Review of Sanitation Public Expenditure in South Africa and Investigation of its Spill-Over Effects in KZN Province

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Abstract: *This study reviews the public sanitation expenditure policies in South Africa and investigates the policies' spill-over effects in KwaZulu-Natal, over the period 1998 to 2014. The use of government funding to provide sanitation highlight's the state's role in social welfare. However, little is known about the spill-over effects of this involvement. Government's actual objectives for the sanitation subsidy were to achieve equality, restore human dignity, environmental and health care improvement, and poverty eradication. This work relies heavily on Mann's 1980 application of Wagner's Law in the Mexican economy. This study draws from Mann 1980 to investigate the spill-over effects on urbanisation and industrial growth in KwaZulu-Natal. An ARDL methodology was applied to the specified model to test for the spill-over effects as real life time series tend to be in polynomial form; ARDL (p,r) was thus applied. The results from testing suggest that operational expenditure tends to have a positive and larger impact on sanitation subsidies than capital expenditure, which is inconsistent with Mann (1980). Therefore this has the following implications on the sanitation policy, government operational spending on sanitation needs to be higher than capital spending.*

JEL Classification: C01, C22, C54, H23, H53, L97

Key Words: Sanitation Policies, Government Expenditure, Urbanisation, Industrial Growth, Sanitation Subsidy and ARDL

Introduction

The debate on subsidization of basic services in developing countries and emerging economies rests on the fact that, worldwide, it is acknowledged that improved water supply, sanitation and energy services are associated with improved productivity and poverty eradication. This is reflected in the United Nations' (UN) Millennium Development Goals. This view also is relevant for South Africa.

The democratic South African government has prioritised equitable and efficient distribution of basic services to address apartheid inequities, ensure that citizens' constitutional rights are upheld, and enhance economic development.

The sanitation subsidy system was implemented in South Africa 20 years ago and is on-going, the total sanitation backlog reported by KwaZulu-Natal (KZN) municipalities alone in 2014 was 775 116 households. This raises the question of the efficacy of the demand side policy in increasing coverage and meeting the intended objectives. Government's actual objectives for the sanitation subsidy were to achieve equality, restore human dignity, environmental and health care improvement, and poverty eradication. However, very little is known of other externalities of the sanitation subsidy targeted for the poor.

Concerns are still mounting in South Africa about the sanitation spending and provision of good quality sanitation. South African government opted to make access to basic sanitation a constitutional right and therefore is highly subsidy dependent and they also adopted a national sanitation policy that is; demand driven, recognises regulation of sanitation institutions and monitoring of intervention, and information gathering and sharing (DWAF: National Sanitation Policy, 2001 and DWS: National Water and Sanitation Policy, 2016). The implementation of this policy has not yielded the best results in coverage and meeting the set target of universal access. Studies on the sanitation policies adopted in South Africa to govern the use of a sanitation subsidy found that the core problems were conflicting objectives and therefore conflicting policies (Wilkinson et al, 2014; Mjoli, 2010; Khumalo et al, 2003). International experience of subsidized sanitation programmes has shown that supply side sanitation delivery approaches led to untenable services because they focused on toilet hardware without considering hygiene education, community involvement and meeting the sanitation demands of beneficiary communities (Hueso et al, 2013; Oti, 2012; Mjoli, 2010; Evans et al, 2010; Bruijne et al, 2007; Bosch et al, 2002; Samanta et al, 1998). However no South African studies, were found, that had attempted to examine the implications of the supply-side sanitation subsidy policy on urbanisation and industrial growth. None of the studies had attempted to project the estimated change in capital expenditure to supply toilet infrastructure as well as other externalities on urbanisation, industrialisation and output growth.

The world over, various economic theories that explain or justify government expenditures and subsidies in order to achieve welfare economics, correcting market failures, promoting other macroeconomic objectives such as boosting economic growth, and equitable distribution of income. The law of Wagner has been interpreted and tested by many studies with conflicting results. The simplest and most accepted interpretation of Wagner's Law of increasing state activity declares that "as the economy develops over time, the activities and functions of government increase" (Peacock & Wiseman, 1967; Pryor, 1969; Musgrave, 1969; Gupta, 1967; Mann, 1980; Payne and Ewing, 1996). This law is applied in this study to examine the spill-over effects of sanitation subsidy on urbanisation and industrial growth in the sanitation subsector, in the province of KwaZulu Natal, following the latest work of Mann (1980).

A subsidy payment constitutes government expenditure. The government sanitation subsidy is to enhance service delivery to the poor, address socio-economic inequity, improve health and hygiene and promote the environmental sustainability of sanitation systems (DWAF, 2005; Municipal Indigent Policy, 2005; National Treasury, 2008). Also, increased government subsidies promote effective

public service delivery and in turn poverty reduction (Reserve Bank Quarterly Bulletin, 2013). Subsidies are part of the South African government's expansionary fiscal policy standpoint. When government chooses an economic stimulus that targets poverty reduction, in the hopes that, full spending will create more jobs in the short run and lead to economic growth in the long run, the expansionary fiscal policy is a positive injection in the economy (Vane & Thompson, 1992).

This paper is a desktop review of the sanitation public expenditure in South Africa and applies an autoregressive polynomial distributed lags estimation method ARDL (p,r) to estimate the spill-over effects on urbanisation and industrial growth in KZN, province.

Debates on Sanitation Subsidies

Studies around the world re-enforced the seriousness of access to sanitation for all whether as a need for economic growth or welfare promotion. This is standard opening theme amongst all the studies that were reviewed for this paper.

The World Health Organisation (WHO) undertook to quantify the economic benefits of universal sanitation and found that each US$1 invested in water and sanitation would yield an economic return of US$3 to US$4, depending on the region (WHO Water sanitation and health, 2005). This view is embraced by the studies that support government supply of water and sanitation infrastructure, the supply side approach. The Millennium Development Goals have called for governments to prioritise investments in sanitation infrastructure, in belief that there is a positive relationship between economic growth, equality and infrastructure (Banerjee et al, 2008). The strong correlation between sanitation infrastructure investment and economic growth, is what all the economic growth theories such as, Solow's (1956) and Barro's (1990) have argued for and it's the hope of many governments that have opted for a fiscal stimulus in sanitation infrastructure as in the theories of public expenditure supported by Wagner (1883) and Keynes (1936). Case in point, in the UK and other European countries investments in sanitation hardware and networks were done fairly late in the industrialisation and urbanisation revolution. The outcome was favourable and worth the course. Universal access to sanitation was also the guaranteed end result of the investment (Evans et al, 2010). In a case study in Romania it was quantifiably proven that government provision of efficient sanitation infrastructure and environmental services is a crucial aspect in stimulating and maintaining economic development (Frone & Frone, 2014). However in the developing countries this discovery may take a while as there are serious problems of coverage in sanitation infrastructure due to limited funding and other drawbacks. Cesar Calderon takes an empirical study using the Ramsey model with long run growth exogenously determined to quantify the relationship between infrastructure and economic development in Sub-Saharan Africa and finds that, under the right conditions, infrastructure investment does lead to economic growth and equality, and that through both these channels poverty is reduced. Infrastructure such as electricity, roads and telecommunication were found to have a significant contribution to economic growth in the long-run and water and sanitation infrastructure did not have the same effect (Calderon et al, 2008). There is also a warning that government intervention that is not effective actually yields a negative impact on economic growth as this is a waste of limited resources and has a potential to displace existing water and sanitation industrial players (Bosch et al, 2002).

The welfare argument is not lagging behind; in fact, it's the loudest of the motives for universal access to sanitation for the poor. Sanitation is viewed to play an important role in poverty reduction, improving the environment, improved health directly translating to low morbidity and mortality and finally improved quality of education and productivity. The benefits listed are a lot and they are solutions to some of the serious problems battling Sub-Saharan Africa. "In recent years pro-poor and human rights based values have achieved growing prominence" (Carter et al, 2003). Sanitation infrastructure

has been known to improve the standard of living and reduce poverty (Bhattacharyay, 2010). Adequate water and sanitation is a human right, a violation to this right is a threat to public health (Meier et al, 2012). Promoting universal access to clean water and adequate sanitation services is grossly inexpensive and the best way to improve public health (Montgomery & Elimelech, 2007; Nastiti et al, 2013). Water, sanitation and health are basic human rights an exclusion from these services should be addressed by government subsidies (Whittington et al, 2012). The goal of sustainable permanent water and sanitation services for the poor is far more important than the dogma or vested interests of the private sector (Carter et al, 2003). South African government recognises clean water and adequate sanitation as a human right and this right is entrenched in the constitution.

