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Can commercialisation address consumer debt in local government? A case study of South African metropolitan municipalities

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ABSTRACT

Consumer debt continues to challenge local government financial sustainability. There is a debate in the literature on whether developing countries should consider commercialising local service delivery. Using data from South African metropolitan municipalities, this study examines the impact of commercialising service delivery on consumer debt. Fixed effects modelling is adopted, and results show that commercialising sanitation increased consumer debt by 22.5 per cent, commercialising solid waste collection reduced consumer debt by 11.9 per cent, while commercialising electricity had no significant impact on consumer debt. These results imply that policymakers should consider the type and nature of public service when deciding its commercialisation.

RÉSUMÉ

La dette des consommateurs reste un défi pour la viabilité financière des gouvernements locaux. Il existe dans la littérature sur le sujet un débat quant aux décisions à prendre par les pays en développement vis-à-vis d'une commercialisation de la prestation locale des services. Dans cet article, nous utilisons des données venant des municipalités métropolitaines Sud-africaines afin d'examiner l'impact de la commercialisation de la prestation des services sur la dette des consommateurs. Nous y présentons un modèle à effets fixes, dont les résultats démontrent que la commercialisation des services sanitaires a augmenté la dette des consommateurs de 22.5%, que la commercialisation de la collecte des déchets solides l'a réduite de 11.9%, et que la commercialisation de l'électricité n'a pas eu d'impact majeur sur elle. Ces résultats suggèrent que les décideurs politiques devraient considérer le type et la nature des services publics lorsqu'ils prennent des décisions quant à leur commercialisation.

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Introduction

Local governments are central to community development in most developing countries as they commonly provide essential services like water, electricity, sanitation, and solid waste removal. To finance their operations and sustain service provision, local governments generally levy tariffs. Thus, service tariffs form the primary source of revenue for most local governments across the world. However, raising sufficient revenue from service charges is usually a major challenge for many local governments in developing countries. Challenges in raising revenue are usually because most local governments in these countries generally serve low-income residents. Equally, developing countries commonly struggle with high levels of unemployment, local government inefficiencies, corruption, and ineffective internal systems which affect revenue collection (Chetty, van Niekerk, and Olivier 2016; Enwereji and Uwizeyimana 2020; Murwirapachena et al. 2019).

Importantly, the problem of non-payment for services continues to challenge many local governments in the developing world. This problem is reported in many developing countries across South America, the Middle East, Asia, and Africa (Abdullah et al. 2022; Dahan and Nisan 2022; Vásquez and Alicea-Planas 2017). In addition to people's inability to pay for services, several other reasons for non-payment are cited in the literature. Common reasons include the lack of trust in local authorities, culture of entitlement, dissatisfaction with service delivery, and unwillingness to pay (Ali, Fjeldstad, and Sjursen 2014; Enwereji and Uwizeyimana 2020). In South Africa, non-payment is often argued to be a culture stemming from the apartheid era where mass civil disobedience manifested through boycotting the payment of rates (Enwereji and Uwizeyimana 2020; Murwirapachena, Kabange, and Ifeacho 2022). Therefore, many local governments record huge consumer debts which affect their ability to sustain service delivery.

While consumer debt may also be due to inability rather than reluctance to pay, it should be noted that South Africa has free basic policies where indigent households receive free basic water, electricity, and sanitation services from the local government (Bhorat, Oosthuizen, and Van Der Westhuizen 2012; Francis and Webster 2019). Local governments mostly use the property-value targeting strategy to determine households that should receive free basic services. Thus, households occupying properties valued below the targeted threshold do not pay for local government services. This is usually the case in the informal settlements and some parts of townships where low-income households predominantly reside (Jegede and Shikwambane 2021; Maphela and Cloete 2020; Muanda, Goldin, and Haldenwang 2020). These efforts aim to exclude those who cannot afford to pay for local services from the revenue database. Nevertheless, South African local governments are still grappling with huge consumer debt, whose origin and implications are discussed in Worku (2018), Enwereji and Uwizeyimana (2020) and Murwirapachena, Kabange, and Ifeacho (2022).

Addressing the rising consumer debt requires innovation and sound internal systems. Most local governments in the developing world are usually criticised for poor management and service delivery inefficiencies. As a result, some scholars in the literature recommend commercialising local government service delivery (Alonso, Clifton, and Díaz-Fuentes 2022; Furlong et al. 2018; Mercille and Murphy 2017). Commercialisation in this context entails the corporatisation of service providers by introducing market

mechanisms into their operations. The common argument is that commercialisation addresses many local government challenges that stem from ineffective internal systems and operational approaches. However, some scholars criticise commercialisation and recommend the municipalisation of local government services delivery (Becker, Naumann, and Moss 2017; McDonald 2018; Paul 2018). Thus, the debate on whether local government should commercialise or municipalise service delivery is ongoing in the current literature.

This study contributes to the discussion on whether service delivery should be commercialised by examining the impact of commercialisation on consumer debt in South African metropolitan municipalities. A South African case study is ideal because the country is among many developing and emerging economies where the local government currently battles high levels of consumer debt and low revenue. Tax compliance is generally lower in developing countries than wealthier countries with more capable states, less corruption, and higher government legitimacy (Touchton, Wampler, and Peixoto 2019). This is the case in developing and emerging economies like South Africa, Brazil, and India where service delivery systems are decentralised to the local government. In Brazil, non-compliance is mainly due to a lack of good governance systems which emphasise on accountability and public participation (Touchton, Wampler, and Peixoto 2019). Comprehensive comparisons among emerging economies are provided in Mohanty (2016) and Ahluwalia (2019) who highlight that total municipal revenue in India constitutes around 1.03 per cent of gross domestic product (GDP). The Indian ratio is very low compared to 4.5 per cent in Poland, 6 per cent in South Africa, and 7.4 per cent in Brazil (Ahluwalia 2019). Differently, Ali, Fjeldstad, and Sjursen (2014) compared tax compliance in South Africa, Kenya, Tanzania, and Uganda, and reported that compliance existed in environments where enforcement makes evasion more difficult.

The above is predominantly the case in South Africa where the aggregate municipal consumer debt amounted to about R230.7 billion (that is, US\$15.8 billion)¹ in early 2021, with a total amount of R73.7 billion (that is, US\$5.1 billion) having been written off as bad debt (National Treasury 2021). During the same period, the total budgeted expenditure for all municipalities was about R494.5 billion (that is, US\$33.9 billion), thus consumer debt was about 47 per cent of budgeted expenditure. Interestingly, some metropolitan municipalities commercialised the provision of some services. A case in point is the City of Johannesburg Metropolitan, where water and solid waste removal service are respectively provided by Johannesburg Water SOC Ltd and Pikitup Johannesburg (SOC) Ltd. Both entities are municipality-owned and use market-based mechanisms to coordinate their operations. Nevertheless, it is important to note that inconsistent dispensations of commercialisation and municipalisation exist across South African metropolitan municipalities. Such inconsistencies make the South African case ideal to contribute to the global debate on whether local governments in the developing world should commercialise service delivery.

