was divided by the total population size to get a per capita value.

Density: this represents the number of people per squared kilometre and was sourced from the Quantec Regional Indicators.

Race proportions: the Community Survey indicated how many people of each race resided in each municipality. These amounts were divided by the total population size to get a proportion for each race group in each municipality.

Dummy for Proportion of total Income from Intragovernmental Grants $\geq$ 50%: the total municipal income acquired through intragovernmental grants is presented in the Financial Census for Municipalities; this was divided by the total income for each municipality in order to get a proportion of income that was received through intragovernmental grants. If this proportion was more than or equal to 0.5, the dummy variable would be 1.

Appendix 4: Robustness Tests

In order to test for the robustness of the models, the same models are run but using different statistical methods. All the models based on subjective satisfaction are rerun below using the Tobit method; the conventional models for electricity provision and refuse removal are run below using a truncated regression; and the conventional models for sanitation and water provision are rerun using a standard OLS, as the truncated regressions did not converge. These results are very similar to the reported results and thus indicate the robustness of the results. The models, indicated by the following numbers, are:

1: Electricity provision using satisfaction as the output - Tobit

2: Electricity provision for the conventional model – truncated regression

3: Refuse Removal using satisfaction as the output - Tobit

4: Refuse Removal for the conventional model – truncated regression

5: Sanitation Services using satisfaction as the output - Tobit

6: Sanitation Services for the conventional model – OLS

7: Water provision using satisfaction as the output - Tobit

8: Water provision for the conventional model – OLS

Table 13: Models to test for robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Gross value added per capita	-856.9*	4473.4						
	(-2.09)	(1.56)						
Proportion of Households with a Female Head	-9.639	-11.61						
	(-1.10)	(-0.20)						
Proportion of Households with a Female Head, squared	10.33	26.28						
	(1.19)	(0.46)						
Number of People Who are Unemployed	-0.0000906*	0.00429***			0.000109	-0.00524**		
	(-2.50)	(4.30)			(0.16)	(-3.07)		
Wealth score	0.0185***	-0.0235					-0.0172*	-0.0362**
	(4.64)	(-1.20)					(-2.24)	(-3.11)
Proportion of			0.479	-2.610**				

Households that Live on Farms								
			(1.27)	(-2.60)				
Proportion of Households that Live on Farms, Squared			-0.558	6.289**				
			(-0.70)	(3.18)				
Proportion of Residents Whose Household Head is Between the ages of 20 and 59, Squared			-25.04	-8.497			53.03**	36.86
			(-1.56)	(-0.29)			(2.84)	(2.02)
Proportion of Residents Whose Household Head is Above the Age of 60			-48.92	-19.27			-352.1*	257.0**
			(-1.55)	(-0.33)			(-2.15)	(2.93)

Proportion of Residents Whose Household Head is Above the Age of 60, Squared			23.92	13.21			-53.50**	-37.64*
			(1.52)	(0.44)			(-2.74)	(-2.08)
Proportion of Residents Whose Household Head is Below the Age of 19			-33.72	-10.91			-376.3*	240.6*
			(-1.39)	(-0.24)			(-2.32)	(2.71)
Proportion of Households that are in Urban Areas			-0.441*	0.295			0.107	-0.127***
			(-2.08)	(0.99)			(1.78)	(-3.79)
Proportion of Households that are in Urban			0.755***	-0.164	0.190***	0.181**		

Areas, Squared								
			(3.76)	(-0.56)	(5.34)	(2.96)		
Provincial Dummy: Eastern Cape			-0.198***	-0.110			-0.0874	-0.0377
			(-4.19)	(-0.71)			(-1.92)	(-1.43)
Provincial Dummy: Free State			-0.199***	0.0565			-0.0709	-0.0848*
			(-6.76)	(0.62)			(-1.60)	(-2.64)
Provincial Dummy: Gauteng			-0.115**	0.0967			0.01000	-0.110**
			(-3.13)	(1.00)			(0.24)	(-2.93)
Provincial Dummy: KwaZulu Natal			-0.141**	0.0828			-0.0226	-0.297***
			(-3.30)	(0.78)			(-0.24)	(-4.81)
Provincial Dummy:			-0.157**	0.257*			-0.132**	-0.0471