Other studies have argued that improved health and environment are more a result of good hygienic practices and less a result of adequate sanitation facilities. Thus the hardware subsidies are not effective if they exclude education and promotion of good hygienic practices such as washing of hands after defecation or nappy changing as well as disposing of faeces in an agriculturally accepted manner in the rural areas. Evans et al. (2004), is of a view that key hygienic practices would have a major impact on good health bill, especially for poorest households with a material knock-on benefit economically. “Hygiene is recognised as an important lever for improved health outcomes, however few countries seem to make the link between sanitation and hygiene promotion in policy” (Evans et al, 2004). Samanta et al. (1998) cites that the clear definition of sanitation does not include adoption of sanitary and hygienic practices, but has to do with access to a latrine. Therefore the building of toilets, alone, is not sufficient to address sanitation implementation for improved health. The complete package includes hygiene and good practices to realise all the benefits of effective sanitation. Rheinlander et al. (2010) asserts that health and hygiene initiatives ought to be culturally and socially appropriate to be successful. The UNICEF rural sanitation programme in India reported that by 1995 estimated sanitation coverage in rural areas was 14 % but the greatest achievement was the improved good hygienic practices for the rural poor. Although hand washing with soap or ash after defecation was still low as only a third of the rural households were taking the practice, country wide (UNICEF, 822-IN95-13283). Oti (2012) posited that the participatory hygiene and sanitation transformation initiatives carried out in Kenya, Uganda, Botswana and Zimbabwe yielded positive outcomes, community participation building of adequate latrines and good hygienic results. However a meta-analysis of the impact water, sanitation and hygiene individual interventions, found that hygiene alone reduced the occurrence of diarrheal by 25 percentage, whereas point of use household water treatment and improved sanitation led to reductions in diarrheal diseases of 35 and 32 percentage, respectively. The study further suggests that sanitation and point of use water treatment may have contributed to more reductions because they directly block bad exposure (Montgomery & Elimelech, 2007).

There is also a fair amount of studies that argued that the benefit of the sanitation subsidies is not enjoyed only by the targeted groups, being the poor or low income households, but is also utilised on the moneyed. Wokadala et al. (2010) used benefit incidence analysis and concluded that the benefits of the water and sanitation subsidies were progressively spread among the poor and non-poor, with the exception of private connections and infrastructure which benefitted the non-poor more and were regressive. However, Komives et al. (2005) observed that although the subsidy on basic services is regressive, it is less regressive than overall levels of income distribution. In urban areas public grants are generally used to fund shared elements of networks (sewers and treatment plants). Sanitation infrastructure subsidies are regarded as normal and proper, even when the benefit is largely a ‘private good’ for anyone who is able to connect to the system. It is common for this type of subsidy to benefit upper income urban areas via the facility of ‘below-cost’ networked sewerage services (Evans et al, 2009; Kelman, 2004). Bosch et al. (2002) stressed the importance of properly identifying the income poor and the water and sanitation poor, he suggests this exercise to be accurately conducted with little or no mistakes. Evans et al. (2010) cited that the advocates of subsidisation encourage the use of targeted hardware subsidies in order to decrease systematic inequities and protect the most

vulnerable social population. Oti (2012) also cites understanding what drives the need for sanitation along the gender lines enables for successful marketing promotion which can be more effective for target groups.

The most deserving groups to receive the subsidy are rural communities, small towns and the urban poor; all three are known to be underserved and are typically the most at risk of sanitation related infections (Elledge et al, 2002). “Utility subsidies tend to be very poorly targeted. It was found that in none of the African countries is the targeting indicator superior to one, it is often below one” This was a finding in Banerjee and Morella (2011)’s study, when they applied Komives (2005)’s benefit incidence framework to 20 African countries. Furthermore it was found that, on average the poor benefit from one-fourth to one-third of what a household randomly selected in the population would receive (Banerjee and Morella, 2011). The advocates of sanitation subsidy also identify the difficulties in guaranteeing the subsidy is received where intended. There are too many dynamics in targeting and tracking the rightful beneficiaries, as poverty status is not constant and neither is population growth. Therefore the advocates of subsidisation go further on to suggest how smart to use the subsidies, the smart use of subsidies includes suggestions such as replacing subsidies with incentives.

A smart subsidy is said to have certain characteristics such as positive multiplier effects and a limited period. Other studies have given instructions on how best to utilise the subsidies to guarantee the best results and positive externalities.

Whittington et al. (2012)’s study takes a few developing countries data and applies cost-benefit analysis methodology to six various interventions, these being: hand washing, total sanitation, water chlorination, Biosand filters, long-lived insecticides nets and cholera vaccinations. The study found total sanitation to be the only intervention with the lowest health and economic benefits. Biosand filters and cholera vaccinations have the highest economic and health benefits. The researchers discovered there was an issue of uptake and usage in the total sanitation intervention. So the study changed focus to include the regions where the uptake and usage was high. The study then revealed that chlorination campaigns yielded better well-being benefits than total sanitation (Whittington et al, 2012). This then begs the question how to best use ‘smart’ subsidies to ensure higher uptake and usage of sanitation hardware? The characteristic of a smart subsidy are reviewed as follows.

A few studies have suggested the poor pay for their sanitation hardware from microfinance (Mader, 2012; Kelman, 2004; Fujita et al, 2005; Hueso et al, 2013; Evans et al, 2010). The rationale behind this school of thought is that it will increase uptake and usage of the facilities because the users will be getting what they desire. Mader, 2012 undertook a case study in India and also studied a previous case study done in Vietnam and found that sanitation access in the rural areas increased where microfinance was used by households to purchase the type of sanitation facilities they could afford. However the poorest households who couldn’t afford the loan were excluded from the project by default (Mader, 2012). Triest, adds that social welfare subsidies should be very cost effective and benefit deserving groups (Triest, 2009). He thus states that cost-benefit analysis is critical in applying a subsidy to develop communities. Hutton & Haller (2004) used cost benefit analysis to test the effects of sanitation subsidies and found that water and sanitation improvements appeared to be cost beneficial in all global regions.

A 2003 World Bank report on water supply and sanitation incentives to promote the Bank reforms identified the following characteristics of a sound sanitation subsidy:

- “Genuine need – A thorough assessment of the need for subsidies should be undertaken, this should include the level of tariff needed to ensure financial sustainability for the service providers and the minimum level of usage by the poor should be determined. Genuine need should be based on the level of demand and willingness to pay by the different consumer groups. This was

particularly important when cross-subsidy was being considered as an option for funding pro-poor sanitation subsidies."

- "Accurate targeting of the poor – The subsidy should be based on accurate targeting of the poor in order to minimize the cost of the subsidy and maximize benefits for the poor."
- "Administrative simplicity – Simple subsidy administration procedures should be developed in order to make sure that most of the budgets allocated to the subsidy for the poor actually benefited the poor households."
- "Preservation of economic incentives – Full subsidies were not encouraged because they could lead to perverse economic incentives for households. The subsidy should be capped at the level that forced the poor households to pay a minimum fee linked to the usage of the service. For example, in Chile, the direct subsidy covered 85% of the water bill and the subsidy was only paid when there was proof that the poor household had paid its share" (Foster et al, 1999).
- "Coverage – The design of the subsidy should be based on the total number of the target population so that the service coverage could reach most people over specified period" (Mehta, 2003).

Well-designed subsidies are said to be transparent, rule bound and time limited, over above the impact must be regularly evaluated. The author goes on to suggest that start-up subsidies are found to be smart when accompanied with information and education for the recipient (Morduch, 2006). Banerjee and Morella (2011), state that "an indefinite, on-going operating subsidy of US$2 per month to ensure that currently unserved customers can continue to afford service places a burden of 1% to 2% on a majority of African countries' GDPs." Samanta et al. (1998), reiterates the importance of an indefinite subsidy to avoid creating on-going dependency and allow recycling of small targeted groups (Samanta et al, 1998). Direct subsidies are preferable, as was the case in Chile in the early 1990s, where subsidies were paid to consumers who could not afford their bills rather than paying the utilities. The core benefit from direct subsidies is transparency and thus they reduce distortions in the behaviour of water utilities and their clients (Foster et al, 1999).

A lot has been said about sanitation subsidies, the use thereof, the benefits yielded and to whom is the benefit directed. How best to utilise a sanitation subsidy is dictated by the policy design, implementation and impact evaluation. The national sanitation policy is South Africa respects sanitation as a constitutional right; however it competes with the guidelines from the national departments that fund the subsidies, such as the, Department of Human Settlements and National Treasury. The implementing agencies are the local municipalities which are governed and report to the Department of Cooperative Governance and Traditional Affairs. The next section unpacks the financial flow of government funds, the players and sanitation policies and guidelines. The next section will also assist in analysing how the design of the demand side driven sanitation policy is implemented and whether the impact of the policy is evaluated.

Review of Public Sanitation Expenditure in South Africa

In South Africa the following basic services are deemed critical to improved standards of living: electricity and energy, water and sanitation, refuse and waste removal (RDP, 1994). The Reconstruction and Development Programme (RDP) that was adopted in 1994 states that meeting basic needs, including sanitation, is aimed at addressing poverty and deprivation (RDP, 1994). Sanitation policies are informed by the RDP. When the RDP was adopted, the South African government committed itself to a national water and sanitation programme that would ensure that every household had an adequate water supply of 20-30 litres per capita per day (Treasury Government Programmes and Policies: Basic Services). In the year 2000 former President Thabo Mbeki committed to 6 000 litres of safe water per month to poor households and the government later undertook to provide universal access to safe water and basic sanitation by 2010 (DWAF, 2003;

DPLG, 2005a; Treasury, 2013). However, the target date was later extended to 2014. DWAF is the policy maker and regulator on all water and sanitation matters, and its policies and commitments are binding on municipalities.

Different mechanisms are used to fund these programmes. The household sanitation subsidy is administered by local government for the provision of infrastructure using various sources of funding, mainly the Municipal Infrastructure Grant (MIG). Other sources may include the Urban Settlements Development Grant (USDG); Rural Households Infrastructural Grant (RHIG); and Human Settlements Development Grant (HSDG) from various government departments (National Treasury Budget Information, 2014).