The rest of this study is organised into six sections. Section 2 reviews some current literature on consumer debt and commercialisation. Section 3 gives an overview of consumer debt in South African metropolitan municipalities. Section 4 provides the methodology used in the study. Section 5 discusses the data and descriptive statistics. Section 6 presents and discusses the results. Section 7 concludes the study.

Local government consumer debt and commercialisation in the literature

Local government service delivery is linked to the standard economic theory which assumes that consumers of public services are rational, aim to maximise their utility, and are not influenced by emotions or other external factors when deciding on consumption (Moscati 2021; Ptaschunder 2021). Thus, the standard economic theory would assume that consumers of local government services are rational and will pay for services received to sustain such provisions and maintain their utility. However, this assumption is somehow further from reality. The non-payment for local government services in most developing countries is an apparent contradiction of the key assumption of the standard economic theory. Ali, Fjeldstad, and Sjørnsen (2014) argue that such a contradiction and the continuous increase in non-compliance is explained using one or more of five theories, namely, economic deterrence, fiscal exchange, social influences, comparative treatment, and political legitimacy theories. These theories are interconnected, with some representing an evolution of others (Ali, Fjeldstad, and Sjørnsen 2014).

Four of the five behavioural theories mentioned in Ali, Fjeldstad, and Sjørnsen (2014) are used to explain non-compliance in this study. These theories are the economic deterrence, fiscal exchange, social influence, and the comparative treatment (or equity) theories. The economic deterrence theory suggests that taxpayers decide whether and how to comply based on what they will gain from complying versus the possible costs of non-compliance. This implies that citizens who perceive non-compliance as costly are more likely to express compliant attitudes (Mendoza, Wielhouwer, and Kirchler 2017; Taing and Chang 2021). Equally, the fiscal exchange theory suggests that compliance increases when taxpayers perceive that they will obtain corresponding benefits from government (Taing and Chang 2021). Thus, taxation and public service provision are interpreted as a contractual relationship between taxpayers and the government (Ali, Fjeldstad, and Sjørnsen 2014). Generally, the economic deterrence and fiscal exchange theories are centred around reciprocity between citizens and the government, where benefits from the government and the cost for non-compliance should be clearly visible for citizens to comply.

However, the social influence and comparative treatment theories are more inclined toward psychological and social aspects which influence compliance. Generally, the social influence theory assumes that citizens' behaviour and attitudes are affected by the behaviour and social norms of their reference group (Czajkowski, Zagórska, and Hanley 2019; Huijts, Molin, and Steg 2012). Thus, compliant citizens believe that other taxpayers comply, whereas non-compliant citizens believe that others are also non-compliant (Ali, Fjeldstad, and Sjørnsen 2014). On the other hand, the comparative treatment theory addresses how citizens perceive their treatment by the state. If the state treats certain groups preferentially, then the relationship between the citizens and the state, and that of the citizens with the group receiving favours is negatively affected (Zhou, Govindan, and Xie 2020). Thus, citizens' compliance is promoted when public administrators practice fairness and provide improved services to all citizens. However, public administrators in many developing countries generally adopt enforcement strategies that rely mainly on penalties and the fear of getting caught (Mendoza, Wielhouwer, and Kirchler 2017; Taing and Chang 2021). Such strategies do not necessarily work in developing economies where severe sanctions usually attract widespread resistance.

Literature provides evidence of non-payment for local government services and taxes in Asian countries like India, Indonesia, and Malaysia (Abdullah et al. 2022; Mathur et al. 2009; Saragih and Aswar 2019), as well as Israel and Yemen in the Middle East (Dahan and Nisan 2022; Helhel and Ahmed 2014). In Latin America, non-payment is reported in many countries including Guatemala, Nicaragua, and Mexico (Vásquez 2015; Vásquez and Alicea-Planas 2017), and it is also rife in African countries like Ethiopia, Kenya, Nigeria, South Africa, and Uganda (Ali, Fjeldstad, and Sjursen 2014; Wambugu 2012). Although people commonly default on paying for water services, non-compliance is also reported for property rates, electricity, and other services (Abdullah et al. 2022; Mathur et al. 2009; Murwirapachena, Kabange, and Ifeacho 2022; Saragih and Aswar 2019).

In the context of South Africa, non-payment for local government services is rife, and several studies in the literature report on its key drivers. Generally, the culture of non-payment which stems from the apartheid era where mass civil disobedience manifested through boycotting the payment of rates is the commonly cited driver (De Lange 2017a; Enwereji and Uwizeyimana 2020; Murwirapachena, Kabange, and Ifeacho 2022). Two dimensions of trust are generally identified as drivers of non-payment in the literature, thus trust in the local authority and trust that others will also pay for public services. The trustworthiness of the revenue enforcement mechanisms, the penalties imposed on defaulters, and knowledge of the compliance behaviour of others affect compliance behaviour. This argument is aligned with both the social influence and comparative treatment theories and is consistent with the practical dynamics in modern South African societies. Generally, citizens who do not trust local authorities, and that other citizens are paying for local government services tend not to pay for services. Key drivers of this mistrust in many developing countries like South Africa include the levels of corruption and mismanagement of resources in local governments. Further, the cross-subsidisation of services where residents from relatively higher-income communities subsidise services delivered to low-income communities also drives non-compliance (Taing 2019).

Most studies that seek to address the problem of non-payment propose improvements in local governments' internal revenue collection systems (Chetty, van Niekerk, and Olivier 2016; De Lange 2017b; Enwereji and Uwizeyimana 2020). Improving communication and relationships between municipalities and communities is also generally recommended in the literature. Although focusing on internal controls may work, reality in most developing countries shows that its success rate is relatively low due to political interference, ineptitude, and corruption. In many developing countries, public services are sometimes used for political reasons, as politicians interfere with local government activities (Akhtari, Moreira, and Trucco 2022; Lapuente and Van de Walle 2020). Interferences with internal revenue and debt management systems usually cripple local government service delivery sustainability.

As a result, commercialising service delivery may be an option for local government sustainability. Although many studies on commercialisation exist, very few, if any, examine its link to improved debt collection. In this context, commercialisation entails the corporatisation of state-owned utilities where they become autonomous organisations that are legally separated from the state and managed by visible managers (Alonso, Clifton, and Díaz-Fuentes 2022; Mercille and Murphy 2017). It involves the application of market mechanisms and practices into the operational decision making

of service delivery (Alonso, Clifton, and Díaz-Fuentes 2022; Furlong et al. 2018; McDonald 2016). Commercialisation is ideal when government utilities struggle with sustainability as it boosts accountability, efficiency, innovation, technical capacities, and fiscal austerity in service delivery (McDonald 2016; Mercille and Murphy 2017). Although it commonly involves having a state-owned enterprise that uses market-based practices to provide local services, other forms of commercialisation include privatisation and private–public partnerships (PPPs).

