




Financial mismanagement and efficiency trade-off in local municipalities: Lessons from Eastern Cape, South Africa

**Authors:**

Syden Mishi¹ 
 Nwabisa Mbaleki¹ 
 Farai B. Mushonga¹ 

Affiliations:

¹Department of Economics, Faculty of Business and Economic Sciences, Nelson Mandela University, Gqeberha, South Africa

Corresponding author:

Syden Mishi,
 syden.mishi@mandela.ac.za

Dates:

Received: 15 Feb. 2022
 Accepted: 01 June 2022
 Published: 29 July 2022

How to cite this article:

Mishi, S., Mbaleki, N. & Mushonga, F.B., 2022, 'Financial mismanagement and efficiency trade-off in local municipalities: Lessons from Eastern Cape, South Africa', *Journal of Local Government Research and Innovation* 3(0), a68. <https://doi.org/10.4102/jolgr.v3i0.68>

Copyright:

© 2022. The Authors.
 Licensee: AOSIS. This work is licensed under the Creative Commons Attribution License.

Background: Local governments are considered an essential part of interpreting and integrating laws and policies at the local level. There is a growing realisation that the success of local government is vital to alleviating poverty and delivering services to communities. However, financial mismanagement as per audit reports has affected a number of local authorities and continues to be a hindrance to progress.

Aim: This study was set to investigate the level of efficiency in each municipality and how financial mismanagement (unauthorised, irregular, fruitless and wasteful expenditure) influences that efficiency.

Setting: The study considered all local municipalities within the Eastern Cape province of South Africa, using publicly available data on each municipality's performance and financial management. The data available and utilised are for the financial years 2012–2015.

Methods: The study used a non-parametric linear programming-based technique to compute efficiencies, with the local municipality being the decision-making unit. The implications of financial mismanagement on efficiency are determined in a second-stage regression model with the use of panel tobit regression.

Results: We found that the mean efficiency ranges between 0.407 (moderate) and 0.724 (high) in general, however, with greater variation across municipalities. Fruitless and wasteful expenditure and unauthorised expenditure negatively affect the total efficiency scores. Irregular expenditure has no statistical effect on efficiency, arguably because of the nature of this financial mismanagement being expenditure that may be for a good cause but not approved procedurally.

Conclusion: There is room to increase efficiency in studied municipalities, especially by reducing wasteful expenditure and unauthorised expenditure. *The Public Finance Management Act* provides astute guidelines that will bring efficiencies in municipalities; however, a review may be necessary to be progressive. The South African Local Government Association and Cooperative Governance and Traditional Affairs Department must capacitate municipalities and work with the auditor general to implement audit recommendations.

Keywords: smart cities; public finance management; local economic development; municipality efficiency; decentralization; wasteful expenditure; irregular expenditure; service delivery.

Introduction and background

In many developing countries, the failure of the central government to avoid large fiscal deficits and macro-economic instability and to provide adequate services has generated an increasing interest in the decentralisation of government functions (Ebel & Yilmaz 2003). South Africa, like Australia and New Zealand, has a developed government structure that gives much authority and discretion to lower tiers of government (Province and Local government). The idea of such a structure is that development is best administered and spearheaded at the grassroots where it is needed. However, that depends on how competently such authorities will be run, mostly when it comes to financial resources. Skilling of municipal management is one way to ensure operational efficiency, as argued in a study by Patience and Nel (2021).

The South African local government is viewed as an essential part of integrating laws and policies to cater for every citizen and those who were unfairly treated by the apartheid system by providing services to people in a sustainable way (Gopane 2012). However, when local

Read online:

Scan this QR code with your smart phone or mobile device to read online.

governments fail to meet these expectations, decentralisation has often been blamed for the underperformance (Ebel & Yilmaz 2003). South Africa consists of 257 municipalities, but according to the audit report by South Africa's auditor general, only 8% of the total municipalities had a clean audit in the financial year 2017–2018, with irregular spending estimated to be R21.2 billion in the region (AGSA [Auditor General of South Africa] 2019).

The South African government has taken great steps in ensuring the promotion of economic growth and development through implementing legislation and regulations that target the improvement of living conditions of its citizens, especially the poor, since democratisation in 1994 (Madumo 2015). However, it has been challenging for the government to accelerate development because of increasing difficulties such as corruption, mismanagement, maladministration and much more ills within different spheres of government (Mathiba 2021). Despite the country's strong economic policy framework, the government has failed to create jobs and increase productivity aimed at improving the country's GDP per capita (Fourie 2014), especially in the Eastern Cape province (Kavese & Erero 2018). Local economic development has not yielded expected results to address unemployment, create business opportunities and help diversify local and regional economies. In addition, municipalities and provinces were structured with federal elements of self-governance to try to tackle the socio-economic issues in South Africa (Dick-Sagoe 2020). However, the municipalities have faced challenges, such as the inability to facilitate and improve societal development (Madumo 2015; Mathiba 2021).

Furthermore, to fast-track the implementation of service delivery, financial management and infrastructure development, the local government introduced the Local Government Turnaround Strategy (COGTA [Cooperative and Governance and Traditional Affairs] 2019). This strategy was introduced to promote accountability and effective, efficient local government. However, the government is continuously experiencing revenue shortfalls because of the increasing government expenditure that usually exceeds the estimated budget and planned outlays, which then leads to periodic fiscal stress. According to Nini and Sgqolana (2018), municipalities in the Eastern Cape have struggled to be efficient because of their poor performance, political instability and irregular expenditure, where municipalities are constantly asking for financial assistance from the national government.

The Eastern Cape (EC) is mostly known as the manufacturing centre for major auto companies, such as Volkswagen and Mercedes-Benz, and it has a rich cultural heritage embodied in the Home of Legends, which is also a true reflection of the senior political leaders who have emerged from this province. The EC consists of 45 municipalities (six district, two metropolitan and 37 local), and only 13% of these municipalities have shown improvement and could provide a quality financial statement to comply with key legislation for the financial period of 2017–2018 (Ncapayi 2019).

Therefore, 77% of these municipalities have remained inefficient with irregular expenditure and mismanagement of funds. According to the *Public Finance Management Act* (1999), government spending that is not in line with the required application of any legislation, the State Tender Board (as implemented in 1968) and any provincial legislation for procurement procedure in a local government is considered irregular expenditure.

Gopane (2012) stated that these municipalities are characterised by poverty and the expanse of rural communities; hence, there is a desperate need to improve their functioning to help address problems of inequality, poverty and unemployment. In addition, Booysen (2012) reported that most executive positions in these municipalities are occupied by unqualified personnel. This compounds the problem, with the system generally being unsuccessful in converting debt into cash over several years, as evidenced by the age of the debt in municipalities. The resulting overall challenge is poor service delivery. Lack of service delivery has in many cases led to violent and destructive strike actions, which put leadership capabilities in question (Mbandlwa & Mishi 2020).

According to Rakabe (2013), most provinces claim to face exogenous cost pressures (some of which are imposed by national government departments) and increasing demand for services that do not always match adequate transfers. With so much complexity over what constitutes provincial fiscal stress, the ability of the national government to hold provinces accountable for service delivery becomes limited, whilst provinces have limited incentives to use resources efficiently because they know that they cannot be held fully responsible for failure to deliver (Fourie 2014). Fiscal stress for cities has long been acknowledged globally (Dethier 2013), vindicating the more urgent need for optimal use of available resources.

Against this background, this study measures the efficiency levels of each municipality in the Eastern Cape and examines trends over time. This study then investigates how inappropriate expenditure (financial mismanagement) affects such efficiency. There is often an argument by municipal management that irregular, unauthorised and wasteful expenditure often takes place to improve service delivery in the face of the stringent *Municipal Financial Management Act* (MFMA) – that is, it is in the interest of the public (Clive Ndou 2021; Greater Tzaneen Municipality 2019; North West Provincial Legislature 2019). The rest of the study is organised as follows: the next section presents a conceptualisation of the key terms and contextualising variables, followed by the literature review, followed by methodology, results and discussion, then the conclusion and recommendations.

Overview and conceptualisation of terms

Financial mismanagement in South Africa

Performance measurements for municipalities are diverse (Pollanen 2005), one being from financial management,

which Rangongo, Mohlakwana and Beckmann (2016) defined as strategies that are implemented by an entity (in this case a municipality) to meet its financial goals. The implementation of these financial management goals can be analysed to evaluate their actualisation. Sibanda, Zindi and Maramura (2020) stated that the evaluation of the financial management goals involves an analysis of how effectively the financial resources have been managed to achieve the optimal goals of the municipality. The analysis of the actualisation of these goals in South Africa has revealed that there is financial mismanagement that can be described as unauthorised, irregular, fruitless and wasteful expenditure causing financial distress (Glasser & Wright 2020). According to Dlomo (2017), financial mismanagement in South Africa is mainly dominated by unacceptable tender processes and inability to follow procedures and variations in the procurement of goods, in which all these are regulated by the law. Financial management of municipalities in South Africa is guided by legislation in which the Constitution provides the framework and guidelines of financial management in South Africa (Dlomo 2017).

Section 152 of the Constitution of South Africa states that municipalities must provide adequate services to their residents to pursue their services (South African Constitution), which Dlomo (2017) argued to mean that municipalities are accountable to their residents. Dlomo (2017) further stated that numerous components of financial management are also explained in section 195(1), section 160(2), 215 and 227, explaining budgetary components, revenue and expenditure, respectively. According to Perez-Lopez, Prior and Zafra-Gómez (2015), the sustainability of the Constitution is supported by the *Municipal Finance Management Act* (Act 56 of 2003), the *Municipal Structures Act* (Act 117 of 1998) and the *Municipal Systems Act* (Act 32 of 2000). Another legislation that governs local government is called the *Public Financial Management Act* (PFMA). The PFMA regulates the handling of budgets in national and local governments. Furthermore, the PFMA is responsible for promoting efficiency and effectiveness of income, expenditure, assets and liabilities by laying out procedures (South Africa, National Treasury 2010). It points out the roles and obligations of government officials handling finance. The goal is to enforce accountability and transparency amongst government and public institutions. Furthermore, the Act describes expenditure that was not incurred in the manner prescribed by the legislation; this expenditure might have been incurred out of the budgetary guidelines, for instance, somewhere in the process that led to the expenditure, and the auditee did not comply with the applicable legislation that is stipulated in *Municipal Finance Management Act* 56 of 2003.