1.1 The National Department of Water Affairs

The Department of Water Affairs has seen many changes since 1994. It was formerly known as DWAF and was then the custodian of South Africa's water and forestry resources entrusted with the formulation and implementation of policies governing these subsectors. It has veto powers on water services provided by local government. In 1996, DWAF introduced the National Sanitation Programme, which aimed to eradicate the sanitation backlog by 2010, and in 2002 the National Sanitation Programme Unit was established. The Water Service Act (Act No. 108 of 1997), the primary policy controlling water service provision in South Africa, provides that all South Africans have the right to basic sanitation (DWAF, WSA No. 108 of 1997). In May 2009, DWAF was split into two, with the forestry responsibilities transferred to the Department of Agriculture and the Department of Water Affairs (DWA) standing alone. In May 2014, the Department of Water and Sanitation (DWS) was established (DWAF, 1994; DWA, 2009; DWS, 2014).

The department's website notes that, "The Department of Water and Sanitation is the custodian of South Africa's water resources. It is primarily responsible for the formulation and implementation of policy governing this sector. While striving to ensure that all South Africans gain access to clean water and dignified sanitation, the department also promotes effective and efficient water resources management to ensure sustainable economic and social development." (https://www.dwa.gov.za/about.aspx#vision)

Although the delivery of water services is a local government responsibility, the DWS is responsible for setting in motion a collaborative process with all spheres of government to implement policies and programmes on water and sanitation, and to develop guidelines and financial models to assist local authorities to implement such (DWS, Annual Report, 2014). The Local Government: Municipal Systems Act 32 of 2000 (Municipal Systems Act, 2000) sets out the apparatus and techniques to enable municipalities to ensure socio-economic upliftment among the communities under their jurisdiction and to provide universal access to basic services. It seeks to empower the poor and ensure that municipalities establish service tariffs and credit/debtor control policies that take the needs of the poor/indigents into account (South Africa, 2000). In terms of the Municipal Systems Act, municipalities must develop an indigent policy that assists poor households to access basic municipal services. In 2005 the Department of Provincial and Local Government (DPLG) circulated its Framework for a Municipal Indigent Policy, as well as Guidelines for the Implementation of the National Indigent Policy by Municipalities. The lack of harmonization in sanitation policies and procedures has led to a lack of clarity, particularly in terms of how household sanitation is integrated into the National Housing Programme subsidy processes (Wilkinson et al., 2014). Case in point: The DWAF Free Basic Water Policy of 2007 states that: At present the Equitable Share of national revenue transferred to local government is on income level as an indicator of poverty (currently R800 per household/ month), and MIG funds are distributed based on household expenditure of R1 100 per month (DWAF2007[1]: Free Basic Water Policy). However, the National Treasury income level poverty line in 2007 was R2 400 per household/month (National Treasury: Treasury StatsSA Poverty Line

[1] The most recent poverty line released by Statistics SA was in 2007 and this is in line with DWAF's policy.

Discussion Paper, 2007). These poses a challenge for the municipalities in identifying the indigents and false targeting of poor threatens the distribution of the subsidy and also have a negative impact on sanitation coverage. Foster et al. (1999) undertook a case study in Chile and found that determining eligibility to subsidisation is far critical. The authors also understand the difficulties of a moving target when using income as a yardstick to determining poverty, such as lack of telephone connection, lack of proper building material at the dwelling. The study then suggests that: "it is necessary to develop eligibility criteria that show a high degree of correlation with the underlying poverty variable of interest." The variable in question should be easy to observe and measure but difficult to falsify or misrepresent. This could be done by targeting zones or individuals to collect detailed data. The authors go on to warn of the types of targeting errors that could occur, namely, exclusion and inclusion errors, exclusion error where eligibility criteria excludes qualifying member or inclusion error where households outside the target group coincidently meet the criteria.

The 1996 and then 2001 National Sanitation Policy has since evolved to the National Water and Sanitation Policy in 2016, however it has always included the principle of community involvement and demand–driven sanitation service provision. The national sanitation policy by DWS has the following as one of it's principles: "Ensuring universal access to basic sanitation is recognised as a Constitutional responsibility of the national sphere of government, with Constitution responsibility of provision of basic sanitation services at the local sphere of government. Local government must take reasonable measures to realise this right." (DWS: National Sanitation Policy, 2016). The other end of the spectrum is the Municipal Indigent Policy which espouses the municipalities' smooth operations to be above the need of the poor (Municipal Indigent Policy, 2005). The implementation of this policy has however always indicated a misinterpretation of the policy as the implementing agents ascribe to the supply driven, top-down approach with less involvement of the communities. This could be a result of the ambiguity of the policy where it recognises the COGTA guidelines to local municipalities for the types of sanitation hardware that must the supplied to the poor and how (DPLG, 2004; SALGA, 2012).

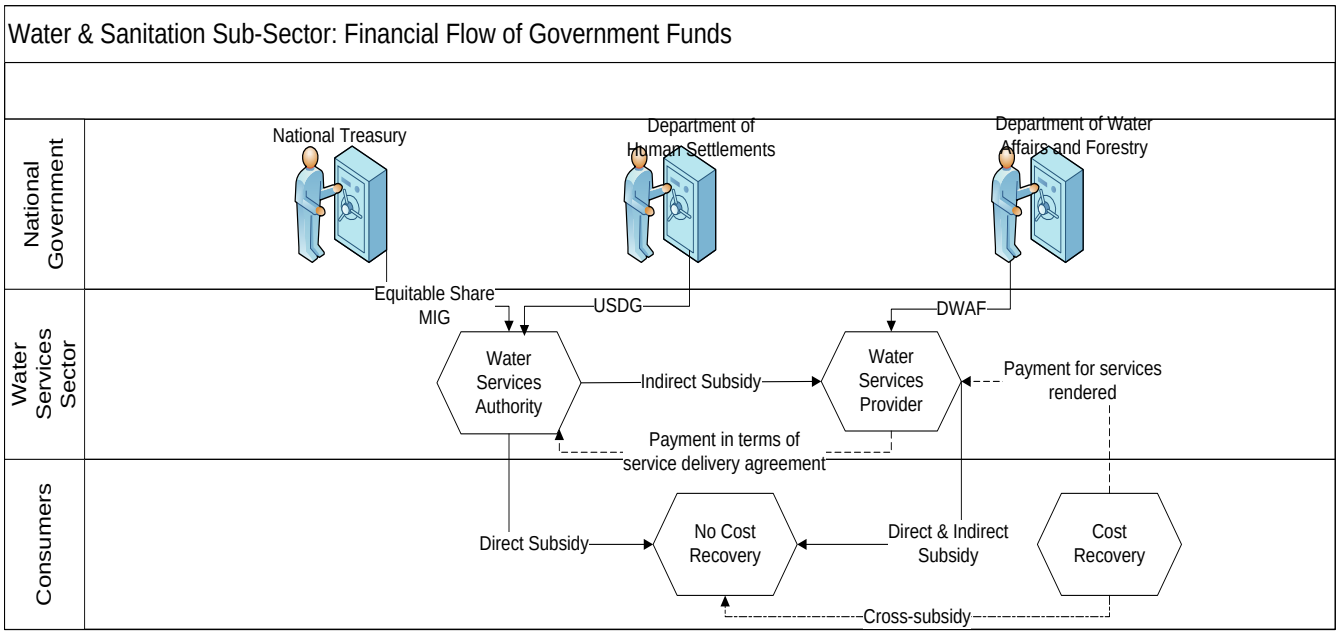
Eberhard's report to National Treasury on Price Administration in Water summarised the responsibilities of the then DWAF as:

- "Custodian of water resources and overall policy maker and regulator (there is no independent regulator),
- Oversees the activities of all water sector institutions,
- Responsible for national/international resource planning and allocation,
- Licenses water use and discharges and collects abstraction and discharge fees
- Manages water resources infrastructure (for example, dams) and also some water services infrastructure" (National Treasury Report: Administered Price Water).

1.2 Financial Flow of the Sanitation Subsidy and Service Charges

The role players in the water and sanitation sub-sector are best expressed in financial flows.

Figure 1: Financial Flow of the Sanitation Subsidy and Service Charges



Financial Flow of Government Funds. Source: Researcher's own formulation

1.2.1 National Treasury

Figure 1 above shows that National Treasury regulates and transfers the Equitable Share and MIG in terms of the Public Funds Management Act.

a. Equitable Share:

The Local Government Equitable Share (LES) was introduced in 1998. It was initially based on a formula with two elements, the sub-grant (S-Grant) and the municipal institution grant (I-Grant). It was reviewed in 2004 and 2012 and more components such as the tax base equalisation grant and the matching grant were added that considerably altered the allocations produced by the formula.

The main driver in the S-Grant component, free basic services (i.e., water, sanitation & refuse) (See

Table **1** below) is intended to supplement the cost of providing basic services to poor households, that is, households with expenditure of less than R1 100 per month. I-Grant formula is quite complex and supports the funding of the institutional and political structures of municipalities. The tax based equalisation grant was designed in accordance with the existence of substructures within metropolitan municipalities and is intended to minimise fiscal disparities across these substructures. The matching grant was designed to address the impact of inter-jurisdictional externalities that might arise from the provision of services (SALGA, LGES Formula Review, 2012).