It is fair to acknowledge that while commercialising service delivery is usually praised for its many advantages, there is also an increasing number of studies which advocate for the re-municipalisation of previously corporatised services. McDonald (2018) points out that most cities worldwide are increasingly re-municipalising service delivery by taking it back into public control, after many decades of privatisation. Studies supporting re-municipalisation generally argue that municipalities should abandon privatisation in favour of in-house service delivery, thus rejecting business-like systems in local public service delivery (Becker, Naumann, and Moss 2017; Paul 2018; Routledge, Cumbers, and Derickson 2018). However, Voorn, Van Genugten, and Van Thiel (2021) call for a more nuanced debate on re-municipalisation. Thus, supporting the argument by McDonald (2018) that while an ideological trend in re-municipalisation is frequently observed in the literature, it may be inaccurate. The literature reveals that many re-municipalisation cases concern a move towards municipally owned corporations, which is another form of corporatisation (Tavares 2017; Voorn, Van Thiel, and Van Genugten 2018, 2021). Therefore, a discussion on whether municipalities should commercialise service delivery is ongoing.

Within the specific context of developing countries, commercialisation is not new, both in academic literature and practice. In Africa, evidence is drawn from many countries, including South Africa, Uganda, and Zambia (Kitonsa and Schwartz 2012; Ngcamu 2019; Tutusaus and Schwartz 2020). Most studies on Africa reinforce the view that while commercialising service delivery improves efficiency and quality, its implications are generally negative for poor households. This is usually the case if poor households are not safeguarded with social safety nets. Although evidence of service delivery sustainability due to commercialisation exists in the African literature, very few, if any, studies have examined the nexus between commercialisation and consumer debt. An analysis of that relationship is important given the glaring evidence of extremely high consumer debt across municipalities in the developing economies.

In South Africa, for example, improved revenue collection will significantly promote quality public service delivery. This is essential in addressing poverty and improving the living standards of many citizens. Regardless of the many benefits of commercialisation reported both in the literature and in practice, the concept is not so popular across South African municipalities. This is mainly because the South African constitution places service delivery within the competencies of the local government. Section 152 of the Constitution of South Africa (1996) mandates the local government to strive within its financial and administrative capacity to achieve the several objects set out in the constitution. More importantly, the country is grappling with poverty and inequalities where commercialising service delivery may be deemed commodifying public services and may be susceptible to massive resistance. In this context, service delivery is generally municipalised; hence, some knowledge on the many benefits of commercialisation is

warranted. More precisely, the municipalisation of service delivery is popular across South African municipalities yet riddled with massive inefficiencies (Murwirapachena et al. 2019; Nithammer, Mahabir, and Dikgang 2022), thus a more efficient alternative model is needed. Therefore, this study contributes to the literature by providing evidence on the impact of commercialisation on consumer debt owed to local governments, and how this may translate to both improved municipal performance and living standards.

Consumer debt in South African metropolitan municipalities

South Africa has 278 municipalities which provide local government services to about 59.4 million people across the country's 9 provinces (Statistics South Africa 2021a). Eight (8) of these municipalities are metropolitans serving about 24.6 million people, that is, about 41.4 per cent of the country's population (Statistics South Africa 2021b).² The average annual population growth rate in these metropolitans is currently estimated at 2 per cent, a figure relatively higher than the national average of 1.28 per cent and the global average of 0.78 per cent (World Population Review 2022). Metropolitans have a higher population growth rate because they are both highly urbanised and industrialised. Thus, people migrate from less developed regions in search of improved socio-economic opportunities in the metropolitans (Selod and Shilpi 2021). Geographically, the metropolitans are distributed across 5 provinces, namely, Western Cape (City of Cape Town), Eastern Cape (Buffalo



Figure 1. Location of metropolitan municipalities on the South African map. Source: Meyer and Neethling (2021).

City and Nelson Mandela Bay), Free State (Mangaung), KwaZulu-Natal (eThekweni), and Gauteng (City of Johannesburg, Ekurhuleni, and the City of Tswane). The locations of these municipalities on the South African map are shown in [Figure 1](#).

Like many other urbanised municipalities in developing countries, South African metropolitan municipalities face a complex mandate of sustaining public service delivery to fast-growing populations. Population growth in South African urban areas normally leads to sprouts in many informal settlements (slums) which usually emerge in areas that are not connected to proper service delivery infrastructure (Paret 2022). The emergence of slums is doing a huge blow to municipalities which are already struggling with both service delivery backlogs and inefficiencies. The democratic South African government inherited service delivery backlogs from a segregating apartheid regime where service delivery infrastructure was generally improved in selected communities (Makapela and Tanga 2022). After achieving democracy, the South African economy was open for all citizens regardless of race, leading to a massive undertaking by the post-apartheid government to extend service delivery infrastructure to previously marginalised areas. While some significant progress can be noted, access to improved service delivery by all South Africans has been marred by several challenges including widespread corruption, slack, inaptitude, and inefficiencies (Mamokhere, John, and Lavhelani 2022; Nithammer, Mahabir, and Dikgang 2022). Generally, South African municipalities have been failing to sustainably deliver public services, the consequence of which is widespread service delivery protests. These protests are so frequent that the country is often labelled the 'protest capital of the world' (Bekker 2022; De Juan and Wegner 2019).

Amid a myriad of challenges, South African urban municipalities are hugely impacted by massive consumer debt which continuously increases each year. The causes and impact of consumer debt in South Africa are widely documented in the literature and were discussed earlier in this study (Enwereji and Uwizeyimana 2020; Murwirapachena, Kabange, and Ifeacho 2022). Generally, consumer debt is highly affecting service delivery sustainability as most municipalities fail to meet their credit obligations because consumers do not pay for services rendered. Consequently, municipalities struggle to pay for bulk water, electricity, and inputs (Murwirapachena, Kabange, and Ifeacho 2022). [Figure 2](#) shows trends in consumer debt for South African metropolitan municipalities from 2009 to 2020.

[Figure 2](#) provides three panels summarising consumer debt trends in South African metropolitan municipalities. Panel A shows trends in the proportion of consumer debt for each metropolitan municipality. Accordingly, the City of Johannesburg consistently has the largest consumer debt during the period. This is in line with practical dynamics where Johannesburg is the most industrialised and populated metropolitan, with a total population of about 5.9 million people, thus 1.5 million people more than the second-placed City of Cape Town (Statistics South Africa 2021b). Panel B shows trends in debt by consumer type, where households are the most defaulting consumers with an average total debt proportion above 60 per cent, while commercial customers are second with an average above 20 per cent. Panel C shows trends in debt by service type where water services, property rates, and electricity services respectively have the largest proportions. This justifies why the non-payment of these three continues to receive considerable attention in the global literature (Abdullah et al. 2022; Dahan and Nisan 2022; Saragih and Aswar 2019; Murwirapachena, Kabange, and Ifeacho 2022; Vásquez 2015).