Monkam (2014) stated that financial mismanagement in South Africa is a result of failures that are derived from poor supply chain management, performance reporting and risk management, whilst Sibanda et al. (2020) found that one of the causes of financial mismanagement is inefficient internal control measures. Dlomo (2017) and Glasser and Wright (2020) also identified that municipalities in South Africa have

poor internal control systems, and there is a need for the effective implementation of internal control measures to ensure that financial activities are completely accounted for and presented. Dlomo (2017) further identified that financial mismanagement in South Africa is a result of poor benchmarking, with Lampe, Hilgers and Ihl (2015) stating that benchmarking derives from commitment and adherence to policies, processes and practices to achieve a clean audit. Nzama (2019) identified that municipalities in South Africa do have budgets that they follow, and the issues of irregular expenditure arise from amendments of these budgets that do not follow due process and fall under financial mismanagement, as guided by the *Municipal Systems Act* of 2000.

Nokwazi and Prunella (2017) highlighted that South African municipalities face irregular expenditure because of auditing, which is in itself not done on a regular basis. Dlomo (2017) noted that auditing is important as it reveals fraud and incompetence, and when done regularly, any mismanagement can quickly be rectified and prevented. Laubscher (2012) noted that financial management can also be because of poor planning of the municipality and that poor human resource management is one of the organisational issues that lead to irregular expenditure. The enactment of the *Municipal Finance Management Act* (MFMA) brought new hope to local municipalities that are expected to adhere to their provisions in the delivery of services. However, poor financial accountability and lack of transparency in municipal finance management adversely affect the capacity of the local municipality to uphold good governance Mbatha, (2020).

Overview of municipality performance and efficiency

Municipal performance measurement

Municipal performance is assessed through five key performance areas (KPA), namely municipal transformation, organisational transformation, local economic development (LED), basic service delivery and good governance and public participation. Their details and how each is related to this study are presented subsequently.

Key performance area 1: Municipal transformation

The following factors illustrate how organisational frameworks and job dynamics of municipalities relate to municipal transition and structural growth to achieve municipal transformation and local government needs.

Stabilisation of administrative and political elements within municipalities: According to De Visser (2010), municipalities face significant problems in terms of interfaces between politicians and authorities. Furthermore, the order of the day appears to be inadequate political interference in administrative matters, as well as strained relations between key political and administrative officials in the municipalities. This is often blamed for the lack of division of authority between legislative and executive bodies at the local government level.

According to Motta and Moreira (2009), municipal administration can be influenced by municipal circumstances and election disputes for elected offices or by local elections for state and federal offices. Political officials, however, also have other goals other than supporting their local citizens. When politicians prioritise their own goals that will benefit them instead of the community, this often leads to looting and wasteful expenditures. This is common in most municipalities in the EC, with wasteful expenditure increasing, and more blame is directed at councils who are not even qualified for the job positions they occupy, according to an audit report (Ncapayi 2019).

Implement a comprehensive capacity-building program: Local government has a special role in the state system, and there is a growing realisation that the success of the local government is vital to alleviate poverty and deliver services to communities. However, there is also a need to reflect on the ability of individual municipalities to enhance their quality of government and the standard of service delivery (Scheepers 2015). This includes having municipal managers, senior managers (Section 57 of the Systems Act), professionals such as chief finance officers, engineers and IT specialists and all other staff levels.

Organisational structure and skills development: For municipalities to be efficient, programmes that promote development skills and performance-oriented needs must be adopted. This includes offering bursary schemes to both employees and students within the jurisdiction of the municipalities, adapting management programmes making sure managers and supervisors are competent and providing training for councillors to enhance their leadership skills and competency in the organisation. The efficiency and financial management of municipalities are dependent on how competent employees are. Therefore, local government is encouraged to invest in human capital and implement an organisational structure that promotes efficiency in the organisation.

Key performance area 2: Local economic development

It is acknowledged that local economic development is based on a local effort, guided by local stakeholders, and requires the recognition and use of local resources, ideas and expertise in an organised way to promote economic growth (Scheepers 2015). There are four fundamental forces that drive the new call for funding cooperatives and SMMEs: firstly, the mainstreaming of youth entrepreneurship; secondly, support for SMMEs through manufacturing and service sector growth; thirdly, encouraging and understanding the township economy; and lastly, strengthening LED planning and service.

There has been an improved performance in municipalities with regard to LED (Eastern Cape Annual Report 2016). The general increase in results may be mostly because of the fact that certain municipalities have correctly given complete attention to their performance in accordance with all

performance metrics, as stipulated by the COGTA department. These municipalities have managed to create jobs, alleviate poverty and improve the standard of living, whilst being financially accountable for budgetary expenditure and revenues (Meyer 2014). Therefore, the implementation of LED encourages efficiency in municipalities because resources are directed to where they are needed the most.

Key performance area 3: Basic service delivery

The delivery of essential services is the central business of local government. Without the required provision of infrastructure, efforts to meet this mandate would be unsuccessful. Provision of basic services by municipalities has increased in the Eastern Cape Province. Most citizens have access to basic services such as clean water, electricity, housing and more. However, the province is faced with net immigration.

Therefore, it is unable to fund all goals because of limited income (Kavese & Erero 2018). Municipalities therefore need to have programmes of urgency to provide service for urgent matters that may hinder economic growth and development, whilst concentrating on systemic and sustained capacity development over the long term (South Africa, Department of Provincial and Local Government 2005).

Service delivery is used as the output variable to measure the efficiency scores of municipalities. There is a positive relationship between efficiency and service in delivery. This is because service delivery also improves as efficiency improves. When service delivery increases at a decreasing value, wasteful expenditure increases, and this means that instead of using the limited available resources to provide basic service to society, these resources are used for activities that do not promote economic growth and development in societies.

Key performance area 4: Municipal viability and management

The goal of this KPA is to ensure that there is financial stability and transparency in municipalities. Financial viability, capital expenditure, budgetary revenues and expenditures are used to measure municipal viability and management (South Africa, Department of Provincial and Local Government 2005). According to Makwetu (2019), the financial state of municipalities in EC has worsened. Furthermore, only 13% of municipalities managed to produce financial statements and had a clean audit, whilst other municipalities failed to produce adequate financial statements that are important to enable accountability and transparency. Most municipalities fail to get a clean audit because their expenditures are more than the budget expenditures, whilst wasteful expenditures continue to increase by millions every year (Wasserman 2019).

According to the COGTA (2005), improving the local capability of municipalities includes the following: firstly, municipalities need to have a long range of budgeting and

financial planning. This consists of the ability to manage the cost of the organisation to promote accountability, increase investment social and economic infrastructure and have a reasonable balanced expenditure for capital investment expenditure, operational expenditure and wages. Secondly, management of both debt and revenue is necessary; thirdly, municipalities need to adhere to the MFMA regulation by having financial controls, and this is done through implementing anti-corruption programmes; and lastly, municipalities must improve financial reporting, and this consists of improving the quality of financial statements for auditing and working on correcting matters raised by the general auditor.

Key performance area 5: Good governance and public participation

The goal of this KPA is to foster a transparent, ethical, competent, sound and responsible governance structure (Gopane 2012). Scheepers (2015) reported that the continuous organisational growth and training strategy, which aims to improve service delivery via successful administrative structures, is an essential component for the development of effective and efficient human capital. This can be done through empowering and improving participation in communities.

Conceptualising efficiency

Efficiency of an organisation or entity is the ability to implement its plans using the smallest possible expenditure of resources (Benito, Bastida & Garcia 2010; Black, Calitz & Steenekamp 2015). On the flip side, it is getting the most possible output from limited resources (inputs). Every decision-making unit needs to optimally utilise available resources that ensure avoidance of waste and allocate resources to non-productive areas. With shrinking fiscal capacity, municipalities (albeit mainly those that provide social goods and services, like health, that do not require profit maximisation) still require the effective utilisation of the available resources to provide the most relevant services.

This study is focusing on municipal efficiency, according to Mahabir (2014), in the face of scarcity, and it is critical for economic actors in order to reduce wastages and maximise outputs. A municipality is considered efficient if the output is maximised at a lower cost (fewer inputs). Secondly, the provision of public goods is allocated to those most in need and efficient in allocation of resources, ensuring that everyone is better off in terms of accessing services. Lastly, expenditure is used to produce the optimal level of service delivery. Municipalities are inefficient when they incur a higher cost of producing or providing the same or fewer public services compared with other municipalities using a higher input (expenditure). According to Dilber (2021), the variables used as inputs are the factors that have a cost and should be kept at a minimum, and the outputs are the products that have a positive value and should be increased and maintained at a maximum.

Literature review

The theoretical framework of the study can be derived from agency theory, participative budgeting theory, trade-off theory and decentralisation theory. Adam Delis and Kamas (2014) stated that agency theory explains the agent-principal relationship, where the agent in the context of local governments is the municipality, whilst the principal is the general public. The agent (municipality) is responsible for implementing a sound financial management system that reduces financial mismanagement (Dzomira 2017). Participative budgeting theory focuses on the correlation between the priorities of the municipality budget and the requirements of the constituents. According to Mwambere and Kosimbei (2022), participative budget theory states that the financial planning and management of municipalities must prioritise consultative procedures to include the constituents' requirements and allocative efficiency. The novelty of the studies of the link between financial management and municipality efficiency can be identified with fiscal decentralisation theory. This is because participative budgeting theory and agency theory mainly focus on financial management, whilst financial decentralisation explicitly explains the link between financial management and efficiency.