Table 1: The LGES formula in 2004 showing allocations through each funding window

Funding Windows of the 2004 LES	Allocations	Percentage (%)
R293 allocations	263 000 000	4%
S-grant	4 746 000 000	67%
I-grant	473 000 000	7%
Nodal allocations	228 000 000	3%
Free basic services (water, sanitation and refuse)	867 000 000	12%

Free basic electricity/energy	500 000 000	7%
Total	7 077 000 000	100%

The LGES formula in 2004 Source: Annexure E to the 2004 Division of Revenue Bill

b. Municipal Infrastructure Grant (MIG):

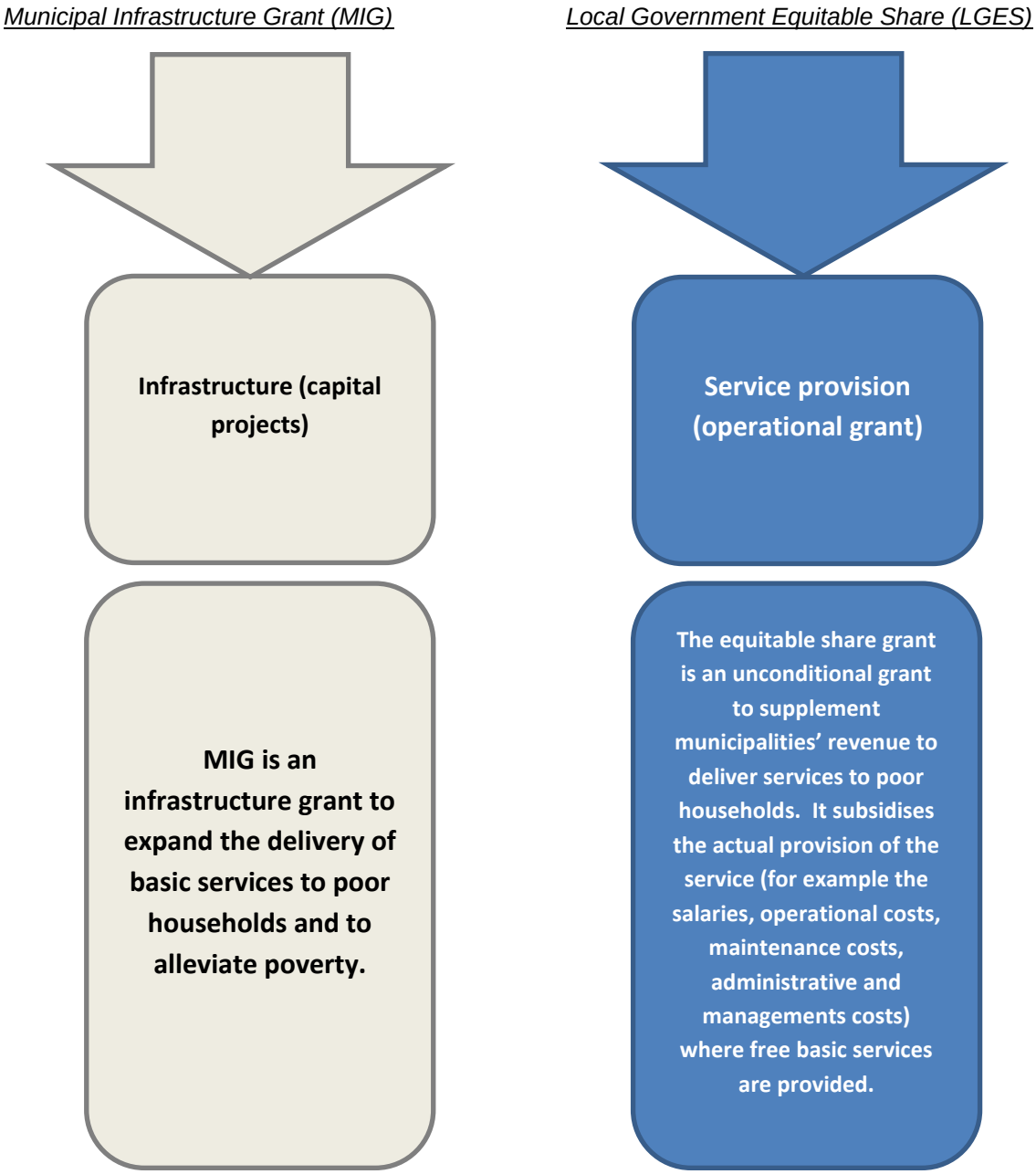
The MIG was established in 2004 to combine all the fragmented capital grants (i.e., the Consolidated Municipal Infrastructure Programme including the Rural Household Infrastructure Grant; Water Services Projects; the Community Based Public Works Programme; Local Economic Development Fund; Urban Transport Fund; the Building for Sports and Recreation Programme and the National Electrification Programme) for municipal infrastructure into a single grant. Although the MIG is paid out by National Treasury it is administered and regulated by the Department of Cooperative Governance and Traditional Affairs (COGTA) that channels it to its provincial departments and local government. Prior to the adoption of the MIG, infrastructure grants were controlled by various departments and were therefore uncoordinated and disjointed. Municipalities were had no power over infrastructure projects within their area of jurisdiction and therefore could not manage such projects. This defeated the objective of cost effective planning and integrated service delivery (DPLG, 2004).

The MIG is designed to assist the poor to gain access to infrastructure, thus, MIG funds can only be used for infrastructure for basic levels of service. For instance, in carrying out the DWA's programme for the year 2000, "a basic water supply facility has been defined as the infrastructure necessary to supply 25 litres of potable water per person per day supplied within 200 metres of a household and with a minimum flow of 10 litres per minute (in the case of communal water points) or 6 000 litres of potable water supplied per formal connection per month (in the case of yard or house connections)" (DWAF, 2000).

The objectives and priorities of the municipal infrastructure grant are listed as follows, in descending order of importance:

a) Fully subsidise the capital costs of providing basic services to poor households. This means that priority must be given to meeting the basic infrastructure needs of poor households through the provision of appropriate bulk, connector and internal infrastructure in municipal services.
b) Distribution of MIGs in an equitable, transparent and well-organized manner that supports a co-ordinated approach to local development and maximises municipal developmental growth outcomes.
c) Promotion and improvement of municipalities' developmental capacity, by enhancing multi-year planning and budgeting systems.
d) Provide a mechanism for the co-ordinated pursuit of national policy priorities with regard to basic municipal infrastructure programmes, while avoiding the duplication and inefficiency associated with sectorally fragmented grants (DPLG, 2004).

Figure 2: The MIG and LGES Mechanisms



MIG & LGES Mechanisms Source: DPLG, 2004

The objectives of the two grants paid out by National Treasury are clearly depicted in Figure 2 above, these being capital projects and operational expenditure for the MIG and LGES, respectively. As the discussion above shows, many departments make different contributions and have different objectives and local government is at the receiving end of such.

1.2.2 Department of Human Settlements

The Department of Human Settlements (DHS) is a vote 31 institution, meaning that it is a fund transferring department. Since it is responsible for providing low-income housing for the poor in South Africa, its objectives are intertwined with those of the DWA. The provision of houses includes installation of adequate water and sanitation infrastructure. Therefore the initiatives, plans and programmes of the two departments have to be communicated and streamlined (DWS, 2012). De facto, the DHS has to adhere to the DWA's standards and guidelines in terms of the type and quality of infrastructure to be installed. If this were not the case, the implementing agents (municipalities)

would bear the burden of conflicting expectations. When the DHS took over the National Sanitation Programme from the DWA in 2009, there was a lack of regulation of sanitation programmes at national level (Tissington, July 2011). "It remains unclear which functions DWA retains and how the two national departments coordinate their efforts. In the meantime, there is very little national regulation of local water services provision, particularly around basic sanitation" (Tissington, July 2011).

As Figure 1 shows, the DHS transfers the Urban Settlement Development Grant to COGTA which then transfers it to local government (DHS, 2011).

c. Urban Settlement Development Grant

The USDG seeks to support the development of sustainable human settlements and an improved quality of life for households. Amongst other goals, it aims to ensure that households in informal settlements have "secure tenure and basic services either in-situ or elsewhere" (DHS, 2011).

The conditions that have to be met to receive the grant include:

- "Multi-year performance targets must be agreed with the national DHS and where required the relevant provincial departments, based on the strategic capital investment plans and programme of the municipality,
- Conditions associated with the grant must be restricted to output and outcome performance of the overall municipal capital expenditure programme,
- Funds may be transferred to a municipality only if the municipality has satisfied the criteria set out in the grant policy framework,
- A municipality must ensure that:

    - ✓ poor households receive the final benefit of the grant
    - ✓ expenditures are consistent with the national and provincial human settlement strategic objectives and goals" (DHS, 2011).

This means that municipalities have to comply with DHS-approved plans and programmes. It is not stated whether or not these programmes are aligned with those of the DWS, nor is there any indication if the strategies of both departments are communicated in a synchronised manner to municipalities.

d. DWAF (Municipal Water Infrastructure Grant)

The DWAF grant was transferred as a once-off sanitation subsidy of R600 for community development and R600 for the basic toilet structure (R1 200) per household (DWAF, 2001) (See Figure 1). However, it is not clear when the DWAF grant started and when it was phased out as the department was later changed to DWA and again to DWS.

The current DWS transfers a grant known as the Municipal Water Infrastructure Grant (MWIG) to municipalities. This grant was established in 2012, after the realisation that backlogs were not decreasing at the intended rate and some municipalities were severely behind in meeting the 2014 target of universal access to safe water and sanitation. Based on existing backlogs, the greatest financial need was in Limpopo, KZN and the Eastern Cape, all provinces that house former bantustans (PMG, 2013). Therefore, it is a special grant to supplement the MIG and is only provided to specific municipalities.

e. Cross-Subsidies

Cross-subsidies occur via the tariffs charged and are easily factored into the water and sanitation sector, with high-volume water consumers compensating for those who consume less, even though each group benefits equally from the operation of the sewerage network and treatment plant (Evans et al, 2009).