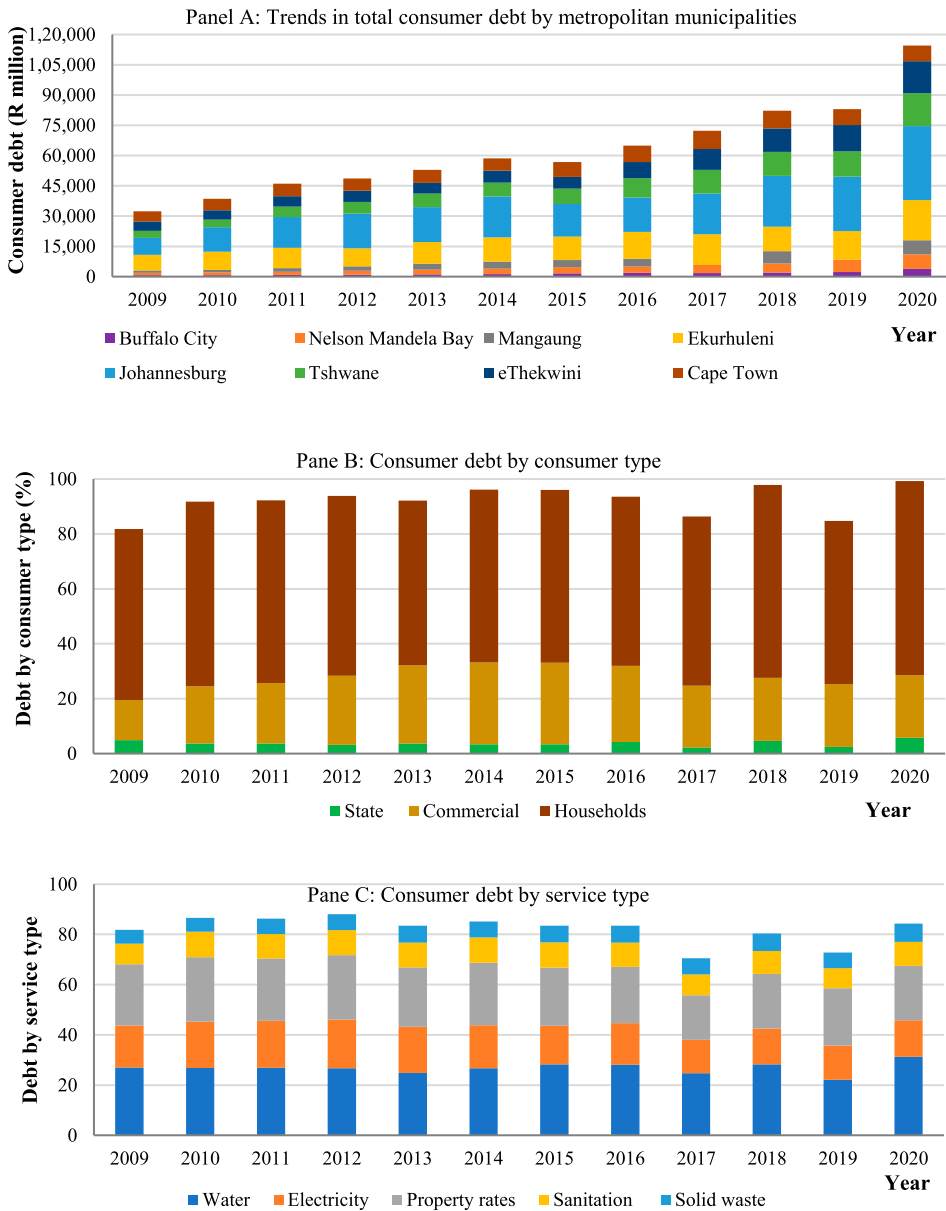


Figure 2. Consumer debt for South African metropolitan municipalities (2009–2020). Source: Own diagram computed using data from the National Treasury.

Literature contains information on the implications of municipal consumer debt. Generally, when consumers of local government services fail to pay for services received, municipalities consequently struggle to meet their credit obligation for bulk purchases of electricity and water. This in turn affects their ability to sustainably deliver services. Evidence exists that South African municipalities continuously fail to meet their debt obligations because they are also owed by their customers (Murwirapachena, Kabange, and Ifeacho 2022; Patji and Selepe 2022). The inability to raise revenue from services has dire

long-term consequences which generally accumulate from the local government's inability to sustainably provide essential public services. Failure by the local government to meet its service delivery obligations usually leads to service delivery protests, which commonly result in vandalism, damaging of local government infrastructure, and in some cases loss of life (Breakfast, Bradshaw, and Nomarwayi 2019; Masuku and Jili 2019; Netswera 2014).

Methodology and empirical model specification

This study uses panel regression models to examine the impact of commercialising local government services on consumer debt. Panel data estimators used in this study are the pooled ordinary least squares (pooled OLS), fixed effects (FE), and random effects (RE) models. The assumptions of each of these estimators are provided in the literature (Allison 2009; Baltagi 2013; Wooldridge 2016). Generally, panel regression models provide insights into analytical questions that multivariate time series or cross-sectional data cannot address alone. Literature provides studies that use panel data to capture dummy variables such as gender and race, which can vary between individuals but remain constant over time (Jæger 2011; Hebner et al. 2018), or capture variables such as inflation and unemployment, which can differ over time but remain consistent across individuals (Awaworyi 2019; Chu et al. 2019). Thus, panel data models capture variables that change over time and between individuals, implying that they can be dynamic, allowing for variables that vary over time and across individuals and variables that change in predictable ways (Awaworyi and Smyth 2021). Theoretically, the basic mathematical formulation for panel regression models is given as:

$$y_{it} = \alpha + x'_{it}\beta + v_i + \epsilon_{it} \quad (1)$$

where y_{it} is the dependent variable for individual i in time period t ; α is the constant; x'_{it} represents the explanatory variables; β is the coefficient for each explanatory variable; v_i is the individual-specific error term which differs between individuals, but has a constant value for any particular individual; and ϵ_{it} is the 'common' error for the usual properties (that is, mean 0, uncorrelated with itself, uncorrelated with x , uncorrelated with v , and homoscedastic). Usually, ϵ_{it} is decomposed to $\epsilon_{it} = v_t + \omega_{it}$, assuming that ω_{it} is a conventional error term which better describes v_t .