Financial decentralisation theory explains the delegation of the delivery of government services and management of public funds from a centralised national sector to a subnational level (Benito et al. 2010). Decentralisation theory provides subnational levels such as municipalities with the role of making expenditure decisions, collection of taxes, raising revenue, borrowing funds and making intergovernmental fiscal borrowings (Adam et al. 2014). In addition, Adam et al. (2014) noted that fiscal decentralisation links financial management and efficiency in terms of increased electoral control and yardstick competition amongst local governments. The electoral control argument of fiscal decentralisation notes that decentralisation reduces the diversion of rents by officials because they will be voted out, thereby increasing efficiency (Adam et al. 2014). According to the theory of yardstick competition argument, which identifies that decentralisation equips citizens with the ability to evaluate across municipality performance, which is their municipality's performance against their neighbours, fiscal decentralisation may increase public sector efficiency, as it offers citizens an opportunity to compare public services and taxes across jurisdictions and helps them to assess whether their government wastes resources through low human capital capacity or rent-seeking (Besley & Smart 2007). However, there are certain necessary conditions that need to be met to achieve efficient service delivery through decentralisation, as detailed in Khan (2021), which includes (amongst others) political will, the relationship between governments at various levels and how revenue generated is managed.

Furthermore, the theory states that fiscal decentralisation improves the efficiency of public services to communities through preference matching and allocative efficiency

(Hayek 1945). Ter-Minassian (1997) followed and emphasised that financial decentralisation can exacerbate the delivery of public services. In addition, Brosio & Ahmad (2008) argued that financial decentralisation will boost efficiencies by promoting greater transparency, and the geographical closeness of public agencies to the local community (final beneficiaries) encourages transparency and can boost the results of public services, particularly in social sectors such as education and health. Therefore, there is no consensus on the implications of government structure (Khan 2021).

One of the most significant consequences of a successful fiscal decentralisation program is the creation of representative and accountable municipalities, as noted in the electoral control argument. Furthermore, fiscal decentralisation creates municipalities that are closer to the citizens and equipped with considerable flexibility and capacity to better address subnational differences in the needs and desires of their constituents (Monkam 2014). Therefore, demand for efficiency is not only allocative, but technological or productive, for which the delivery of local government services is one of the greatest expectations of a sound process of fiscal decentralisation. However, fiscal decentralisation may also exert a negative impact on government efficiency (Khan 2021; Razafimahefa & Sow 2015). This impact can be attributed to a number of potential advantages gained by the provision of public goods by central governments. Firstly, in the presence of economies of scale, higher decentralisation might lead to a higher average cost of production for the public good (Stein 1997). Secondly, other scholars emphasise the potential danger that local politicians and bureaucrats are likely to face, particularly an increase in pressure from local interest groups, with these groups being more influential when the size of the jurisdiction is small (Bardhan & Mookerjee 2000; Prud'homme 1995).

Service delivery is influenced by different factors in different locations; for instance, Moreno (2005) found that transparency and competition in the world of politics have a positive and significant effect on the provision of basic services by municipalities. Implying that municipalities that are hotly contested are more likely to be efficient, Chowdhury and Al-Hossienie (2012) also added that the efficiency of municipalities is dependent on political economy, specifically how policies are crafted and the degree of accountability to the citizens. Motta and Moreira (2009) argued the importance of politics on policies crafted, whilst Benito et al. (2021) found that the dedication required from politics for efficiency is also dependent on their remuneration. It is important to note that Zafra-Gómez, Antonio and Muñiz (2010) identified that smaller municipalities have high levels of political efficacy, and the citizens participate more in the day-to-day activities than large municipalities. Zafra-Gómez et al. (2010) stated that politics play a significant role in smaller municipalities, and McDonnell (2020) stated that municipalities that are governed by progressive parties tend to have higher efficiency. Loikkanen et al. (2011) found that there are four main facets of political factors that impact efficiency, which

are ideological position, political concentration, voter turnout and potential for re-election.

On the contrary, Loikkanen, Susiluoto and Funk (2011) stated that characteristics of city managers, such as educational level and their ability to motivate workers, contribute to the level of efficiency in municipalities. Mbandlwa and Mishi (2020) found a U-shaped service delivery and councillor leadership characteristics, depicting that there is an optimal level of leadership characteristics to be reached to start to have a sustainable high level of service delivery. Loikkanen et al. (2011) stated that the educational level of the citizens has a positive effect on municipality efficiency, as they require accountability.

Loikkanen et al. (2011) found that municipality management does not only depend on the educational characteristics of the managers but also can be affected by their age, political affiliation and gender, where they found that female managers had an insignificant impact on efficiency. However, it is important to note that the sample of the study in Loikkanen et al. (2011) was small, and that might have had a significant impact on the results. Whilst Perez-Lopez et al. (2015) deviated from looking at managers' characteristics and looked at the management style of the municipality, which they described as a new public management delivery form. Perez-Lopez et al. (2015) stated that new public management involves contracting out, creation of public agencies, cooperation with private companies and other municipalities to improve efficiency and finding out whether contracting out, agencies and intermunicipal cooperation reduce cost efficiency.

Service delivery is also dependent on government expenditure, as argued by Charles & Lemos (2018) concluding that government expenditure on education, health and other services is statistically significant. The author further argued that government investment in education bears more returns, as it increases total revenue for municipalities because more constituents will be employed once they have acquired the relevant skills. However, according to Liu et al. (2017), an increase in government expenditure to stimulate service delivery did not necessarily translate to efficiency in China. Liu et al. (2017) stated that in China, increasing government expenditure failed to transform into efficiency because they solely focused on the level of investment whilst coupled with poor management, political determination and skills. The effect may differ based on other factors like the national government structure, degree of tolerance for corruption and irregular activities in society and the size of the economies, amongst other factors. To this, Zafra-Gómez et al. (2010) suggested that the small-scale municipalities face high costs compared with large municipalities that have economies of scale, and there is need to give them government grants to increase their efficiency.

The analysis of the impact of financial management and its importance towards the efficiency of local municipalities has

varied from large municipalities and small municipalities taking cognisance of differences in economies of scale between the small and large municipalities. Hence, Zafra-Gómez et al. (2010) stated that small municipalities do not have economies of scale, and there is need for an extra funding to ensure efficiency.

The studies that have explored financial management in municipalities include Benito et al. (2010), Kalb (2010), Lampe et al. (2015) and Zafra-Gómez et al. (2010), with Kalb (2010) measuring financial management using fiscal capacity. According to Kalb (2010), fiscal capacity is explained relative to the needs of the municipality, stating three categories of fiscal capacity: fiscally abundant (when the fiscal resources exceed fiscal needs), fiscally weak (when fiscal capacity lies between 60 and 100% of the needs of the municipality) and very weak (when fiscal capacity has less than 60% of the needs of the municipality). On the contrary, Lampe et al. (2015) analysed the accrual accounting in municipalities and how an accounting approach can have an effect on the efficiency of municipalities. Zafra-Gómez et al. (2010) explained financial management using short-run solvency, self-funding, weight of financial load and budgetary results.

The facets of municipality efficiency can be measured using outputs in terms of service delivery in spheres such as safety and security (policing), refuse collection, sports and water supply, as in Benito et al. (2010) and Geys and Moesen (2009). Lampe et al. (2015) stated that the proxies of output to reflect efficiency have been explained with variables such as education, recreation, social needs and infrastructure. The mandate of a municipality needs to be understood to correctly identify the outputs.

It is important to note that the analysis of financial management or any other factors that impact municipality efficiency has been largely analysed using data envelopment analysis (DEA) to obtain technical efficiency in municipalities (Afonso & Fernandes 2008; Boetti, Piacenza & Turati 2010; Kokkinou 2009; Murillo-Zamorano 2004). Benito et al. (2010) stated that when applying DEA as a method of extreme point, having a borderline of efficient units, deviation from the efficient border is defined as inefficiency. The simple DEA input/output quotient is mainly applied in the analysis of efficiency, and the advantage is that it does not require *a priori* specifications of weights of each input or output; however, it is important to note that the commonly used method is the weighted sum of outputs and the weighted sum of inputs (Zafra-Gómez et al. 2010). Contrary to Benito et al. (2010), Loikkanen and Susiluoto (2004) critiqued the use of DEA and free disposal hull (FDH) models for two reasons. Firstly, the DEA model carries less information in that the location and shape of the predicted output region are calculated purely by the most effective measurements. Secondly, DEA is essentially a non-stochastic method. Procedurally, Monkam (2014) stated that to generate output y decision-making units (DMUs), use input x ; therefore, the test is on how efficiently the input is being used to generate y .

To measure efficiency assumptions of how increases in scale relate to the returns on the entity, we either assume variable returns of scale (VRS) or constant returns of scale (CRS) (Foo et al. 2015). Municipalities are input oriented instead of output oriented, and this is because the nature of service delivery is determined by the needs of societies and welfare considerations, providing a social public good (Mahabir 2014). Furthermore, the level of service delivery by municipalities may have significant social and political effects on the citizens. In the case of France, Narbón-Perpiñá et al. (2020) asserted that no one method can be considered the best.