1.2.3 Summary

The discussion showed that different departments have certain expectations of the implementing agents, in terms of how funds are used. Moreover, municipalities are governed by the Municipal Systems Act 32 of 2000. Where the different department's objectives or expectations are not in conflict, they are a duplication of efforts. Wilkinson et al. thus conclude that, "the provision of sanitation services utilising subsidies may be one of the most difficult regulatory environments in which to operate in South Africa, largely due to the lack of clarity and often conflicting legislation, policies and strategies from national to local government levels" (Wilkinson et al, 2014).

Combining water and sanitation in one department has also been posited as a problem as water seems to get better attention than sanitation. Some studied have suggested institutional reforms where water and sanitation are separated, as it was found that more attention is given to water projects and therefore more funding and evaluation (Evans et al, 2004; Elledge et al, 2002).

The top-down approach is also criticised by some studies as it does not involve the communities in decision making and also does not take into account the users' preferences of hardware which is said to have resulted in lack of uptake and usage of toilets provided by government in some communities. It is common consensus among a lot of researchers that the 1980s approach on sanitation coverage has not worked and they suggest a few ways to improve the approaches or country sanitation policies, these include: community led total sanitation (CLTS), demand driven, incentives based. Whereas the 1980s approach is more supply driven, subsidy dependent and is a top-down approach (Hueso et al, 2013; Bosch et al, 2002; Bruijne et al, 2007; Oti, 2012; Evans et al, 2010; Samanta et al, 1998). The supply of hardware has been noted to fail because hardware is expensive to supply and because it assumes a top-down approach which excludes consumer participation and therefore user acceptance (Oti, 2012).

1.3 Challenges in the Water and Sanitation Sub-Sector

Challenges in addressing sanitation backlogs and in providing on-going, adequate sanitation services have been identified by government departments, municipalities and sanitation service providers.

The DWA's 2012 report on the status of sanitation services in South Africa identified a number of challenges experienced in the delivery of quality sanitation, ranging from infrastructure provision, to the maintenance of infrastructure, vandalism, the supply of sanitation services and cost recovery for services rendered. The list includes:

- The upgrading and expansion of bulk infrastructure capacity,
- Ensuring the quality of the sanitation facilities constructed,
- The maintenance of reticulation and/or on-site infrastructure,
- Revenue collection to fund the on-going provision of services,
- Community liaison and participation to ensure acceptability and responsibility for the services, and
- Effective oversight, regulation and management of sanitation services at all levels of government (DWAF, 2012 – Sanitation services: Quality of Sanitation in SA).

1.3.1 Quality of Sanitation Facilities

A case in point was the Khayelitsha Township toilets saga, where the toilets provided to the poor were erected without walls for privacy. A class action was pursued in the Cape High Court and a compliant

was laid with the South African Human Rights Commission (SAHRC). In this landmark case, both found that this was a violation of human dignity and the constitutional right to a clean environment (SAHRC, 2012). The proportion of South African households that live without proper sanitation facilities decreased steadily between 2002 and 2014, from 12,3% to 4,9% during the 2014/15 year. Nationwide surveys showed that nearly a quarter of households were concerned with poor lighting and inadequate hygiene, while 22% felt unsafe and uncomfortable using outdoor shared ablution facilities. A fifth (18.7%) of the respondents criticised the lack of hand washing facilities, and 21% pointed to long queues and therefore problems with the cleanliness of the ablution blocks. About 6,6% of households were frustrated by constant damage to the plumbing system and 4,4% had sewage overflowing in their yard (GHS, 2014). Ablution blocks are commonly built to accommodate between 50 and 75 households (eThekwini Municipality, Provision of Sanitation to Informal Settlements Report).

1.3.2 Vandalism of Property

Vandalism of property is rife in South Africa during service delivery protests. Vandalism to, and the theft of water and sanitation infrastructure cost eThekwini Municipality an estimated R 605 425 87.58 in 2013/2014, and the KZN Provincial Department of Public Works spent R20 million on repairs to sanitation facilities in KZN schools (eThekwini Water Services Authority (WSA) 2013/2014 Statistics). The KZN Provincial Treasury and National Treasury do not have statistics on estimated cost or losses due to infrastructure vandalism or theft. Vandalism to property can be the result of dissatisfaction with the level of service delivery or the poor quality of infrastructure and could even represent defiance in the face of cost recovery by those that are not accustomed to paying for services. This strategy was adopted during the 1980s to make South Africa ungovernable and by those that could not afford to pay for services.

1.3.3 Challenges confronting Municipalities

eThekwini Municipality's annual reports identify the following challenges in relation to basic services infrastructure and delivery.
The funds transferred and grants to municipalities have been steadily cut back over the years, making cost recovery measures necessary (see Figure 1 on page - 10 -for the flow of funds),

- Urban migration and population growth are increasing at a faster rate than the public funds allocated (Annual Report, 2012/13).

a. Dwindling Funds

National government grants account for approximately 57% of capital spending by municipalities on water and sanitation services with the other 43% coming from loans. In order to deliver on its services delivery mandate, eThekwini Municipality secured a 20-year loan to the tune of R1 billion in the 2011/2012 financial year to fund its capital programme (eThekwini Municipality Annual Report 2011/2012).

Table 2: eThekwini Municipality Conditional Grants and Transfers Received Over the Last Seven Years

Operating Transfers and Grants Received	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
Financial Year	2008	2009	2010	2011	2012	2013	2014
National Government Transfer	-	1 593 796	1 149 689	1 469 169	1 613 063	2 026 005	2 191 385
Equitable Share	1 315 720	1 653 244	1 126 996	1 414 535	1 581 802	1 769 412	1 869 806

Department of Water Affairs	2 484	2 949	8 366	13 362	4 000	-	-
Municipal Infrastructure Grant	35 701	370 962	508 950	595 912	-	-	-
Urban Settlement Development Grant	-	-	-	-	1 091 574	1 287 560	1 580 999
Top 5 Grants and transfer	1 353 905	2 027 155	2 794 001	3 492 978	4 290 439	5 082 977	5 642 190

eThekwini Conditional Grants and Transfers from National and Provincial Government[23]

Source: eThekwini Municipality Annual Reports 2007/2008 – 2013/2014

While the table shows that transfers and non-conditional grants increased over this seven-year period, information was not available on the prior years' national budget surplus for comparison. Furthermore, the DWAF, MIG and USDG are not consistent as they depend on certain conditions being met. The conditions could include how much was spent previously as opposed to how much was requested or the number of programmes and commitments planned for the current year compared to the previous year's commitments. Therefore the previous year's performance is the key deciding factor. The data presented in Table 2 above suggest that the challenge might not be decreasing national and provincial governments' transfers, but rather systemic failures at local government level.

According to Kate Tissington of the Socio-Economic Rights Institution of South Africa, the countless challenges at local government level include:

- "failure of many municipalities to implement free basic water and free basic sanitation policies, and to ensure access to basic services for poor households,
- inadequate national financing to address sanitation backlogs, particularly in small towns and rural areas,
- municipal tariff structures generally not well developed outside metropolitan municipalities,
- shortage of critical skills and competencies in most municipalities, especially rural and poor municipalities,
- lack of strong leadership and management at the local level,
- involvement of political representatives/politicians in the management of service provision, and the need to limit these inappropriate political interventions in service delivery,
- financial viability deteriorating in many municipalities due to poor revenue collection and management, coupled with the inability of those living in poverty to pay for services and the challenges of providing free basic services sustainably in this context" (Tissington, July 2011).

b. Urban Migration and Population Growth

Rural-urban migration is a growing phenomenon in South Africa. Present day KZN incorporates the previous KwaZulu bantustan that was combined with the former province of Natal after 1994. Spatial issues may lead to population growth and rural-urban migration.

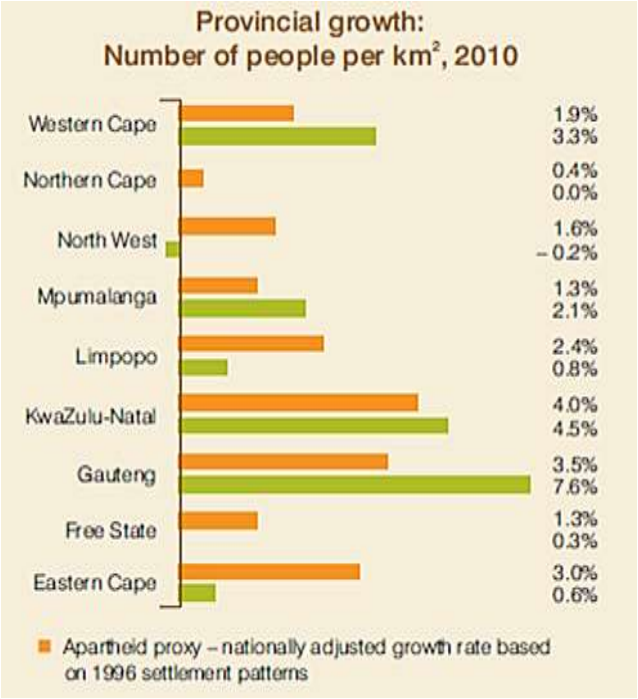
- The 2012 DBSA Infrastructure Barometer (see Figure 3 below) notes that:
- Between 1996 and 2007, household size decreased from 4.5 to 3.9 people, increasing the number of households,

[2] Motivation for this study

[3] Note: These figures are totals before allocation to other competing programmes such as electrification, housing and capital projects. Of the top 5 grants, only the DWA's grant is fully allocated to water and sanitation projects.