Generally, Equation (1) provides the basis for estimating β in panel data analysis. The FE model also called the within estimator, amounts to using the OLS to perform the estimation. However, the RE mode a weighted average of estimates produced by the between and within estimators. Detailed discussions of panel data models are given in the literature (Allison 2009; Wooldridge 2016). In the context of this study, Equation (1) is transformed into a consumer debt model where the commercialisation of local government services is adopted as the main explanatory variables. Other control variables that influence consumer debt are also included in the model which is specified as follows:

$$\begin{aligned} \ln DEBT_{it} = & \alpha_{it} + \beta_1 COMWAT_{it} + \beta_2 COMELEC_{it} + \beta_3 COMSAN_{it} \\ & + \beta_4 COMSOL_{it} + \beta_5 ELECONS_{it} + \beta_6 SOLCONS_{it} \\ & + \beta_7 \ln INDIGENT_{it} + v_i + \epsilon_{it} \end{aligned} \quad (2)$$

where i and t respectively denote the municipality and year for each variable. $\ln DEBT_{it}$ is the natural logarithm of total consumer debt owed to municipality i in year t ; $COMWAT_{it}$ represents the commercialisation of water services; $COMELEC_{it}$ is the commercialisation of electricity services; $CONSAN_{it}$ is the commercialisation of sanitation (wastewater removal) services; and $COMSOL_{it}$ refers to the commercialisation of solid waste services. These three variables (COMLEC, COMWAT, COMSAN, and COMSOL) are captured as dummy variables, where 1 represents the commercialisation of each service and 0 otherwise. On the other hand, $ELECONS_{it}$ is the number of consumer units connected to the electricity grid; $SOLCONS_{it}$ is the number of consumer units receiving solid waste collection services; $\ln INDIGENT_{it}$ is the natural logarithm of the number of poor households. These three variables (ELECONS, SOLCONS and POOR) are used as control variables in the model. Further, v_i is the municipal-specific error term, while ϵ_{it} is the ‘common’ error term.

Data and descriptive statistics

This study uses annual panel data for the eight South African metropolitan municipalities from 2009 to 2020. Therefore, the data used in the study is a panel consisting of cross-sections ($N = 8$ metropolitan municipalities) and time series ($T = 11$ years). The data refers to the variables identified in the previous section (that is, in Equation (2)). Consumer debt data were obtained from Section 71 data compiled by the South African National Treasury to secure sustainable management of the local government’s financial affairs according to the Municipal Finance Management Act No. 56 of 2003 (MFMA). On the other hand, data for the explanatory variables were obtained from the Non-Financial Census of Municipalities (P9115) published by Statistics South Africa. This data provides annual baseline non-financial information from municipalities. Both the National Treasury and Statistics South Africa datasets are publicly available online.³

Descriptive statistics of the data are given in Appendix 1. These descriptive statistics show an average consumer debt of about R7.82 billion (that is, about US\$536 million) for the sample, with lower standard deviations (overall, within, and between), which indicate fewer variations in the sample. Interestingly, 74 per cent of the consumer debt is more than 90 days old, thus it is historic debt that accumulated over an extended period and is not realistically collectable (De Lange 2017a). Further, households account for 64 per cent of the consumer debt, followed by businesses (commercial customers) at 24 per cent, and lastly organs of state at 4 per cent. On average, 27 per cent of the consumer debt accrued from water services, while property rates accounted for 23 per cent, electricity services accounted for 16 per cent, sanitation/wastewater services accounted for 9 per cent, and solid waste collection services accounted for 6 per cent. The frequency of service delivery commercialisation is presented in Appendix 2 and it includes water services (12%), electricity services (77%), sanitation (11%), and solid waste collection services (38%).

Prior to estimation, a correlation test was performed to establish whether multicollinearity problems among the explanatory variables and serial correlation among residuals exist. The existence of multicollinearity among explanatory variables would cause problems when fitting the model and interpreting results. On the other hand, the existence

of serial correlation biases the standard errors and leads to less efficient results (Gujarati, Porter, and Gunasekar 2012). Therefore, the study performed a variance inflation factor (VIF) to existence of multicollinearity among explanatory variables. VIF is a test which measures the correlation and strength of correlation between the explanatory variables in a pooled regression model (Salmerón Gómez et al. 2016). This test evaluates how the variance of an estimator may be inflated due to a high correlation between more than two variables. Generally, a VIF value of 1 indicates no correlation between a given explanatory variables, while a value between 1 and 5 indicates moderate correlation. Such an outcome is desired as it shows that the existing correlation is not severe enough to warrant attention (Salmerón Gómez et al. 2016). However, a VIF value greater than 5 indicates potentially severe correlations between given explanatory variables, thus the coefficient estimates and p -values in the regression output are likely unreliable. Table 1 shows the VIF values for the explanatory variables used in the study.

The VIF test was performed twice, where the first test included 11 possible explanatory variables and reported an average value of 9.59, indicating severe multicollinearity that would lead to unreliable results. In this test, WATCONS (number of units receiving water services) and SANCONS (number of units receiving sanitation services) had extremely high VIF values of 35.48 and 25.61, respectively suggesting that the two variables were highly correlated with other explanatory variables. If these two variables were to be removed from the model, not much information would be lost since they add little unique or independent information to the regression model. As a result, removing these variables from the model can address the problem of multicollinearity without necessarily reducing the overall quality of the model. Therefore, WATCONS and SOLCONS were removed as possible explanatory variables and a second VIF test was performed. Second test results reported values that were below 5 for all possible explanatory variables, with a very low average VIF value of 2.71, indicating very little correlation. Therefore, the estimation will be performed using the remaining variables.

Three control variables, namely, SANCONS, ELECONS and POOR are included in the consumer debt model estimated in this study. The descriptive statistics for these variables are given in Appendix 1. The average number of consumer units for SANCONS is 547,083, while the average for ELECONS is 529,432, and the average for POOR is 165,326. Standard deviations for SANCONS and ELECONS are all less than the mean for each variable, implying that there is not much variation from the sample mean. Thus, the mean for each control variable is a true representation of the sampled

Table 1. Test for correlation using the VIF test.

	First test		Second test	
	VIF	1/VIF	VIF	1/VIF
WATCONS	35.48	0.028	–	–
SANCONS	25.61	0.039	–	–
ELECONS	7.13	0.140	4.49	0.222
SOLCONS	6.58	0.152	4.72	0.229
COMWAT	3.81	0.262	3.02	0.331
COMSAN	2.62	0.381	2.43	0.412
COMSOL	2.25	0.444	1.90	0.527
InPOOR	1.63	0.615	1.62	0.617
COMELEC	1.18	0.844	1.11	0.900
Mean VIF	9.59		2.71	

municipalities. However, the overall standard deviation for POOR (that is, 169,394) is slightly greater than the sample mean although the other standard deviations (that is, between and within) are less. Thus, while some overall deviations from the mean are noted, there is not much variation between the municipalities and within each municipality regarding the number of poor households. Generally, these descriptive statistics show that heterogeneity is minimal in the sample, and this is because the sample consists of metropolitan municipalities alone.

Further, a Spearman correlation test was performed to ascertain the specific nature and direction of the relationship between the selected explanatory variables. The Spearman's rank correlation is a test used in econometrics to measure the strength and direction of association between two ranked variables (Gujarati, Porter, and Gunasekar 2012). This test basically gives the measure of monotonicity of the relation between two variables. Thus, it shows how well the relationship between two variables could be represented using a monotonic function. Matrices for the Spearman correlation test performed in this study are presented in Appendix 3 which shows a high and positive correlation of 0.754 between COMWAT and COMSAN. Another high and positive correlation of 0.824 was also reported between ELECONS and SOLCONS.