Most empirical studies in the available literature have employed total current expenditures as municipal inputs for analysing productive or technological efficiency in local service delivery (i.e. resources used in the provision of local services). These include Loikkanen and Susiluoto (2005), who studied the cost efficiency of municipalities, whilst Stein (1990) investigated the budgetary effects and effectiveness of municipal service and found that one of the current expenditures of municipalities is the cost of labour. The cost of labour is known to be an input variable which reduces both profitability and efficiency of firms. Therefore, Voorn, Van Genugten and Van Thiel (2017) stated that municipalities who manage to reduce operational costs are more efficient because they can foster basic services to communities. Population also plays a big role in determining the effectiveness of municipalities, as the bigger the population, the broader the revenue base. According to Hauner and Kyobe (2010), richer countries have better performance and efficiency in the public sector. Furthermore, institutional and demographic factors also have a significant role to play. This is because higher government expenditure compared with GDP appears to be correlated with lower efficiency in the industry. Loikkanen and Susiluoto (2004) also added that most municipalities are more efficient when they are large in size because the efficiency of service delivery is dependent on the scale of activities. As a result, the inputs utilised in literature included total revenue per capita (the budget – as in Benito et al. [2010]), employee cost (labour costs – Brettigny and Sharp [2016]; Thanassoulis [2000] only considered operational costs) and population density (revenue base), and the expected outputs are service delivery or infrastructure (enabling an environment for citizens and businesses to flourish), GVA per capita (output of the region in relation to its population, a proxy for well-being) and productivity (output per worker employed) (Boetti et al. 2010). The details and the nature of data utilised will be defined fully in the next section.

Revenue for municipalities comes in the form of taxes; therefore, the efficiency of municipalities is dependent on how well revenue is utilised given limited budgets. Managa (2012), who studied local government performance and South Africa's issue of poor service delivery, concluded that efficiency of municipalities is dependent on the service delivery; this is a result of municipalities facing a

massive backlog of service delivery whilst festering with maladministration and corruption. Municipalities who are not able to deliver basic services to households are regarded as inefficient. To assess the efficiency of municipalities, total revenue (budget) is measured and compared with the service delivery.

Benito et al. (2010) found that financial management has an impact on certain facets of the municipality, such as water supply, because of the financial requirements of treating it and a supply system to sustain it. Benito et al. (2010) stated that the effect of financial management coincides with the impact of financial mismanagement coupled with vandalism in South Africa. Benito et al. (2010) further noted that in Spain, the short-term financial health of the municipality has an ambiguous relationship with service efficiency. It is imperative to note that the study by Benito et al. (2010) also found that the indebtedness of the municipality has a positive impact on the efficiency of the municipality. Zafra-Gómez et al. (2010) found that there is no interrelation between financial management and local government efficiency for small municipalities. Narbón-Perpiñá et al. (2019) identified inefficiencies in Spanish municipalities, suggesting that the same level of output can be produced using 26 and 46% fewer resources. On the contrary, Zafra-Gómez et al. (2010) advocated for the increase in government funding to increase the efficiency in small municipalities, which contradicts Kalb (2010), who analysed the impact of inter-governmental grants on cost efficiency and stated that there is a negative incentive effect of inter-governmental grants on cost efficiency in German municipalities.

In the context of developing economies, studies include Monkam (2014) and Mahabir (2014) for South Africa. Monkam (2014) stated that municipalities in South Africa experience inefficiency and could achieve the same output levels with 83% fewer operating expenditures. Furthermore, Monkam's (2014) findings were supported by Mahabir (2014), who found that wasteful expenditure has a negative effect on municipal efficiency, and the reason that most municipalities are inefficient in South Africa is because 60% of resources are spent inefficiently. According to Gopane (2012), deterioration in the financial performance of municipalities is caused by the lack of accountability of both the national and local governments. Mbura (2013) assessed the efficiency of internal auditing on financial management in Tanzania. The study revealed that inadequate support from top management, lack of autonomy amongst internal auditors, insufficient human and financial resources and absence of quality assurance mechanisms are critical factors affecting the performance of internal audit units in municipal and district councils. On the contrary, the higher economic performance of countries such as China indicates that municipalities are operating efficiently (Tang, Tang & Lee 2014). This shows that efficiency is often measured by the economic performance of local government, and hence most municipalities in developed countries are efficient.

Materials and methods

This study analysis was performed for a sample of South Africa's local government in one of the nine provinces, namely, the Eastern Cape province. This region consists of 45 (6 districts, 2 metropolitan and 37 local) municipalities with an estimated 6.7 million population (the fourth largest in the country) and is one of the worst performing on a number of indicators such as employment, economic growth and well-being (Kavese & Erero 2018). However, because of data availability, the study's sample was restricted to 37 municipalities (35 local and 2 metropolitans) for the period of 2012 to 2015. The study makes use of secondary data sources from Statistics South Africa and the National Treasury's local government budget database, drawing six variables for efficiency computation, in which three are input indicators and five are output indicators. Both input and output indicators are designed to capture the crucial attributes of the most significant programmes rendered by local governments. Data for population were extracted from the 2007 community census from Statistics South Africa, whilst data for tax revenue, conditional grants, income or employment costs, irregular expenditure and service delivery were sourced from the South African National Treasury's local government budget database.

As there are no specifically direct factors to measure and quantify the efficiency in municipalities, both municipal inputs and outputs are used to approximately determine the inefficiencies in municipalities.

Efficiency scores range from 0 to 1 and are obtained from the DEA estimation, implying that the distribution is constrained, and ordinary least squares estimations will be biased (Banker et al. 2010; Das & Ghosh 2006). Therefore, the tobit model is used to examine the relationship between the computed municipal efficiency and irregular expenditure in the Eastern Cape province. According to Adepoju, Salau and Obayelu (2007), continuous variables bounded by nature are generally addressed using tobit models, censored regressions

TABLE 1: Description of the variables on efficiency.

Variable	Description
Efficiency	As resources are scarce, how local government utilise these limited resources determines if they are efficient or not. This is computed using the DEA approach.
Inputs	
Total revenue per capita	Total revenue received by the municipality in the form of collections and transfers from central government.
Employee cost	Total expenses incurred for services rendered by labour.
Population density	Population density (total population/total surface area). Population is the number of people who receive or benefit from service delivery by municipalities and who provide revenue to the municipalities through tax and rates. This is the tax base of each municipality, yet it is a group to be serviced.
Outputs	
Service delivery and infrastructure	The number and quality of public services rendered to the community by municipalities, such as water supply, refuse collection, street lighting and recreation parks, amongst many others.
Gross value added per capita (GVA per capita)	The value added by production activity in an area to the resident population of that area. This is the continuation of the local area to the country's economy.
Productivity	Productivity of local government output per worker employed.

DEA, data envelopment analysis.

or truncated models. According to Weimar (2008), the tobit model can be used to determine a more appropriate estimate of how various characteristics affect efficiency. The tobit model allows adjustment of the estimated slope when data are censored. In tobit analysis, a single maximum likelihood estimate of the slope coefficients is generated, which corrects for the bias associated with the use of censored data. This type of methodology uses minimal assumptions about the structure of the economy; instead, it focuses on the derivation of a good statistical representation of the previous interactions between the variables, letting the data determine the model.

To estimate efficiency in the Eastern Cape municipalities, we followed Balaguer-Coll et al.'s (2019) functional form specification, given as follows:

$$Y_{i^*} = X_i\beta + U_i \tag{Eqn 1}$$

where $Y_i = Y_{i^*}$ if $Y_{i^*} > 0$ [Eqn 2]

$Y_i = 0$, otherwise

where X_i is the vector of the explanatory factors, i corresponds to the municipality and β is the vector of the variables to be measured. Y_{i^*} is a latent variable that can be interpreted as a level above which the explanatory variables will have an impact for Y_i to 'move' from 0 (here being efficient) to a meaningful value (here being inefficient in specific degrees). The tobit model can be estimated using the maximum probability method by assuming that the μ_i error is normally distributed. The study uses tobit regression, and this is because the dependent variable (efficiency) is constrained or censored (Weimar 2008).

The model is specified as in Equation 3, given as follows:

$$\text{Efficiency}_{it} = f(\log fwexp, \log exp, \log Unexp, \log ges, \log Gvt \text{ transfer}, \log debt)$$

$$\text{Efficiency} = \beta_0 + \ln\beta_1 wexp_{it} + \ln\beta_2 iexp_{it} + \ln\beta_3 unexp_{it} + \ln\beta_4 lges_{it} + \ln\beta_5 gvt \text{ trans}_{it} + \ln\beta_6 gvt \text{ debt}_{it} + \mu_{it} \tag{Eqn 3}$$

where i denotes municipalities, t denotes time (years), efficiency is the estimated local efficiency index, $Inwexp$ represents the log of wasteful expenditure, $Iniexp$ denotes the log of irregular expenditure, $InUnexp$ signifies the log of unauthorised expenditure, $Inlges$ denotes the log of local government economic services, $Ingovt \text{ trans}$ stands for the log of government transfers, $Indebt$ denotes public debt and ui is the error term.

Results and discussion

Output-oriented efficiency was computed using Stata software, following the DEA specification discussed above. The efficiency measures presented are constant returns to scale (CRS), variable returns to scale (VRS) and non-increasing revenue (NIR) for technical efficiency and scale efficiency; theta was also presented, which is an optimal solution of efficiency score.

Table 3 provides descriptive statistics of efficiency scores with different efficiency measures, and the mean efficiency variables ranged between 0.407 and 0.724. However, theta is the best one to measure efficiency in the studied DMUs and is therefore used in further analysis.

The efficiency mean of constant returns to scale technical efficiency (CRS-TE) of all the municipalities for all the years is 0.407. The efficiency mean of variable returns to scale technical efficiency (VRS-TE), including all municipalities for the years, is 0.724. For non-increasing returns to scale technical efficiency (NIRS-TE), the mean efficiency for all municipalities in all the years is 0.773. The scale efficiency (scale) of all municipalities for all the years is 0.545, and for theta, the mean efficiency is 0.724 for all the municipalities. The similarity in the values of VRS and theta points to the relevancy of VRS assumptions in the municipal setup, compared with the other assumptions of scale.

TABLE 2: Variables in the regression equation: drivers of efficiency.