- Average annual population growth between 2001 and 2011 was 2% or more for the Western Cape and less than 2% for all the other provinces,
- Access to basic services has increased since 1996, although there has been increased demand in the former bantustans due to the apartheid spatial legacy, and
- Migration has led to population concentration in urban areas (DBSA Infrastructure Barometer, 2012).

Figure 3: Provincial Growth in Percentage Comparisons between 1996 and 2010



Provincial Growth in Percentage Comparisons between 1996 and 2010 Source: DBSA, Infrastructure Barometer, 2012

These statistics highlight the challenges posed in providing access to free basic sanitation and improved service delivery to the poor. They imply that KZN could suffer significant backlogs.

1.3.4 Challenges facing Sanitation Service Providers

Many urban utilities (Water Services Providers) charge households to connect to networked sewerage services. Households are often charged a connection fee, plus part or all of the capital costs of connecting the house to a sewer in the street and are also often required to pay a 'deposit' on some or all of the assets provided. These connection charges are costly and are often regarded by utilities as a significant revenue generator. From the indigents' point of view, high once-off connection fees can be a significant deterrent to connecting to public sanitation networks (Evans et al, 2009). Furthermore, if the service is disconnected by the WSP due to non-payment, a re-connection fee is chargeable when the services are re-instated.

Other challenges raised by sanitation service providers (operational and infrastructure water and sanitation services providers) include:

- Despite industry and government guidelines on a ceiling amount per household for the provision of a basic sanitation service, there are perceptions that the capital and institutional social development (ISD) costs of the provision of basic sanitation services are much higher than the recommended unit cost,

- There are growing perceptions that the capital cost for construction of a basic sanitation facility has been unreasonably high,
- There are perceptions in the sanitation sector that some households have benefited from more than one subsidy,
- There is also a growing perception within the public sector and the sanitation sector that the sanitation subsidy provided to poor households is not being effectively and responsibly applied (Wilkinson et al, 2014:2).

Sanitation retail tariffs are set and regulated by the Water Services Authority guided by the Water Services Act and Municipal Systems Act (see Figure 1 on page - 10 - for the financial flow). In order to accommodate the poor, there is downward pressure on sanitation prices, often leading to cost containment of maintenance expenditure and capital programmes, this has a negative impact on infrastructure supply which ultimately impacts on sanitation services provision. Furthermore, the subsidy received by municipalities may cover administration costs which are indirect costs for sanitation services provision (Wilkinson et al, 2014).

Wilkinson et al. found that the total supply costs of access to subsidised sanitation technology are between R22 800 for a VIP latrine system and R46 400 for a septic tank system (adjusted to 2012 prices). The environmental and health costs of an incorrectly erected, functioning and maintained facility increase the unit cost of a subsidised VIP toilet to R33 800, a 32% increase. Likewise, the cost of a UD toilet shoots up to R38 300 (a 29% increase) and the unit cost of septic tanks increases to R57 300 (an increase of 19%) (Wilkinson et al, 2014).

In contrast, a DWA study indicated that, “basic sanitation facilities can be provided at a cost below R1 000 per household. The cost of operating these services is approximately R5 per household per month or R60 per household per annum” (DWAF, 2002: Sanitation Policy).

There is thus a stark difference between actual and anticipated costs. Although the policy does not specify the type of toilet, the amount of R1 000 is way below any of the types listed in Wilkinson et al.’s study.

According to Statistics SA, expenditure-in-kind[4], by South African municipalities towards providing access to free basic services for the years 2005/06[5] was as follows:

- Free basic water: estimated to average R31 per month per household
- Free basic sanitation: estimated to average R28.08 per month per household (Income and Expenditure Survey 2005/2006)[6].

In comparison, the national indigent policy sets out total expenditure of R161.15 made up of free basic water at R87.90 and sanitation at R73.25 (The Municipal Indigent Policy Framework, 2005).

This difference could be the result of the actual cost of providing the services as opposed to how much is received in subsidies and what municipalities can afford.

1.3.5 Sanitation Success Stories

Despite these challenges, some success has been reported. The DWA notes that, “South Africa achieved the Millennium Development Goal (MDG) of halving the number of people without access to sanitation in 2008. In 1994 more than 50% of households did not have access to sanitation, one of the terrible legacies of apartheid inherited by the new democratic state. By 2010 this was reduced to 21%

[4] Expenditure-in-kind refers to items acquired by households without paying for them, e.g., free basic services for the poor
[5] The 2005/06 data was used as this was the latest survey published with this relevant data
[6] These are average results and would therefore differ from one municipality to another

of households" (DWA, 2012 – Sanitation services: Quality of Sanitation in SA). Furthermore, "Nationally, the percentage of households that continued to live without proper sanitation facilities had been declining consistently between 2002 and 2014, decreasing from 12,3% to 4,9% during this period" (GHS, 2014). However, the effectiveness of the policies and the proof of poverty reduction are called into question by the number of people using basic sanitation services and the increase in the number of service delivery protests in South Africa.

In 1994, it was estimated that approximately 21 million South African citizens lacked access to adequate sanitation (DWAF, 1994). This dropped to 18 million in 2001, or three million households in 2001 (DWAF, 2001).

A White Paper produced by the South African Human Sciences Research Council for DWAF noted that, "while access to sanitation is increasing (albeit at less than an optimal pace) from a functionality and adequacy point of view, as many as 26% (or about 3.2 million households) are at risk of service failure and/or are experiencing service delivery breakdowns. Add to this the 9% (or 1.4 million households) in formal settlements that have no services and the 584 378 households or 64% of households in informal settlements making use of interim services" (DWAF, 2012). The reality for many individuals and households is thus the daily insult of inadequate access to sanitation. The media has exposed numerous cases of inadequate sanitation across the country (Tissington, July 2011).

This section examined the national departments responsible for funding access to free basic sanitation. The policies and legislation guiding their efforts were discussed as well as the policies they have formulated to regulate the receipt and use of such funds. It was noted that there is a lack of alignment of policies and therefore objectives and expectations.

As the sphere of government closest to citizens, municipalities have their fingers on the pulse of communities. Therefore, guided by National Treasury, DWS and DPLG/COGTA as well as community input, they should be entrusted with the formulation of their own annual plans and programmes. This would ensure that the funds are utilised equitably, transparently and efficiently to improve the lives of the poor. The "lack of bottom-up planning, proper consultation and participation by communities" has been identified as a particular challenge (SAICE, 2011). The national sanitation policy clearly states that sanitation initiatives should be people-centred and demand driven, whereas the Municipal Infrastructure Grant, the vehicle to implement the policy, is designed to fully subsidise hardware supply for the poor and the types of accepted hardware are prescribed. The conflicting 'top-down' policies are compounding the problems of municipalities where, administrative capaticy, institutional capacity, human and organisational behaviour changes, reduction of dependence are already a problem.

Methodology

All in all, the role of government in society is to supplement and step in wherever the private sector falls short in terms of capital expenditure and to ensure that the private sector enjoys a favourable environment to grow, enhancing economic growth. In developing economies, government plays a more important role. This is the point of departure for our examination of spill-over effects.

Peacock and Scott (2000) interpreted Adolph Wagner's work between 1883 and 1911. Drawing on their interpretation, the law is adapted and applied to this study based on the following assumptions in relation to South Africa:

1. In developing economies, the activities of the central and local government increase on a regular basis.

2. Government will only take on services where it enjoys a comparative advantage in relation to private sector, therefore, government is seen to be efficient in providing basic sanitation.
3. The purpose of government activities is to meet the economic need to stimulate growth as well as citizens' welfare needs.
4. Expansion and intensification of government functions and activities leads to an increase in public expenditure.
5. Government capital expenditure leads to industrial growth which leads to welfare spending, *ceteris paribus*.
6. There are limitations to government spending due to the tax burden imposed to fund government activities.

Peacock and Wiseman (1967) were the first to apply Wagner's Law that hypothesises that government spending grows at a faster rate than output. They examined federal government spending across all government departments, thus excluding local government spending.

Mann (1980) built on Peacock and Wiseman's work when he tested a time series in a developing country, Mexico over a period of 50 years (1925-1976) using federal government capital expenditure only, GDP at 1969 constant peso, total number of people living in urban areas, GVA in the manufacturing sector and GVA in the primary sector, excluding mining.

The equation used by Mann was specified as:

$$logGEX = \omega + \varphi logGDP + \alpha logMan + \theta logPS + \beta logUrb + e \quad (1\text{-}1)$$

Table 3: A few of the variations of Wagner's Law (special focus on Mann, 1980)

VARIATIONS	FUNCTION	DATA TYPE	STUDY
1	Gex = f(GDP)	Time series	Peacock and Wiseman (1967)
2	**Gex = f(GPD , ManIndu, PrimarySector, LivinUrban)**	**Time series**	**Mann (1980)** **Modified version of P-W**
3	Gex/GDP = f(GDP/P)	Time series	Musgrave (1969)
4	Gex = f(GDP/N)	Pooled	Murthy (1993) Amplified Musgrave
5	Gex= f(GDPofAfricanCountries)	Cross section	Gandhi (1971)

A few of the variations of Wagner's Law (special focus on Mann, 1980) Source: Researcher's own table created from different sources

Pre-1994, South Africa witnessed many changes in the political climate, policies and the economy. The macroeconomic policy this study focuses on was implemented in 1998 and has seen increasing government spending to promote universal access to free basic sanitation. South Africa suffered a significant recession in 2009. Demand for basic sanitation continues to grow and there is no end in sight. The South African economy is dominated by industry rather than the services sector, industrialisation is on-going as is urbanisation. While government supply of basic sanitation enhances its social welfare role, little is known about the spill-over effects of such involvement.