Further, the existence of heteroscedasticity among the explanatory variables was tested. Heteroscedasticity refers to a statistical phenomenon that occurs when the variance in a data set changes over time or can vary between different subgroups of the data. This phenomenon can have serious implications for the reliability of the results obtained from statistical analyses. For example, if heteroscedasticity is present, it may be difficult to interpret whether differences in means are statistically significant or are due to random chance (Baltagi, Jung, and Song 2010; Gujarati, Porter, and Gunasekar 2012). To accurately assess any potential heteroscedasticity within a data set, researchers often use a test known as the Breusch–Pagan Test (BPT). This test produces a Chi-square (Chi^2) statistic, and a corresponding p -value. The decision rule of the BPT is that a significant p -value indicates the presence of heteroscedasticity in the data. In this study, the BPT was used and produced a Chi^2 value of 14.38 which is strongly significant with a p -value of 0.000. This suggests the existence of the heteroscedasticity problem in the data; thus, residuals are not constant. To address this problem, the study estimates panel regression models with robust standard errors.

Results

The study used three different estimators to examine the impact of commercialisation on municipal consumer debt, namely, the pooled OLS (Model 1), FE (Model 2), and RE (Model 3) models. Each of these models was specified with robust standard errors. The reason for using robust standard errors is for example, pooled OLS assumes that all municipalities are the same, implying that the estimated coefficient for each variable applies across all municipalities in the sample. Hence, applying a pooling analysis in this context without spotting peculiar characteristics of each municipality may cause an omission bias and distort the findings (Anton and Bostan 2017). Similarly, where distinct coefficients apply across municipalities, one must choose between the FE and RE models.

While an FE model assumes that all variation within a group is due to individual-level differences and not group-level differences, an RE model assumes that individual and

group-level differences can contribute to variation within a group. In the context of this study, the FE model (also called the ‘within estimator’), controls unobservable constant heterogeneity, showing that each municipality has its specificity or characteristics to be noticed throughout the study period (that is, area, population density, culture, etc.), possibly influencing the outcome variable. Further, the FE model controls for potential endogeneity generated by omitted variables (Wooldridge 2016). For the RE model (also called the ‘between estimator’), individual effects of municipalities are randomly distributed across the cross-sectional units. Thus, the RE model captures such individual effects with an intercept term representing an overall constant term.

The study applied the Hausman test to decide on the most robust model between FE and RE. The Hausman test is required to enable researchers to compare these two models and determine which provides better fitting results for their data set (Gujarati, Porter, and Gunasekar 2012). In a nutshell, the Hausman test works by measuring whether a particular estimator is consistent or biased. The null hypothesis of this test suggests that RE is appropriate, which is tested against the alternative hypothesis that FE is appropriate. Suppose the p -value of the Hausman test is less than the 5 per cent significance level (that is, the p -value is statistically significant), then the alternative hypothesis that FE is appropriate is accepted.

When the RE model is appropriate, the Breush and Pagan Lagrangian Multiplier (BPLM) test is recommended to decide the best model between the pooled OLS and RE models and determine if the estimates from the pooled OLS are reliable (Murwirapachena, Kabange, and Ifeacho 2022). Alternatively, when the FE model is appropriate, an F-test is performed to test the most efficient model between the pooled OLS and FE models, where a significant p -value suggests that the FE model is preferred. The Hausman test performed in this study (full results in Appendix 4) produced a significant p -value of 0.000, confirming that the FE model is preferred to the RE model. Furthermore, a significant p -value of 0.000 was reported for the F-statistic, implying that the FE model is preferred to the pooled OLS model.

Further, some critical diagnostic tests were performed to check whether the data used in estimation were normally distributed. In this regard, the Jacque Bera normality test was used. This test assesses whether the residuals in a regression model follow a normal distribution (Wooldridge 2016). The test works by calculating various statistics such as skewness and kurtosis on the residuals of a given panel regression model and then comparing these statistics against predetermined critical values based on how large or small our sample size is (Gujarati, Porter, and Gunasekar 2012). Suppose. In cases where any statistic falls outside its respective critical value range, it can conclude that the residuals do not conform to normality, thus estimated coefficients may be biased or unreliable. Alternatively, the p -value of the Jacques Bera normality test is checked and a p -value above 5 per cent would mean that we fail to reject the null hypothesis of normality and a p -value below 5 per cent would mean otherwise. Test result in this study indicated a p -value of 0.139, which is greater than the 5 per cent significance level, implying that we cannot reject the null hypothesis of normality. Thus, confirming that the data were normally distributed. Additionally, the study tests whether time-fixed effects are needed when running the FE model.⁴ This was important to account for individual effects unique to each municipality (Gormley and Matsa 2014). The null hypothesis for this test suggests that the coefficients for all the years are jointly equal to zero.

Thus, the study assessed whether the dummies were equal to zero for all years. If they were equal to zero, then no time-fixed effect is needed in this case. This is tested against the alternative hypothesis that time-fixed effects are required. When the p -value of the time-fixed effects test is greater than 5 per cent (that is, statistically insignificant), we fail to reject the null hypothesis suggesting no time-fixed effects are needed. However, time-fixed effects tests for this study produced a significant p -value of 0.000, confirming the need for time-fixed effects in the FE model.

Generally, the literature identifies cross-sectional dependence as an issue in panel data, especially in FE models (Hoechle 2007). However, Pesaran (2021) argues that cross-sectional dependence only becomes a problem in macro panels with long time series (over 20–30 years). The current study only covers the period 2009–2020, thus 11 years across the selected municipalities. This makes the FE model a micro panel, implying that cross-sectional dependence is not a problem in this study. Results from the pooled OLS, FE, and RE models are presented in Table 2.

Table 2 presents empirical results from three-panel data estimators: pooled OLS, FE, and RE models. However, the diagnostic tests prior to estimation suggested that the FE model is the most efficient among the three. Therefore, the FE model is the one adopted for interpretation in the context of this study. The FE model reported four of the seven explanatory variables as significant determinants of consumer debt. These variables are COMSAN, COMSOL, ELECSON and SOLCONS. However, the model omits COMWAT, while COMELEC and lnPOOR were reported as insignificant determinants of consumer debt. The omission of COMWAT in the FE model is not new in the literature and is because the key explanatory variables are dummy variables, hence the STATA software would omit at least one of the dummy variables citing perfect multicollinearity. Generally, the empirical estimates presented in Table 2 are interpreted in terms of the statistical significance, sign, and magnitude of each coefficient. In the context of this study, positive coefficients imply a positive relationship between the explanatory variable and consumer debt, while a negative coefficient suggests an inverse relationship between each explanatory variable and consumer debt.