Variable	Description
Dependent	
Efficiency	As resources are scarce, how local government utilise these limited resources determines if they are efficient or not. This is computed using the DEA approach, and theta was used as an independent variable.
Independent variables	
Wasteful expenditure	Expenditure that was made in vain and would have been avoided had reasonable care been exercised is also termed fruitless expenditure.
Irregular expenditure	Expenditure that was not incurred in the manner prescribed by legislation is the expenditure that incurred out of the budgetary guidelines (for example, somewhere in the process that led to the expenditure), and the auditee did not comply with the applicable legislation.
Unauthorised expenditure	This can be divided into two categories, which are given as follows: <ol style="list-style-type: none"> <i>Overspending of a vote or main division within a vote.</i> This is when authorities have used more than what was allocated, which usually results in a bank overdraft; furthermore, it is easy to identify and tricky to calculate. <i>Expenditure not in accordance with the purpose of a vote, or in the case of a main division, not in accordance with the purpose of the main division.</i> This is when they have used allocated funds for a purpose other than intended (linked to vote- and/or programme-predetermined objectives); furthermore, it is not easy to identify and quantify.
Local government economic services	These are services to ensure a secure and stable environment in which economic development can take place. They provide physical infrastructure – roads, water supply, waste management, information and communication technologies – and promote public health, education and environmental sustainability.
Local government transfers	This includes unconditional (general) and conditional (project-specific) transfers. Many examples exist of cities accessing conditional transfers and grants – sometimes via competitive processes and sometimes requiring matching funds – to advance local urban regeneration plans.
Debt	When the municipality borrows funds to finance its budgetary shortfalls.

DEA, data envelopment analysis.

TABLE 3: Descriptive statistics.

Variable	Obs	Mean	SD	Min	Max
CRS-TE	148	0.407	0.286	0.031	1
VRS-TE	148	0.724	0.237	0.263	1
NIRS-TE	148	0.773	0.248	0.269	1
Scale	148	0.545	0.29	0.054	1
Theta	148	0.724	0.237	0.263	1

CRS-TE, constant returns to scale technical efficiency; VRS-TE, variable returns to scale technical efficiency; NIRS-TE, non-increasing returns to scale technical efficiency; Scale, efficiency based on size; Theta, optimal efficiency.

Table 4 compares the statistics over the period 2012–2015 based on the constant returns to scale (CRS) measure. The results show that there is noticeable variation of mean efficiency across the years. The mean efficiency in 2012 was 0.456, and in 2013, the mean efficiency increased to 0.488. For 2014, the mean efficiency decreased to 0.263 and increased to 0.43 in 2015. All the mean efficiencies are below 50%, meaning, on average, most municipalities had low efficiency for the period 2012–2015 under the constant returns in the model. Table 4 summarises the efficiency scores over time.

For VRS, the mean declined between the 2012 and 2015 period. The mean efficiency was 0.815 in 2012, and in 2013, the efficiency averaged was 0.793 and 0.646 in 2014. However, in 2015 the average efficiency increased slightly to 0.673. This means that the municipalities' efficiency scores are

TABLE 4: Summary statistics of the different measures of efficiency.

Year	n	Mean	SD	Min	Max
CRS-TE					
2012	37	0.465	0.319	0.039	1
2013	35	0.488	0.302	0.146	1
2014	36	0.263	0.21	0.031	1
2015	37	0.430	0.261	0.033	1
VRS-TE					
2012	37	0.815	0.199	0.478	1
2013	35	0.793	0.22	0.315	1
2014	36	0.646	0.249	0.263	1
2015	37	0.673	0.228	0.327	1
NIRS-TE					
2012	37	0.871	0.194	0.479	1
2013	35	0.828	0.234	0.319	1
2014	36	0.73	0.272	0.269	1
2015	37	0.698	0.239	0.327	1
Scale					
2012	37	0.533	0.301	0.072	1
2013	35	0.618	0.294	0.155	1
2014	36	0.401	0.247	0.054	1
2015	37	0.627	0.267	0.073	1
Theta					
2012	37	0.815	0.199	0.478	1
2013	35	0.793	0.22	0.315	1
2014	36	0.646	0.249	0.263	1
2015	37	0.673	0.228	0.327	1

CRS-TE, constant returns to scale technical efficiency; VRS-TE, variable returns to scale technical efficiency; NIRS-TE, non-increasing returns to scale technical efficiency; Scale, efficiency based on size; Theta, optimal efficiency.

TABLE 5: Random effects tobit regression.

Theta	Coef.	St. Err.	t-value	p-value	[95% conf. interval]		Sig.
lfw_exp	-0.153	0.036	-4.21	0	-0.224	-0.082	***
li_exp	0.102	0.064	1.59	0.111	-0.024	0.227	
lu_exp	-0.149	0.069	-2.17	0.03	-0.283	-0.014	**
lges	-0.204	0.09	-2.26	0.024	-0.382	-0.027	**
lgvt_transfer	0.097	0.046	2.10	0.036	0.006	0.187	**
ldebt	0.249	0.064	3.91	0	0.124	0.374	***
Constant	1.083	0.658	1.65	0.1	-0.207	2.373	*
sigma_u	0	0.045	0.00	1	-0.089	0.089	
sigma_e	0.132	0.028	4.66	0	0.077	0.188	***
Mean dependent var.		0.624		SD dependent var.	0.244		
Number of obs		13.000		Chi-square	21.741		
Prob > chi ²		0.001		Akaike crit. (AIC)	5.802		

*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

above 60% based on this measure. The NIRS presented in Table 4 show that the mean efficiency for NIRS over the years has been decreasing. In 2012, the mean efficiency was 0.871. In 2013, the mean efficiency declined to 0.828. In 2014, the mean efficiency continued to decrease amounting to 0.73. In 2015, the average efficiency was 0.673. This means that the municipalities' efficiency scores are above 65%. Even though the efficiency scores have been decreasing, the decrease rate is very low.

For the scale efficiency measure, the mean efficiency has subsequently declined from 0.533 to 0.401 in 2012–2014, and in 2015, the mean efficiency started to increase, amounting to 0.627. Theta average efficiency of all municipalities was 0.815 in 2012 and decreased to 0.793 in 2013. In 2014, the mean efficiency further declined to 0.646. In 2015, the average efficiency increased to 0.673. This shows that the mean efficiency has decreased between 2012 and 2014 and increased in 2015. However, even though the efficiency scores have been decreasing, the municipalities' efficiency scores still managed to be above 65%. Efficiency scores are used by the tobit regression as an endogenous variable for prospective candidates of influential variables (Lee, Lee & Kim 2009). Table 5 shows the estimation measure using theta variable, and all independent variables are logged to have numbers that are comparable to the ones with efficiency scores. As theta is the best dependent variable at estimating, other estimations using different independent variables are included in Appendix 1.

The study found out that government transfers and public debt are positively related to total efficiency scores, and fruitless and wasteful expenditure, unauthorised expenditure and local government economic status are negatively related to the total efficiency scores. On the contrary, irregular expenditures have no relationship with efficiency. The results show that fruitless and wasteful expenditure is negatively related with the total efficiency scores of DMUs at 1% level of significance. This means that a 1% increase in fruitless and wasteful expenditure will lead to 0.153 unit decrease on total efficiency, holding other variables constant. This is in accordance with a study conducted by Mahabir (2014), which found that about 60% of this wasteful expenditure has a negative effect on efficiency.

According to classical economics, there must be no or limited government intervention because markets are efficiently operating on their own. Furthermore, government intervention will cause inefficiency in the markets, because government imposes policies that increase the cost of production (minimum wages) and discourage demand for goods and services by imposing taxes, and because of money neutrality, government intervention leads to inflation. From this discussion, it is understood that the economy is better off without government intervention. However, the Keynesian theory disagrees, stating that markets will fail, and therefore, the government is needed to correct the instability in the economy (Keynes 1930). Keynes encouraged deficit expenditure, especially when there was high inflation. Furthermore, Keynes modified wasteful expenditure, stating that legislators must be made aware of the repercussions to avoid making those mistakes in the future.

The results show that irregular expenditure is insignificant, and therefore, there is no relationship between efficiency and irregular expenditure. According to the Pareto efficiency theory, as long as the allocation of resources benefits most people, the policy is considered efficient. Therefore, if the local government allocates its limit to service delivery, municipalities will be considered efficient because many people benefit from the services provided by the government, regardless of how some of the money was spent. However, Gopane (2012) found that irregular expenditure has a negative effect on the impact of municipal efficiency and the ability to provide basic services to communities.

Unauthorised expenditure is negatively related with the total efficiency scores of DMUs at 5% level of significance. This means that a 1% increase in unauthorised expenditure will lead to a decrease of 0.149 units on the total efficiency of municipalities. These results coincide with those of Balaguer-Coll et al. (2019), which state that irregular expenditure and budgetary mistakes result in a higher level of municipalities' inefficiency and that local government economic status is negatively related with the total efficiency scores of DMUs at 10% level of significance. This means that a 1% increase in local government economic status will lead to a 0.204 unit decrease in cost efficiency. This is in accordance with the findings of Tang et al. (2014), which indicate that the province with higher economic performance often demonstrates better performance in government efficiency.

Government transfers are positively related with the total efficiency scores of DMUs at 5% level of significance. This states that a 1% increase in government transfers will lead to a 0.09 unit increase in efficiency. This coincides with the findings of Susetyo et al. (2017), which state that the influence of regional spending on gross regional domestic product districts or cities is positive and significant. The bigger local spending will increase the gross regional domestic product of regencies or cities. Local spending is one form of government investment to stimulate local economic growth.

Public debt is positively related with the theta efficiency scores of DMUs at 5% level of significance. A 1% increase will lead to public debt with a 0.249 unit increase on efficiency. This is in accordance with the Keynes theory, stating that to access public debt, municipalities must provide a detailed plan on how they will utilise this public debt; therefore, this promotes efficiency in municipalities. Table 6 lists all municipalities in the Eastern Cape with highest and lowest output-oriented efficiency scores. The top 4 municipalities with the highest average efficiency scores (with a max of 1) across the period are Nkonkobe municipality with an efficiency score averaging at 0.855 with 100% total efficiency, followed by Ngqushwa municipality with a mean efficiency score of 0.842. Inxuba municipality is the second last, with a 0.836 mean efficiency score. Lastly, Ikwezi has a mean efficiency score of 0.831.