Limpopo								
			(-2.83)	(2.54)			(-3.22)	(-1.25)
Provincial Dummy: Mpumalanga			-0.170***	0.261**			-0.114**	-0.119***
			(-3.71)	(2.64)			(-2.94)	(-3.77)
Provincial Dummy: Northern Cape			-0.171***	-0.252*			-0.0977***	0.0142
			(-4.00)	(-2.08)			(-5.78)	(0.71)
Provincial Dummy: North West			-0.136***	0.183			-0.155**	-0.00189
			(-4.37)	(1.93)			(-2.87)	(-0.05)
Total Municipal Income			2.48e-09	0.000000131	2.69e-08	-0.000000160*	4.07e-08	-0.000000339***
			(0.68)	(1.45)	(1.03)	(-2.55)	(0.72)	(-5.36)
Population Size					-0.0352	1.360***	-0.0961	1.340***
					(-0.27)	(3.59)	(-0.47)	(6.32)

Gross Value Added Squared					-0.0000218	-0.0000636***	0.00000145	-0.0000887***
					(-1.94)	(-3.75)	(0.08)	(-4.98)
IDP Submitted					-0.0116	0.129*		
					(-0.49)	(2.53)		
Municipality Monitored Water Quality					-0.0268	-0.142*		
					(-1.29)	(-2.47)		
Population Size Squared					1.69e-13	5.94e-13***	-3.98e-14	6.64e-13***
					(1.72)	(3.96)	(-0.25)	(4.34)
Nominal Compensation Per Capita, Squared					10.58	28.31**	-75.00	-20.39
					(1.38)	(3.23)	(-1.91)	(-0.52)
Proportion of Residents Who are Employed					-1.405**	0.855		
					(-2.94)	(1.27)		

Proportion of Residents Who are Employed, Squared					1.150**	-0.740	-0.274**	-0.00635
					(2.62)	(-1.27)	(-3.19)	(-0.08)
Proportion of Residents Whose Household Head is Between the ages of 20 and 59					-0.402*	0.0579	-457.4**	183.5
					(-2.33)	(0.28)	(-2.78)	(1.86)
Proportion of Households that are of Size 6-10 People					2.570**	-0.507	-0.00297	-0.330*
					(2.73)	(-0.39)	(-0.01)	(-2.34)
Proportion of Households that are of Size 6-10 People Squared					-4.905**	0.954		
					(-3.00)	(0.40)		

Proportion of Residents with No Formal Education					0.624	0.565		
					(1.83)	(1.69)		
Proportion of residents Whose Highest Level of Education is Completed Secondary School, Squared					0.324	-1.827		
					(0.49)	(-1.87)		
Audit Dummy: Adverse with Findings					-0.403***	-0.0248		
					(-9.77)	(-0.42)		
Audit Dummy: Audit not Finalised at Legislated date					-0.120***	-0.0262		
					(-3.46)	(-0.49)		
Audit Dummy: Qualified with Findings					-0.130***	-0.0388		
					(-4.33)	(-0.72)		

Audit Dummy: Disclaimed with Findings					-0.0896**	0.0655		
					(-2.62)	(0.97)		
Audit Dummy: Unqualified with Findings					-0.0720**	-0.0626		
					(-2.69)	(-1.36)		
Simple Percentage of Unemployed People					-0.00663***	0.00352		
					(-3.94)	(1.70)		
Number of Councilors Per Capita							-56.94	177.3*
							(-0.68)	(2.08)
Density (Population Per Squared Kilometre), Squared							7.14e-08	-0.000000266***
							(1.79)	(-5.20)

Nominal Compensation Per Capita							9.106***	5.223
							(3.54)	(1.29)
Proportion of residents Whose Highest Level of Education is Completed Primary School, Squared							14.06	1.492
							(1.72)	(0.30)
Proportion of Residents who are Black Africans							-0.0960	-2.797***
							(-0.16)	(-6.03)
Proportion of Residents who are Coloured							-0.00672	-2.899***
							(-0.01)	(-6.23)

Proportion of Residents who are White							-0.0229	-2.583***
							(-0.04)	(-6.09)
Proportion of Residents Whose Highest Level of Education is Incomplete Secondary School							4.005	5.182*
							(1.93)	(2.44)
Proportion of Residents Whose Highest Level of Education is Incomplete Secondary School, Squared							-8.132*	-7.838*
							(-2.45)	(-2.37)

Total Municipal Income Squared							-4.87e-16	1.40e-14***
							(-0.27)	(5.84)
Wealth Score Squared							0.00185	0.00330*
							(1.87)	(2.32)
Constant	3.149	-1.810	25.52	8.478	1.234***	-0.431	404.9*	-218.2*
	(1.41)	(-0.13)	(1.60)	(0.29)	(6.09)	(-1.29)	(2.48)	(-2.39)
N	176	174	192	189	146	146	140	140

t statistics in parentheses

* p<0.05, ** p<0.01, *** p<0.001