Considering the above, results show that commercialising sanitation (wastewater) services (COMSAN) increases consumer debt by about 22.5 per cent, *ceteris paribus*. Wastewater services can be used as a proxy for commercialising water services since water and wastewater services are generally intertwined because the water that gets into a property as clean water leaves the property as wastewater. Thus, when billing wastewater disposal, South African municipalities generally make estimates based on the volume of clean water consumed at the property in each period. The Spearman's correlation test performed earlier revealed a higher correlation matrix of 0.754 between COMWAT and COMSAN, which is one of the reasons for the FE model to omit COMWAT. Therefore, the estimated coefficient of COMSAN can be applied to COMWAT, thus commercialising sanitation services increases consumer debt. Consequently, this justifies the position held by many scholars in the literature who supports the municipalisation of public services and oppose commercialisation (Becker, Naumann, and Moss 2017; McDonald 2018; Paul 2018; Routledge, Cumbers, and Derickson 2018). Generally, the view held by these scholars is that business-like systems do not efficiently work in local public service delivery. This is generally true in terms of public services like water and wastewater services, where access is predominantly considered a fundamental human right.

Table 2. Estimation results of the consumer debt models.

	Pooled OLS model		FE model		RE model	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
COMWAT	0.960***	0.180	0	omitted	0.960***	0.206
COMELEC	0.157	0.134	-0.011	0.081	0.157	0.245
COMSAN	-0.273**	0.108	0.225**	0.089	-0.273***	0.066
COMSOL	-0.242*	0.143	-0.119*	0.067	-0.242	0.155
ELECONS	1.46e-06***	4.00e-07	-1.29e-06 ***	3.07e-07	1.46e-06**	5.90e-07
SOLCONS	1.10e-06***	3.75e-07	5.54e-07***	1.55e-07	1.10e-06**	5.35e-07
InPOOR	-0.214***	0.049	0.018	0.040	-0.214***	0.064
Year						
2010			0.143**	0.077		
2011			0.382***	0.081		
2012			0.501***	0.083		
2013			0.627***	0.083		
2014			0.743***	0.085		
2015			0.790***	0.085		
2016			0.921***	0.086		
2017			1.094***	0.096		
2018			1.219***	0.094		
2019			1.305***	0.100		
2020			1.576***	0.095		
_cons	23.312***	0.510	21.829***	0.493	23.312***	0.696
N	96		96		96	
Prob > Chi ²	0.000		0.000		0.000	
R ²	0.820					
Prob > F			0.000			
Within			0.906		0.237	
Between			0.107		0.927	
Overall			0.078		0.767	
Rho			0.974		0	
Sigma_u			0.934		0	
Sigma_e			0.153		0.357	

Note: ***, ** and * represent significance at 1 per cent, 5 per cent, 10 per cent level, respectively. Std. error, Standard errors.

The variable COMSOL was reported to have a statistically significant coefficient which suggests that the commercialisation of solid waste collection services reduces consumer debt by about 11.9 per cent, *ceteris paribus*. This revelation is essential as it suggests that the commercialisation of solid waste collection services can be a tool to address the problem of consumer debt. Therefore, it can be argued that locally provided services like solid waste collection that are not deemed extremely essential for human existence (relative to water and sanitation, which are basic human rights) may be commercialised. The inconsistency reported by the estimates of sanitation and solid waste collection services may be one of the reasons for the continued debate on whether public service delivery should be municipalised or commercialised (Alonso, Clifton, and Díaz-Fuentes 2022; Furlong et al. 2018; Paul 2018; Routledge, Cumbers, and Derickson 2018; Voorn, Van Genugten, and Van Thiel 2021). Generally, studies that examine the impact of commercialisation with respect to one locally provided service (for example, sanitation), are likely to report different results compared to studies that examine a different service (for example, solid waste collection). By examining the impact of commercialising on consumer debt in the context of the main locally provided services, this study provides broad evidence on which services to commercialise and municipalised.

Apart from the commercialisation variables (which are the key explanatory variables), the study also controlled for the number of consumer units connected to the electricity

grid in each municipality (ELECONS), the number of consumer units receiving solid waste collection services (SOLCONS), and the number of poor households in each municipality (POOR). While POOR was statistically insignificant, ELECONS and SOLCONS reported statistically significant coefficients. The negative coefficient of ELECONS implies that an increase in the number of consumer units receiving electricity reduces consumer debt by about 1.29×10^{-06} per cent, while the positive coefficient of SOLCONS implies that an increase in the number of units receiving solid waste collection services increases consumer debt by about 5.54×10^{-07} per cent, *ceteris paribus*. The percentage effect of ELECONS and SOLCONS are minimal in magnitude to affect consumer debt either positively or negatively. These results are not surprising and corroborate with the literature supporting that several factors like poverty, unemployment, and dissatisfaction with public service provision, are key determinants of consumer debt (Worku 2018; Enwereji and Uwizeyimana 2020).

In terms of the time-fixed effects in the FE model, the result reveals that each time-fixed effect on consumer debt was positive and significant. Additionally, with a Rho coefficient of 0.973, the result suggests that 97 per cent of the variance is attributed to the municipality-level fixed effects. This time-fixed effect captures any impact that could alter the level of commercialisation of services across the selected municipalities for a given year. In other words, there are still observed differences across metropolitan municipalities. This is consistent with reality, where the sample municipalities differ in size and operating environments even though they belong to the same municipal category because they are all metropolitans. Such differences can also affect consumer debt differently across municipalities.

Differences reported in the impact of commercialisation on each type of service can be explained by several factors. Among these are the socio-economic perceptions of South Africans towards each type of service (Ali, Fjeldstad, and Sjursen 2014). Access to water and sanitation are considered basic constitutional rights in South Africa, implying that commercialising these services may be deemed the commodification of social goods whose access is guaranteed in the constitution. Municipalities predominantly provide water and sanitation services at tariffs below production cost because these are perceived social goods (Enqvist and Ziervogel 2019). Thus, they face the common dilemma of water and sanitation being both social goods whose access is guaranteed in the constitution and being commodities, whose revenue should cover service provision costs. However, this is not the case with electricity and solid waste collection services where access is not enshrined as basic rights in the constitution.

Therefore, while the resistance to pay for electricity and solid waste collection services also exists, its magnitude is less than that of water and sanitation services due to the distinct perceptions that people have on these services. Apart from the City of Johannesburg which commercialised all four services during the study period, most of the other metropolitans commercialised the provision of electricity services, some have also commercialised solid waste collection over the years. However, water services provision was never commercialised by all the metropolitans, except for the City of Johannesburg. Equally, sanitation services have never been commercialised by any other municipality except for the City of Johannesburg (throughout the period of study) and the City of Cape Town (in 2009 and 2010 only). This confirms the distinct nature of these public services, confirming the distinct results reported for each service in this study.

Conclusion

Most local governments in developing countries struggle with huge consumer debt, which challenges both financial and service delivery sustainability. Many possible solutions to the consumer debt problem are provided in the literature. However, very few studies, if any have looked at the possibility of adopting commercialisation as a solution to commercial debt in local government. Therefore, this study was set to investigate whether commercialising local government service delivery can be an effective tool for addressing consumer debt. To achieve this, the study used panel data for South Africa's 8 metropolitan municipalities from 2009 to 2020. The pooled OLS, FE, and RE models were used in the estimation. However, diagnostic tests prior to estimation recommended FE as the most efficient estimator among the three. Therefore, results from the FE model were adopted and interpreted.