This research has quantified the technical efficiency scores of municipalities in the Eastern Cape under the effect of wasteful

TABLE 6: Summary statistics.

DMU	n	Mean	SD	Min	Max
Amahlathi	4	0.654	0.25	0.424	1
Baviaans	4	0.621	0.258	0.424	1
Blue Crane Route	4	0.781	0.266	0.461	1
Buffalo City	3	0.581	0.196	0.413	0.796
Elundini	4	0.651	0.306	0.336	1
Emalahleni (EC)	4	0.783	0.323	0.315	1
Engcobo	4	0.642	0.323	0.326	1
Gariep	4	0.66	0.3	0.403	1
Great Kei	3	0.736	0.359	0.327	1
Ikwezi	4	0.831	0.303	0.378	1
Inkwanca	3	0.769	0.356	0.359	1
Intsika Yethu	4	0.79	0.236	0.44	0.948
Inxuba Yethemba	4	0.836	0.212	0.528	1
King Sabata Dalind'olo	4	0.581	0.306	0.263	0.998
Kouga	4	0.586	0.301	0.273	0.998
Koukamma	4	0.547	0.272	0.284	0.925
Lukhanji	4	0.577	0.3	0.294	1
Makana	4	0.62	0.28	0.35	1
Maletswai	4	0.674	0.299	0.359	0.993
Matatiele	4	0.745	0.295	0.489	1
Mbhashe	4	0.734	0.256	0.381	0.987
Mbizana	4	0.734	0.225	0.42	0.949
Mhlontlo	4	0.75	0.238	0.43	1
Mnquma	4	0.743	0.22	0.44	0.955
Ndlambe	4	0.736	0.246	0.446	1
Nelson Mandela	4	0.84	0.153	0.631	1
Ngqushwa	4	0.842	0.148	0.642	1
Nkonkobe	4	0.858	0.153	0.641	1
Ntabankulu	4	0.907	0.114	0.751	0.998
Nxuba	4	0.794	0.187	0.556	1
Nyandeni	4	0.788	0.198	0.522	0.988
Port St Johns	4	0.789	0.149	0.568	0.887
Sakhisizwe	4	0.736	0.212	0.522	0.961
Senqu	4	0.821	0.158	0.591	0.954
Sundays River Valley	4	0.821	0.16	0.587	0.949
Tsolwana	4	0.777	0.167	0.533	0.888
Umzimvubu	4	0.686	0.232	0.419	0.88

n mean SD min max by decision-making units.

DMU, decision-making units; SD, standard deviation.

expenditure for the period of 2012–2015. It assessed how these municipalities use their limited resources such as money available (input) to feed the increasing demand of service delivery by communities whilst measuring the effect of irregular expenditure, fruitless and wasteful expenditure and authorised expenditure on the efficiency scores of municipalities.

Conclusion, policy recommendations and areas of future research

The study investigated the level of efficiency in local municipalities and assessed the implications of financial mismanagement as defined by legislation using a two-stage procedure, namely DEA and tobit regression. The DEA empirical results show that the mean efficiency is between 0.407 and 0.724, showing variations between municipalities and that no municipality is completely inefficient on average. The study in the second stage used the tobit regression to determine the relationship between explanatory variables on municipal efficiency scores. The results show that fruitless expenditures have a negative effect on the efficiency scores of municipalities. According to the auditor general, the main reason why municipalities are inefficient is because these municipalities are managed by personnel who are not qualified for their jobs. Therefore, policies guiding competency levels for certain office bearers must be enforced at all times and not yield to political pressure, which is often exerted to meet cadre deployment goals (Mbandlwa & Mishi 2020).

There is a need to broaden the demographic groups who are actively seeking leadership roles in community. In the Eastern Cape, the majority of people who participate in government matters are the elders. Therefore, diversifying participation will allow in a younger generation with ideals that also accommodate the needs of the youth, such as employment. This can be done by municipalities employing young people, whether inside the organisation or on other government programmes. The chief financial officer and other officials need training and capacitation in budgeting in line with the needs of the municipality and they need to be guided by MFMA. Unauthorised expenditure may arise because responsible officials do not cater for all needs when budgeting, and then when expenditure is needed, it is carried out without supporting budget lines. Therefore, many are adamant that the funds are used for the benefit of citizens, not individuals, and it is the process of budgeting and expenditure that is not aligned. The empirical results of the study provide the basis for major improvement in the efficiency analysis of municipalities. The study discusses a variety of fields of study that can be explored, especially if primary qualitative data can be gathered to solicit responses from municipal managers and chief financial officers for what led to those expenditures and what was the exact use of the expenditures.

Acknowledgements

Competing interests

The author(s) declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

All the authors contributed equally to this work.

Ethical considerations

This article followed all ethical standards for research without direct contact with human or animal subjects.

Funding information

This work is based on the research supported wholly by the National Research Foundation of South Africa (grant no. 121890).

Data availability

The data that support the findings of this study are available in the public domain. Data sharing is not applicable to this article.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

References

- Adam, A., Delis, M.D. & Kammas, P., 2014, 'Fiscal decentralisation and public sector efficiency: Evidence from OECD countries', *Economics of Governance* 15(1), 17–49. <https://doi.org/10.1007/s10101-013-0131-4>
- Adepoju, A.A., Salau, A.S. & Obayelu, A.E., 2007, *The effects of external debt management on sustainable economic growth and development: Lessons from Nigeria*, pp. 23–27, Munich Personal Repec Archive(MPRA), Munich, Germany.
- Afonso, A. & Fernandes, S., 2008, 'Assessing and explaining the relative efficiency of local government', *The Journal of Socio-Economics* 37(5), 1946–1979. <https://doi.org/10.1016/j.socec.2007.03.007>
- Auditor-General of South Africa (AGSA), 2019, *Integrated annual report 2017-18 annual report*, viewed n.d., from <https://www.agsa.co.za/Reporting/MFMAReports/MFMA2017-2018.aspx>.
- Balaguer-Coll, M.T., Brun-Martos, M.I., Márquez-Ramos, L. & Prior, D., 2019, 'Local government efficiency: Determinants and spatial interdependence', *Applied Economics* 51(14), 1478–1494. <https://doi.org/10.1080/00036846.2018.1527458>
- Banker, R.D., Chang, H. & Lee, S.Y., 2010, 'Differential impact of Korean banking system reforms on bank productivity', *Journal of Banking & Finance* 34(7), 1450–1460. <https://doi.org/10.1016/j.jbankfin.2010.02.023>
- Bardhan, P. & Mookerjee, D., 2000, *Corruption and decentralization of anti-poverty program delivery in developing countries*, Institute for Economic Development, Boston University, Boston, MA.
- Benito, B., Bastida, F. & Garcia, J.A., 2010, 'Explaining differences in efficiency: An application to Spanish municipalities', *Applied Economics* 42(4), 515–528. <https://doi.org/10.1080/00036840701675560>
- Benito, B., Martínez-Córdoba, P.J. & Guillamón, M.D., 2021, 'Impact of politicians' salaries and their dedication regime on the efficiency of municipal public services', *Local Government Studies* 47(5), 784–807.
- Besley, T. & Smart, M., 2007, 'Fiscal restraints and voter welfare', *Journal of Public Economics* 91(3–4), 755–773. <https://doi.org/10.1016/j.jpubeco.2006.09.009>
- Black, P., Calitz, E. & Steenkamp, T., 2015, *Public economics*, OUP Catalogue, 6th edn., Oxford University Press, Washington, DC, USA.
- Boetti, L., Piacenza, M. & Turati, G., 2010, 'Decentralization and local governments' performance: How does fiscal autonomy affect spending efficiency?', Paper Presented at the 66th Congress of the International Institute of Public Finance (IIPF), Uppsala, 23–26 August 2010.