A time series in line with Mann's 1980 application of Wagner's Law in the Mexican economy is tested for the years 1998 to 2014 (quarterly) and the spill-over effects on urbanisation and industrial growth in KZN are examined.

The sanitation subsidy is a provincial and local government component of government expenditure. Wagner's law has been used to test various components of government expenditure such as federal government expenditure at current prices only, federal government expenditure at constant prices only, government consumption expenditure at current prices only, and government capital expenditure at constant prices only. For the purpose of this study, the measure of the size of government is total sanitation expenditure, which means both capital and operational expenditure at provincial level.

Specification of the sanitation subsidy linear regression is:

SS = f (Govt$_{capitalexpenditure}$, Govt$_{operationalexpenditure,}$ Industry, GDP$_{KZN}$, Urbanisation, Population, Backlog, Toilets) (1-2)

Logarithm and lagged the equation derives equation 2 below:

$$lnSS_t = ln\theta + \sum_{i=0}^{4} \beta_i lnGcap_{t-i} + \sum_{i=0}^{4} \varphi_i lnGopex_{t-i} + \sum_{i=1}^{4} \propto_i lnSS_{t-i} + \sum_{i=0}^{4} \delta_i lnIndustry_{t-i} + \sum_{i=0}^{4} \emptyset_i lnGdp_{t-i} + \sum_{i=0}^{4} \omega_i lnUrbanisation_{t-i} + \sum_{i=0}^{4} \aleph_i lnToilets_{t-i} + \sum_{i=0}^{4} \beth_i lnBacklog_{t-i} + \sum_{i=0}^{4} \tau_i lnPop_{t-i} + \epsilon_t \quad (1\text{-}3)$$

Where: SS is the measure of the size of government, capital and operational expenditure on sanitation have been separated because they are not spent at the same time and are spent by different entities (the WSA and WSP, respectively), G_{cap} is government capital expenditure on sanitation and G_{opex} is government operational expenditure, Industry is a gross value add (GVA) measure of the water and sanitation industry, urbanisation is the total number of people living in urban areas; GDP; population is the total number of people in KZN, backlog is the total number of outstanding sanitation infrastructure planned for provision, toilets is the number of households with access to type of sanitation/toilet per household. All the roman symbols measure the elasticities.

1.4 Model Estimates

The general equilibrium model is estimated using the ARDL(p,r) - autoregressive polynomial distributed lags estimation method. This method was applied because it guarantees stability where a time series is dynamic, such as the sanitation subsidy model used in this study. Using distributed lags can also assist in the analysis of how a variable relates to its future, over the lagged four quarters of government expenditure, sanitation subsidy, GPD per capita and other included variables, and finally including polynomial lags can help address the misspecification errors, especially where the estimated results show a DW statistic that is less than a strong R^2 due to the increased number of parameters, making the goodness of fit doubtful.

Data

KwaZulu-Natal, is an east coast province in South Africa. It hosts the City of Durban as the largest city in the province, Pietermaritzburg as the capital city and surrounding towns, and has a population of approximately 10.2 million people, with a population density of 110/km^2. The province area consists of 94,361 km^2, of which 46% is rural traditional and a further 54% is peri-urban. KwaZulu-Natal, is the second most populous of the nine South African provinces (StatsSA, 2011).

Primary data was obtained from the KZN provincial Department of COGTA and the secondary data was obtained from Global Insight. The data covers the period 1998Q1 to 2014Q4.

The following key variables were obtained disaggregated per quarter: Sanitation subsidy, Capital expenditure, Operational expenditure, and GDP. All the other variables were obtained aggregated to annual data. These variables were disaggregated from annual to quarterly data by applying a linear frequency conversion method. The linear method assigns each value in the annual time series to the last values of the quarter series' observations associated with the low frequency period, then places all intermediate points on a straight-line connecting all points. Therefore, the last observations are matched exactly to the annual time series.

Our study will therefore consist of 4 quarters in a year x 17 years (68 observations). Due to the nature of quarterly intervals data, adjustments for seasonality were performed on data using the ARIMA-SEATS model-based methodology.

Table 4: Data obtained and utilised in quantitative estimates

Variable	Definition	Expected impact
SS	Government size is a dependant variable of the total sanitation subsidy per quarter in billions of Rands	
$Govt_{capex}$	the portion of government expenditure that went towards capital spending per quarter in billions of Rands	Positive
$Govt_{opex}$	the portion of government expenditure that went towards operational spending per quarter in billions of Rands	Positive
Industry	Water and sanitation industry growth in KZN per annual GVA-R (Gross Value Added by Region) in billions of Rands. This indicator is used by both National & Provincial Treasury in the budget reports and for planning purposes (National Treasury, Budget 2015).	Positive
Urbanisation	The urban population indicator is used to indicate the level of urbanisation in KZN per annual. This indicator is used by both the national and provincial Departments of COGTA & municipalities in spatial planning and the medium term expenditure framework preparation every February and August and therefore, budget planning and preparation (National Treasury, MTEF Guideline 2015, COGTA Annual Report 2015)	Positive
GDP_{KZN}	Gross Domestic Product at constant 2010 prices per quarter is an economic indicator used to measure economic growth.	Positive
Pop	the size of the population in KZN Province per annual (GHS: StatsSA)	Positive
Backlog	the number of outstanding sanitation infrastructure per household per annual. The UN uses this variable as an indicator of the level of urbanisation and living standards (UNDP, Human Development Report, 2009).	Negative

Toilets	the number of households with access to type of sanitation/toilet per household per annual. The UN uses this variable as an indicator of the level of urbanisation and living standards (UNDP, Human Development Report, 2009).	Positive

Source: Created by researcher based on data obtained from KZN Department of COGTA and Global Insight.

1.5 Parameter Estimates

This sub-section of the chapter presents the estimated parameters and related statistics such as standard errors. The results from the estimated sanitation subsidy model are reported as follows (Also refer to Appendix, Table 5, page - 37 -):

Coeffic	*156*	*–*	*14.40*	*–*	*-*	*3.0684*	*-*	*-*	*–*	*14.40*	*0.044*	*-*	*-*	*–*	*0.00*	*-*	*2.93*	*2.1212*	*–0.8967*	*-*
ients	*9.21*	*0.1181*	*70*	*8.7597*	*137.8*	*Δ*	*7.62e*	*0.110*	*0.324*	*67*	*2*	*0.300*	*5.97e*	*8.840*	*95*	*140.9*	*10*	*lnGDPC*	*lnGDPC*	*7.38*
		ΔlnGC	*ΔlnG*	*ΔlnInd*	*116*	*lnGDP*	*10*	*0*	*1*	*lnGO*	*lnGCa*	*3*	*9*	*8*	*lnUrb*	*622*	*lnUr*	*apita$_{t-1}$*	*apita$_{t-4}$*	*e6x$_t$*
		apex$_t$	*Opex$_t$*	*ustry$_t$*	*ΔlnUr*	*Capita$_t$*	*lnGCa*	*lnGCa*	*lnGO*	*pex$_{t-1}$*	*pex$_{t-4}$*	*lnGO*	*lnIndu*	*lnIndu*	*an$_t^8$*	*lnUrb*	*ban$_{t-}$*			
					ban$_t$		*pex$_t^7$*	*pex$_{t-1}$*	*pex$_t^2$*			*pex$_{t-4}$*	*stry$_t^4$*	*stry$_{t-1}$*		*an$_{t-1}$*	*$_4$*			
SE	350.	0.01	1.42	2.85	32.63	0.65	0.00	0.00	0.03	1.41	0.00	0.08	0.00	2.89	0.00	32.74	0.51	0.43	0.29	0.00
	33																			
P	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05

N = 64, *d.f* = 19, *D.W = 1.52, R^2 = 0.99, Adj R^2 = 0.99, F(18,64) = 19719.19, Prob > F = 0.000*

The above results are the final results after removing all the correlated variables so that the t and F statistics tests make sense. The specified model is in a log-log form so that the elasticities can be read directly as percentages.

The results have proven that all the independent variables are individually significant at no higher than 5% level of significance. Furthermore, the overall model is statistically significant as can be illustrated by looking the F-statistic of 19719.19. These are all good indications for the explanation variables remaining in this model. After running the ideal model, this study found that the R^2 statistic, measuring the goodness of fit, is high at 0.99, which could be due to the high degrees of freedom. The adjusted R^2 is high at 0.99 after adjusting for the degrees of freedom. This means that at least 99% of changes in the sanitation subsidy are explained by all the explanatory variables together. While this may be a good thing, a very high R^2 can be suspicious and suggest misspecification errors, therefore, the DW statistic is compared to the R^2. The DW is higher than R^2 at 1.52, this is a good quality for our estimated regression as it means that the estimated regression may not be spurious. Furthermore, a DW statistic closer to 2 is within the reasonable bounds.

To address the problem of a very high R^2 a few more models with lesser lags were estimated, the R^2 though reduced, other worse problems were presented in the diagnostic statistics and autocorrelation. Thus, a second regression was estimated in pursuit of the best fit. On comparing the results of a similar regression, the difference is that the dependent variable, Sanitation Subsidy, is also differenced at first level. The findings were: the $R^2 = 0.91$ and DW = 1.65. While at face value, these are better results, looking at the descriptive statistics below in sub-section 5.10 it is clear which one is the better fit. Next an analysis of the better regression is performed (Refer to Appendix, Table 5, page - 37 -).