The study found that commercialising sanitation services increases consumer debt, while commercialising solid waste collection services reduces consumer debt. However, commercialising electricity service was found to have no significant impact on consumer debt, while inconclusive results were reported on water services commercialisation. Three control variables were included in the model: the number of consumer units receiving electricity services, the number of consumer units receiving solid waste collection services, and the number of poor households. Results indicated a negative relationship between the number of consumer units receiving electricity services and consumer debt, while a positive relationship was reported between the number of consumer units receiving solid waste collection services and consumer debt. However, the number of poor households served by each municipality was not a statistically significant determinant of consumer debt.

Overall, the implication of these results is that policymakers in the local government should carefully consider the nature of the service provided when deciding whether to commercialise it or not. Ideally, they should rank services according to their importance to the consumers. Basic services like sanitation (and water) should generally be publicly provided without necessarily adopting corporate systems and principles. This is essential in the context of developing countries where many households generally earn low incomes, and access to such services is a basic human right for existence. Adopting commercial systems to manage such services may border between human rights violations and unacceptable moral behaviour, especially when a service is discontinued because of non-payment. However, services like solid waste collection, which are ranked lowly in terms of the essentiality for human existence, may be commercialised. Therefore, regarding the current debate on commercialisation and municipalisation that exists in the literature, the study recommends that policy decisions on such matters should be based on the type of each service. Thus, such decisions should not be generalised or applied to all local government services using a blanket approach.

There is so much scope for future research on the commercialisation of local government services. While this study focused on metropolitan municipalities which are highly urbanised, future studies can also investigate this phenomenon in the context of other municipal categories, for example, in municipalities with medium and smaller towns. This will essentially add more value as different perspectives which can aid to this discourse may be derived. However, studies that opt to focus on such environments

should carefully control for variables such as poverty and unemployment, especially when less developed municipalities where household income levels are generally low are investigated. Therefore, the results reported in this study can be a precursor to the many studies which will seek sustainable solutions to the problem of consumer debt in local government, especially in the context of developing and emerging economies. While the results reported in this study may be replicated over time and space, it should be acknowledged that differences in the operating environments of local governments may have a significant impact on consumer debt and the ability of people to pay for services. As a result, more studies of this nature are warranted, especially in operating environments other than the one investigated in this study.

Notes

1. As of 27 March 2022, US\$1 = R14.58.
2. South African municipalities are categorised into metropolitan (A), district (C) and local (B) municipalities. Detailed discussions on these municipal categories are given in the literature (Murwirapachena et al. 2019).
3. The National Treasury data is available at http://mfma.treasury.gov.za/Media_Releases/s71/Pages/default.aspx, while the Statistics South Africa data is available at http://www.statssa.gov.za/?page_id=1859.
4. This was done using the *tesparm i,year* STATA command.

Data availability statement

The authors undertake to provide the data used in this study if requested to do so.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendices

Appendix 1. Descriptive statistics

Variable	Description		Mean	SD	Minimum	Maximum
DEBT	Debt owed by consumer (R'000)	Overall	7,820,000	6,510,000	0	36,600,000
		Between		5,830,000	1,580,000	19,400,000
		Within		3,520,000	150,000	25,100,000
DEBT90	Consumer debt over 90 days old (%)	Overall	74	12	0	86
		Between		5	67	80
		Within		11	6	92
STATE	Debt owed by state organs (%)	Overall	4	4	-0.3	26
		Between		3	1	11
		Within		3	-7	19
COMDEBT	Debt owed by commercials (%)	Overall	24	9	0	44
		Between		4	19	30
		Within		8	-3	42
HHDEBT	Debt owed by households (%)	Overall	64	15	0	100
		Between		8	53	76
		Within		12	12	102
WATDEBT	Debt attributed to water services (%)	Overall	27	8	0	45
		Between		5	18	33
		Within		6	-3	43
ELECDEBT	Debt attributed to electricity (%)	Overall	16	6	0	31
		Between		4	11	24
		Within		4	1	24
PROPDEBT	Debt attributed to property rates (%)	Overall	23	7	0	46
		Between		6	17	35
		Within		5	5	44
SANDEBT	Debt attributed to sanitation (%)	Overall	9	5	0	18
		Between		4	3	15
		Within		3	-6	17
SOLDEBT	Debt attributed to solid waste (%)	Overall	6	4	0	17
		Between		4	1	14
		Within		2	2	10
WATCONS	Water consumer units (Number)	Overall	626,429	306,296	164,324	1,004,505
		Between		316,479	198,312	956,656
		Within		72,497	442,932	818,360
ELECONS	Electricity consumer units (Number)	Overall	529,432	278,377	132,717	1,209,754
		Between		284,051	146,451	942,829
		Within		78,430	333,496	796,356
SANCONS	Sanitation consumer units (Number)	Overall	547,083	263,251	119,052	938,949
		Between		271,561	176,604	832,343
		Within		63,991	413,675	782,163
SOLCONS	Solid waste consumer units (Number)	Overall	644,045	364,386	128,046	1,517,794
		Between		367,207	162,332	1,080,929
		Within		116,401	356,241	1,080,910
POOR	Poor households (Number)	Overall	165,326	169,394	14,365	687,000
		Between		149,909	35,978	500,919
		Within		93,935	-193,058	506,281

Note: SD, standard deviation; observations (N) = 96; Number of municipalities (n) = 8; time period (T) = 12 years.

Appendix 2. Frequency of consumer debt by selected binary predictor variables (N = 96)

		Frequency (%)	Pearson Chi ²	P-value	Cramér's V
COMWAT	Commercialised water	12	96.000	0.423	1.000
COMELEC	Commercialised electricity	77	96.000	0.423	1.000
COMSAN	Commercialised sanitation	11	96.000	0.423	1.000
COMSOL	Commercialised solid waste	38	96.000	0.423	1.000

Appendix 3. Spearman correlation matrices

	COMWAT	COMELEC	COMSAN	COMSOL	ELECONS	SOLCONS	InPOOR
COMWAT	1.000						
COMELEC	0.206	1.000					
COMSAN	0.754	0.196	1.000				
COMSOL	0.488	0.013	0.464	1.000			
ELECONS	0.264	0.126	0.247	0.232	1.000		
SOLCONS	0.375	0.139	0.289	0.039	0.824	1.000	
InPOOR	0.080	-0.039	0.129	0.079	0.604	0.526	1.000

Appendix 4. Hausman test results

	Coefficients		Difference (b - B)	SD
	FE (b)	RE (B)		
COMELEC	0.354	0.1569	0.197	0.119
COMSAN	-0.221	-0.273	0.052	-
COMSOL	-0.495	-0.242	-0.254	0.049
ELECONS	1.76×10^{-06}	1.46×10^{-06}	2.98×10^{-07}	4.67×10^{-07}
SOLCONS	5.91×10^{-07}	1.10×10^{-06}	-5.11×10^{-07}	2.13×10^{-07}
InPOOR	0.094	-0.214	0.309	0.053
Chi ²	50.46			
Prob > Chi ²	0.000			