- Booyesen, S. (ed.), 2012, *Local elections in South Africa: Parties, people, politics*, African Sun Media.
- 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>
- Brosio, G. & Ahmad, E., 2008, *Local service provision in selected OECD countries: Do decentralized operations work better?*, IMF Working Paper No. 08/67, viewed 14 June 2021, from <https://ssrn.com/abstract=1112209>.
- Chowdhury, M.S. & Al-Hossienie, C.A., 2012, 'Quest for an effective and efficient local government: Local government in Japan and policy implication for local government in Bangladesh', *Lex Localis—Journal of Local Self-Government* 10(3), 247–264. <https://doi.org/10.4335/188>
- COGTA (Co-operative Governance and Traditional Affairs), 2019, *The South African government*, viewed 02 May 2020, from <https://www.gov.za/about-government/government-system/local-government>.
- Das, A. & Ghosh, S., 2006, 'Financial deregulation and efficiency: An empirical analysis of Indian banks during the post reform period', *Review of Financial Economics* 15(3), 193–221. <https://doi.org/10.1016/j.rfe.2005.06.002>
- Dethier, J., 2013, *Coping with urban fiscal stress around the World*, Policy research working paper, no. 6693, World Bank, Washington, DC, viewed 05 July 2021, from <https://openknowledge.worldbank.org/handle/10986/16921>.
- De Visser, J., 2010, 'The political-administrative interface in South African municipalities: Assessing the quality of local democracies', *Commonwealth Journal of Local Governance* 15(5), 86–101. <https://doi.org/10.5130/cjlg.v0i5.1473>
- Dick-Sagoe, C., 2020, 'Decentralization for improving the provision of public services in developing countries: A critical review', *Cogent Economics & Finance* 8(1), 1804036. <https://doi.org/10.1080/23322039.2020.1804036>
- Dilber, C.O., 2021, 'The Turkish Cypriot municipalities' productivity and performance: An application of data envelopment analysis and the Tobit model', *Journal of Risk and Financial Management* 14(9), 407. <https://doi.org/10.3390/jrfm14090407>
- Dimo, P.A., 2017, *The impact of irregular expenditure in the South African public finance with specific reference to the national department of public works*, pp. 1–125, viewed 08 May 2021, from <http://etd.cput.ac.za/handle/20.500.11838/2453>.
- Dzomira, S., 2017, 'Financial accountability & governance in an emerging country', *Corporate Ownership and Control* 14(3), 204–208. <https://doi.org/10.22495/cocv14i3c1art6>
- Eastern Cape Provincial Legislature, 2016, Annual Report, 2016/17 FINANCIAL YEAR; Eastern Cape Government; viewed n.d., from https://provincialgovernment.co.za/entity_annual/535/2017-eastern-cape-provincial-legislature-annual-report.pdf
- Ebel, R.D. & Yimaz, S., 2003, 'Globalization and Localization: Decentralization Trends and Outcomes', *World Bank Institute Course Intergovernmental Relations & Local Financial Management*, World Bank, Washington, DC, USA.
- Foo, C.Y., Lim, K.K., Sivasampu, S., Dahian, K.B. & Goh, P.P., 2015, 'Improving the effectiveness of service delivery in the public healthcare sector: The case of ophthalmology services in Malaysia', *BMC Health Services Research* 15(1), 349. <https://doi.org/10.1186/s12913-015-1011-0>
- Fourie, D.J., 2001, 'The restructuring of state-owned enterprises: South African initiatives', *Asian Journal of Public Administration* 23(2), 205–216. <https://doi.org/10.1080/02598272.2001.10800388>
- Greater Tzaneen Municipality, n.d., *UIF report for 2015–2016 financial year: MPAC UIF Investigation report*, viewed n.d., from <chrome-extension://efaidnbnmnmbpcjpcgclclefndmkaj/http://www.greatertzaneen.gov.za/documents/mpac/20181005114131124.pdf>.
- Geys, B. & Moesen, W., 2009, 'Measuring local government technical (in)efficiency: An application and comparison of FDH, DEA, and econometric approaches', *Public Performance & Management Review* 32(4), 499–513. <https://doi.org/10.2753/PMR1530-9576320401>
- Glasser, M.D. & Wright, J., 2020, 'South African municipalities in financial distress: What can be done?', *Law, Democracy and Development* 24, 413–441. <https://doi.org/10.17159/2077-4907/2020/ldd.v24.17>
- Gopane, O.M., 2012, 'Effectiveness of the Eastern Cape provincial department of local government and traditional affairs to monitor and evaluate the performance of municipalities: A case study of Cacadu District Municipality', Doctoral dissertation, Cape Peninsula University of Technology, Cape Town.
- Hauner, D. & Kyobe, A., 2010, 'Determinants of government efficiency', *World Development* 38(11), 1527–1542. <https://doi.org/10.1016/j.worlddev.2010.04.004>
- Hayek, F.A., 1945, 'The use of knowledge in society', *The American Economic Review* 35(4), 519–530.
- Kalb, A., 2010, 'The impact of intergovernmental grants on cost efficiency: Theory and evidence from German municipalities', *Economic Analysis and Policy* 40(1), 23–48. [https://doi.org/10.1016/S0313-5926\(10\)50002-X](https://doi.org/10.1016/S0313-5926(10)50002-X)
- Kavese, K. & Erero, J.L., 2018, 'Impact of fiscal expansion in South Africa – The case of the Eastern Cape province', *Journal of Economics & Management* 34(4), 103–127. <https://doi.org/10.22367/jem.2018.34.05>
- Kekana, M., 2019, *Mail & Guardian*, viewed 03 July 2020, from <https://mg.co.za/article/2019-06-26-financial-state-of-municipalities-has-worsened-ag/>.
- Keynes, J.M., 1930, *Treatise on money: Pure theory of money*, vol. I, pp. 1–327, Macmillan & Co., London.
- Khan, S.A., 2021, 'Decentralization and the limits to service delivery: Evidence from Northern Pakistan', *Sage Open* 11(1), 1–15. <https://doi.org/10.1177/2158244021994505>
- Kokkinou, A., 2009, *Stochastic frontier analysis: Empirical evidence on Greek productivity*, University of Glasgow, London, UK.
- Lampe, H.W., Hilgers, D. & Ihl, C., 2015, 'Does accrual accounting improve municipalities' efficiency? Evidence from Germany', *Applied Economics* 47(41), 4349–4363. <https://doi.org/10.1080/00036846.2015.1030562>
- Laubscher, L.H., 2012, 'Challenges on financial control and accountability in South African municipalities', *Journal for New Generation Sciences* 10(1), 63–79.
- Lee, Y., Zimmermann, S.G., Kieu, A.T. & Von Gunten, U., 2009, 'Ferrate (Fe (VI)) application for municipal wastewater treatment: A novel process for simultaneous micropollutant oxidation and phosphate removal', *Environmental Science & Technology* 43(10), 3831–3838. <https://doi.org/10.1021/es803588k>
- Lemos, M.H. & Charles, G., 2018, 'Public Programs, Private Financing', *Law and Contemporary Problems* 81(137), 137–160.
- Liu, Q., Wang, S., Zhang, W., Li, J., Zhao, Y. & Li, W., 2017, 'China's municipal public infrastructure: Estimating construction levels and investment efficiency using the entropy method and a DEA model', *Habitat International* 64, 59–70. <https://doi.org/10.1016/j.habitatint.2017.04.010>
- Lokkainen, H. & Susiluoto, I., 2004, 'Cost efficiency of Finnish Municipalities 1994–2002. An application of DEA and Tobit methods', *Paper Presented at the 44th Congress of the European Regional Science Association*, Porto, 25–29 August 2004, Porto, Portugal.
- Loikkanen, H.A. & Susiluoto, I., 2005, 'Cost efficiency of Finnish municipalities 1994–2002', *An application of DEA and Tobit methods*.
- Loikkanen, H.A., Susiluoto, I. & Funk, M., 2011, *The role of city managers and external variables in explaining efficiency differences of Finnish municipalities*, Discussion Paper 312, Helsinki Centre for Economic Research (HECER), University of Helsinki, Finland, Helsinki.
- Madumo, O.S., 2015, 'Developmental local government challenges and progress in South Africa', *Administratio Publica* 23(2), 153–166.
- Mahabir, J., 2014, 'Quantifying inefficient expenditure in local government: A free disposable hull analysis of a sample of South African municipalities', *South African Journal of Economics* 82(4), 493–517. <https://doi.org/10.1111/saje.12050>
- Managa, A., 2012, *Unfulfilled promises and their consequences: A reflection on local government performance and the critical issue of poor service delivery in South Africa*, Policy Brief, Africa Institute of South Africa, p. 76, Pretoria, South Africa.
- Mathiba, G., 2021, 'Corruption in land administration and governance: A hurdle to transitional justice in post-apartheid South Africa?', *Obiter* 42(3), 561–579. <https://doi.org/10.17159/obiter.v42i3.12902>
- Mbandlwa, Z. & Mishi, S., 2020, 'Ward councillors' leadership characteristics and their impact on service delivery: Case of eThekweni metropolitan municipality, South Africa, in 2018', *Journal of Local Government Research and Innovation* 1, a5. <https://doi.org/10.4102/jolgr.v1i0.5>
- Mbatha, N.P., 2020, 'Examining financial management of local government in South Africa: a case study of Alfred Duma Local Municipality in KZN', Doctoral dissertation, viewed 15 July 2021.
- Mbura, J.J., 2013, 'Assessing the efficiency of internal auditing and its contribution to improving financial management in local government authorities in Tanzania: A case study of Musoma municipal and district councils', Doctoral dissertation, Mzumbe University.
- McDonnell, J., 2020, 'Municipality size, political efficacy and political participation: A systematic review', *Local Government Studies* 46(3), 331–350. <https://doi.org/10.1080/03003930.2019.1600510>
- Meyer, D.F., 2014, 'Local economic development (LED), challenges and solutions: The case of the northern Free State region, South Africa', *Mediterranean Journal of Social Sciences* 5(16), 624. <https://doi.org/10.5901/mjss.2014.v5n16p624>
- 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>
- Moreno, C., 2005, 'Analyzing the Performance of Local Government in Mexico: A Political Explanation of Municipal Budgetary Choices', University of California at San Diego, Center for U.S.-Mexican Studies, UC San Diego.
- Motta, R.S.D. & Moreira, A., 2009, 'Political factors and the efficiency of municipal expenditure in Brazil', *Economia Aplicada* 13(4), 353–370. <https://doi.org/10.1590/S1413-80502009000400001>
- Murillo-Zamorano, L.R., 2004, 'Economic efficiency and frontier techniques', *Journal of Economic Surveys* 18(1), 33–77. <https://doi.org/10.1111/j.1467-6419.2004.00215.x>
- Mwambere, P.L. & Kosimbei, G., 2022, 'Financial management practices and government performance: A case of Taita Taveta County, Kenya', *International Journal of Advanced Research and Review* 7(3), 65–83. <https://doi.org/10.5281/zenodo.6400689>
- Narbón-Perpiñá, I., Balaguer-Coll, M.T., Petrović, M. & Tortosa-Ausina, E., 2019, 'Which estimator to measure local governments' cost efficiency? The case of Spanish municipalities', *SERIEs* 45(1), 1–32. <https://doi.org/10.1093/wbro/10.2.201>
- Narbón-Perpiñá, I., Balaguer-Coll, M.T., Petrović, M. & Tortosa-Ausina, E., 2020, 'Which estimator to measure local governments' cost efficiency? The case of Spanish municipalities', *SERIEs* 11, 51–82. <https://doi.org/10.1007/s13209-019-0194-8>
- Ncapayi, F., 2019, *Mail & Guardian*, viewed 14 April 2020, from <https://mg.co.za/article/2019-03-08-00-people-must-take-back-the-municipalities/>.
- Ndou, C., 2021, 'KZN government departments' unauthorised spending justified, says Scopa', *The Witness*, 13 April, viewed n.d., from <https://www.citizen.co.za/witness/news/kzn/kzn-government-departments-unauthorised-spending-justified-says-scopa-20210413/>.
- Nini, A. & Sgqolana, T., 2018, 'Failing Eastern Cape municipalities may be axed', *DispatchLive*, 28 February, pp. 1–2.

- Nokwazi, N. & Prunella, P., 2017, 'Evaluation of the current procurement planning process in a district municipality', *International Journal of Public Policy and Administration Research* 4(1), 19–34. <https://doi.org/10.18488/journal.74.2017.41.19.34>
- North West Provincial Legislature, 2019, *North West Legislature on irregular expenditure and poor performance in municipalities*, viewed n.d., from <https://www.gov.za/speeches/north-west-scopa-blames-failure-5-sep-2019-0000>.
- Nzama, L., 2019, 'Do poor financial performance indicators affect municipal grants budget allocation in South Africa?', *Journal of Reviews on Global Economics* 8, 1514–1528. <https://doi.org/10.6000/1929-7092.2019.08.135>
- Patience, J.J. & Nel, D., 2021, 'Municipal infrastructure management and its impact on service delivery in the city of Ekurhuleni', *Africa's Public Service Delivery and Performance Review* 9(1), a508. <https://doi.org/10.4102/apsdpr.v9i1.508>
- Perez-Lopez, G., Prior, D. & Zafra-Gómez, J.L., 2015, 'Rethinking new public management delivery forms and efficiency: Long-term effects in Spanish local government', *Journal of Public Administration Research and Theory* 25(4), 1157–1183. <https://doi.org/10.1093/jopart/muu088>
- Pollanen, R.M., 2005, 'Performance measurement in municipalities: Empirical evidence in Canadian context', *International Journal of Public Sector Management* 18(1), 4–24. <https://doi.org/10.1108/09513550510576125>
- Prud'Homme, R., 1995, 'The dangers of decentralization', *The World Bank Research Observer* 10(2), 201–220.
- Rakabe, E., 2013, *The state of fiscal stress in South Africa's provinces: Improving fiscal performance*, Financial and Fiscal Commission Policy Brief, pp. 3–32.
- Rangongo, P., Mohlakwana, M. & Beckmann, J., 2016, 'Causes of financial mismanagement in South African public schools: The views of role players', *South African Journal of Education* 36(3), 1–10. <https://doi.org/10.15700/saje.v36n3a1266>
- Razafimahefa, I.F. & Sow, M., 2015, 'Fiscal decentralization and the efficiency of public service delivery', IMF working papers 2015/059, International Monetary Fund.
- Scheepers, L.A., 2015, *An institutional capacity model of municipalities in South Africa*, Doctoral dissertation, Stellenbosch University, Stellenbosch.
- Sibanda, M.M., Zindi, B. & Maramura, T.C., 2020, 'Control and accountability in supply chain management: Evidence from a South African metropolitan municipality', *Cogent Business & Management* 7(1), 1785105. <https://doi.org/10.1080/23311975.2020.1785105>
- South Africa, Department of Provincial and Local Government, 2005, *Annual report (RP53/2005)*, Government Printer, Pretoria.
- South Africa, National Treasury, 2010, *Guideline on irregular expenditure*, Government Printer, Pretoria.
- Stein, R.M., 1990, 'The budgetary effects of municipal service contracting: A principal-agent explanation', *American Journal of Political Science* 34(2), 471–502. <https://doi.org/10.2307/2111458>
- Stein, J.C., 1997, 'Internal capital markets and the competition for corporate resources', *The Journal of Finance* 52(1), 111–133. <https://doi.org/10.1111/j.1540-6261.1997.tb03810.x>
- Susetyo, D., Zunaidah, S.R., Yulianita, A., Adam, M. & Valeriani, D., 2017, 'Expenditure analysis of local government and regional economic development district/city of ten province in Sumatra island Indonesia', *An International Journal of Applied Business and Economic Research, Scopus and JEL Index Journal* 15(3), 17–42.
- Tang, R., Tang, T. & Lee, Z., 2014, 'The efficiency of provincial governments in China from 2001 to 2010: Measurement and analysis', *Journal of Public Affairs* 14(2), 142–153. <https://doi.org/10.1002/pa.1518>
- Thanassoulis, E., 2000, 'The use of data envelopment analysis in the regulation of UK water utilities: Water distribution', *European Journal of Operational Research* 126(2), 436–453. [http://doi.org/10.1016/S0377-2217\(99\)00303-3](http://doi.org/10.1016/S0377-2217(99)00303-3)
- Ter-Minassian, T., 1997, 'Intergovernmental fiscal relations in a macroeconomic perspective: An overview', *Fiscal Federalism in Theory and Practice* 61(1), 3–24.
- Voorn, B., Van Genugten, M.L. & Van Thiel, S., 2017, 'The efficiency and effectiveness of municipally owned corporations: A systematic review', *Local Government Studies* 43(5), 820–841. <https://doi.org/10.1080/03003930.2017.1319360>
- Wasserman, 2019, *Business Insider SA*, viewed 06 January 2021, from <https://www.businessinsider.co.za/worst-municipalities-2019-6>.
- Weymar, M., Balducci, P., Fathelrahman, E., Whitmore, S. & Rufolo, A., 2008, *Identifying and Quantifying Rates of State Motor Fuel Tax Evasion*, The National Academies Press, Washington, DC.
- Zafra-Gómez, J.L., Antonio, M. & Muñoz, P., 2010, 'Overcoming cost-inefficiencies within small municipalities: Improve financial condition or reduce the quality of public services?', *Environment and Planning C: Government and Policy* 28(4), 609–629. <https://doi.org/10.1068/c09118>

Appendix starts on the next page →

Appendix 1

Estimation measures using other dependent variables

TABLE 1-A1: Random-effects tobit regression.

crs_te	Coef.	St. err.	t-value	p-value	[95% conf. interval]		Sig.
l _{fw} _exp	-0.137	0.034	-4.01	0	-0.204	-0.07	***
l _i _exp	0.016	0.045	0.36	0.718	-0.072	0.104	
l _u _exp	-0.047	0.036	-1.31	0.189	-0.117	0.023	
llges	-0.26	0.099	-2.63	0.009	-0.454	-0.066	***
lgvt_transfer	0.13	0.054	2.39	0.017	0.024	0.237	**
ldebt	0.276	0.068	4.08	0	0.143	0.409	***
Constant	0.173	0.665	0.26	0.794	-1.129	1.476	
sigma_u	0	0.057	0.00	1	-0.112	0.112	
sigma_e	0.169	0.035	4.80	0	0.1	0.239	***
Mean dependent var	0.415		SD dependent var		0.309		
Number of obs	13.000		Chi-square		29.565		
Prob > chi ²	0.000		Akaike crit. (AIC)		11.459		

*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

TABLE 2-A1: Random-effects tobit regression.

vrs_te	Coef.	St. err.	t-value	p-value	[95% Conf. interval]		Sig.
l _{fw} _exp	-0.153	0.036	-4.21	0	-0.224	-0.082	***
l _i _exp	0.102	0.064	1.59	0.111	-0.024	0.227	
l _u _exp	-0.149	0.069	-2.17	0.03	-0.283	-0.014	**
llges	-0.204	0.09	-2.26	0.024	-0.382	-0.027	**
lgvt_transfer	0.097	0.046	2.10	0.036	0.006	0.187	**
ldebt	0.249	0.064	3.91	0	0.124	0.374	***
Constant	1.083	0.658	1.65	0.1	-0.207	2.373	*
sigma_u	0	0.045	0.00	1	-0.089	0.089	
sigma_e	0.132	0.028	4.66	0	0.077	0.188	***
Mean dependent var	0.624		SD dependent var		0.244		
Number of obs	13.000		Chi-square		21.741		
Prob > chi ²	0.001		Akaike crit. (AIC)		5.802		

*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

TABLE 3-A1: Random-effects tobit regression.

Nirs_te	Coef.	St. err.	t-value	p-value	[95% Conf. interval]		Sig.
l _{fw} _exp	-0.162	0.056	-2.90	0.004	-0.271	-0.052	***
l _i _exp	0.013	0.092	0.14	0.891	-0.167	0.193	
l _u _exp	-0.079	0.095	-0.82	0.41	-0.266	0.108	
llges	-0.3	0.137	-2.19	0.029	-0.569	-0.031	**
lgvt_transfer	0.131	0.072	1.82	0.069	-0.01	0.273	*
ldebt	0.328	0.101	3.24	0.001	0.129	0.526	***
Constant	1.043	0.969	1.08	0.282	-0.857	2.943	
sigma_u	0	0.071	0.00	1	-0.14	0.14	
sigma_e	0.204	0.051	4.01	0	0.104	0.304	***
Mean dependent var	0.660		SD dependent var		0.262		
Number of obs	13.000		Chi-square		11.528		
Prob > chi ²	0.073		Akaike crit. (AIC)		19.774		

*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

TABLE 4-A1: Random-effects tobit regression.

Scale	Coef.	St. err.	t-value	p-value	[95% Conf. interval]		Sig.
ifw_exp	-0.093	0.038	-2.45	0.014	-0.168	-0.019	**
li_exp	0.005	0.05	0.10	0.923	-0.093	0.102	
lu_exp	-0.026	0.04	-0.66	0.511	-0.104	0.052	
llges	-0.291	0.109	-2.66	0.008	-0.505	-0.077	***
lgvt_transfer	0.132	0.06	2.19	0.029	0.014	0.251	**
ldebt	0.228	0.075	3.03	0.002	0.081	0.376	***
Constant	0.687	0.737	0.93	0.351	-0.757	2.131	
sigma_u	0	0.063	0.00	1	-0.123	0.123	
sigma_e	0.187	0.039	4.81	0	0.111	0.264	***
Mean dependent var	0.605		SD dependent var		0.261		
Number of obs	13.000		Chi-square		12.825		
Prob > chi ²	0.046		Akaike crit. (AIC)		13.699		

*, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.