The estimated coefficients show that when the Q1 (quarter 1) is differenced to the Q2 (quarter 2) capital expenditure is negatively related to sanitation subsidy at 0.11% elasticity. However, the same cannot be said for operational expenditure as it increases sanitation subsidy at 14.40%, this is as expected. The estimated coefficients also show that after the first difference both the water and sanitation industry GVA (output) and urban population decrease sanitation subsidy by 8.75% and 137.81%, respectively. However GDP maintained a positive effect on sanitation subsidy even after the Q1 difference at an elasticity of 3.06%. All the corresponding standard errors are lower than the estimated coefficients, which is an indication of a good quality for the estimated regression fitting the true regression.

Further to autocorrelation correction of the explanatory variables the coefficients were estimated using a polynomial form of each explanatory variable to the power of eight, simply because in real life relationships between variables tend to follow a polynomial form. This was done to eliminate misspecification errors. The estimated coefficients show that urbanisation is positively related to sanitation subsidy at 0.01% elasticity. Furthermore, operational expenditure, capital expenditure and water and sanitation industry output are all negatively related to sanitation subsidy at 0.32% elasticity and 0.00%, inelasticity, respectively.

Finally the coefficients were estimated including four lags for each explanatory variable, representing the four quarters, to determine the effects of the exogenous variables on sanitation subsidy over the entire future time path. All the lags that were correlated were removed and only the remainder are estimated. The estimated coefficients suggest that after the first quarter, capital expenditure had a negative effect on sanitation subsidy at 0.11% elasticity, operational expenditure had a positive effect on sanitation subsidy at 14.40% elasticity, water and sanitation industry output had a negative effect on sanitation subsidy at 8.84% elasticity; urban population had a negative effect on sanitation subsidy at 140.96% elasticity and GDP per capita had a positive effect on sanitation subsidy. After the fourth quarter, operational expenditure had a negative effect of 0.30%, capital expenditure had a positive effect of 0.04% and GDP had a negative effect of 0.89%, on sanitation subsidy. The lagged coefficients and their signs clearly indicate the changes in effects on sanitation subsidy over the time

path. However, urbanisation indicated a 178.24% decrease in sanitation subsidy in quarter 1 and a slight inclination towards growth in sanitation subsidy of 2.93% in the fourth quarter.

The above results are inconsistent with Mann (1980), capital expenditure is at less than 1% elasticity and has a negative supply effect on sanitation subsidy, whereas operating expenditure has more than unit positive elasticity of supply at 14% on sanitation subsidy. Mann observes that the positive elasticity of supply of capital expenditure on government spending in Mexico is typical of developing countries, however, the elasticities were also found to be less than unit for consumption expenditure and therefore Mann paid very little attention to the effects due to the functional relationship being negligible.

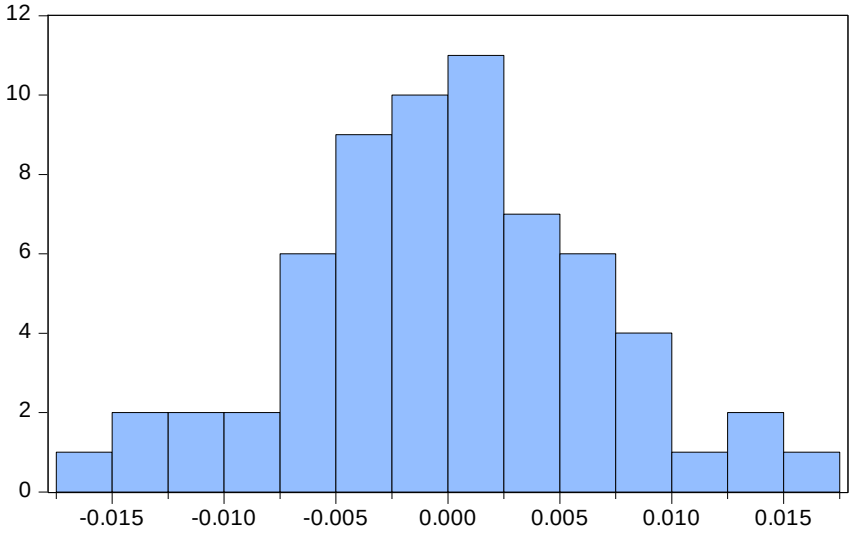
The results of this study suggest that government expenditure on basic sanitation is spent more on operational expenditure than on capital expenditure. The operational expenditure elasticities are larger than 10% and positive whereas the capital expenditure elasticities are less than 1% and negative. These results are consistent with Wagner's view that government provides for welfare needs, which increases government activities in the economy.

Urbanisation and industrialisation elasticities are both negative, which is inconsistent with Mann (1980) and Wagner's original work, with industrialisation at 8% and urbanisation at 140%. These results suggest that government activities in basic sanitation decrease due to growth in urbanisation which could suggest the limited resources supplied by government. Wagner warns about limitations on government spending due to the tax burden. The tax burden is better illustrated by the DSGE (dynamic stochastic general equilibrium) framework which is outside the scope of this study.

1.6 Descriptive Analysis

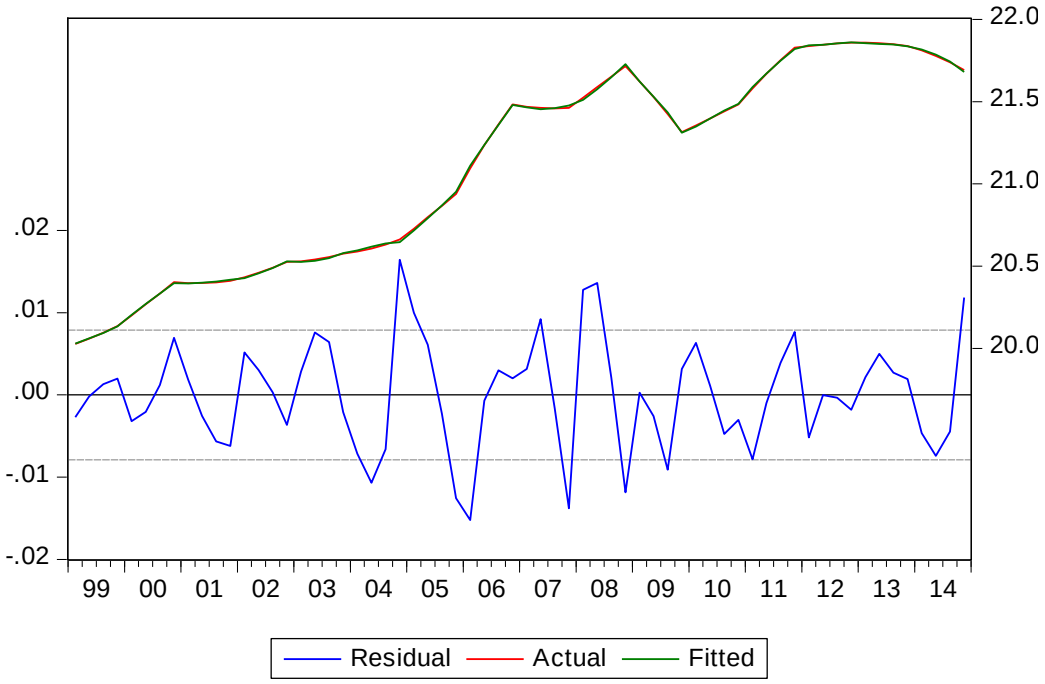
The purpose of this sub-section is to perform some diagnostic analysis of our estimated regression. The residuals of the estimated regression are generated and then analysed as follows:

Figure 4: Descriptive Statistics & Histogram and Residuals over time 1998Q1-2014Q4



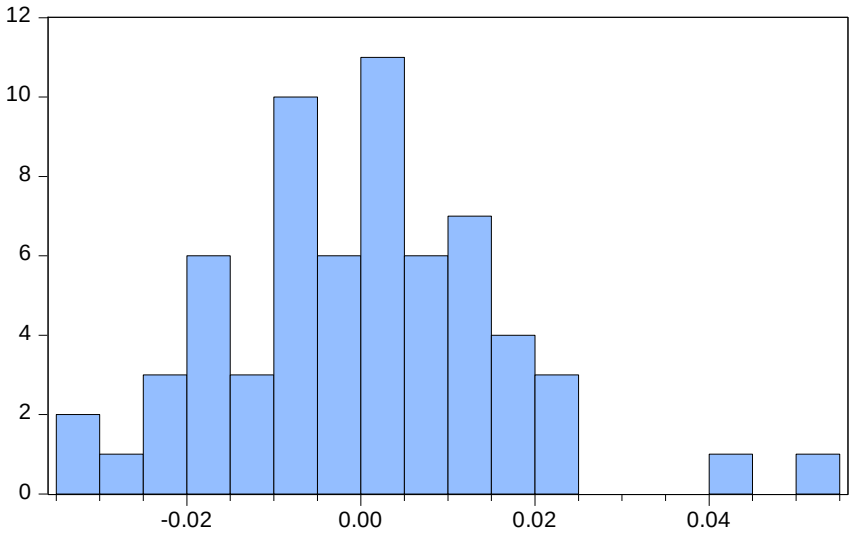
Series: Residuals
Sample 1999Q1 2014Q4
Observations 64

Mean	5.77e-14
Median	0.000129
Maximum	0.016437
Minimum	-0.015195
Std. Dev.	0.006590
Skewness	0.034881
Kurtosis	3.048597
Jarque-Bera	0.019276
Probability	0.990409

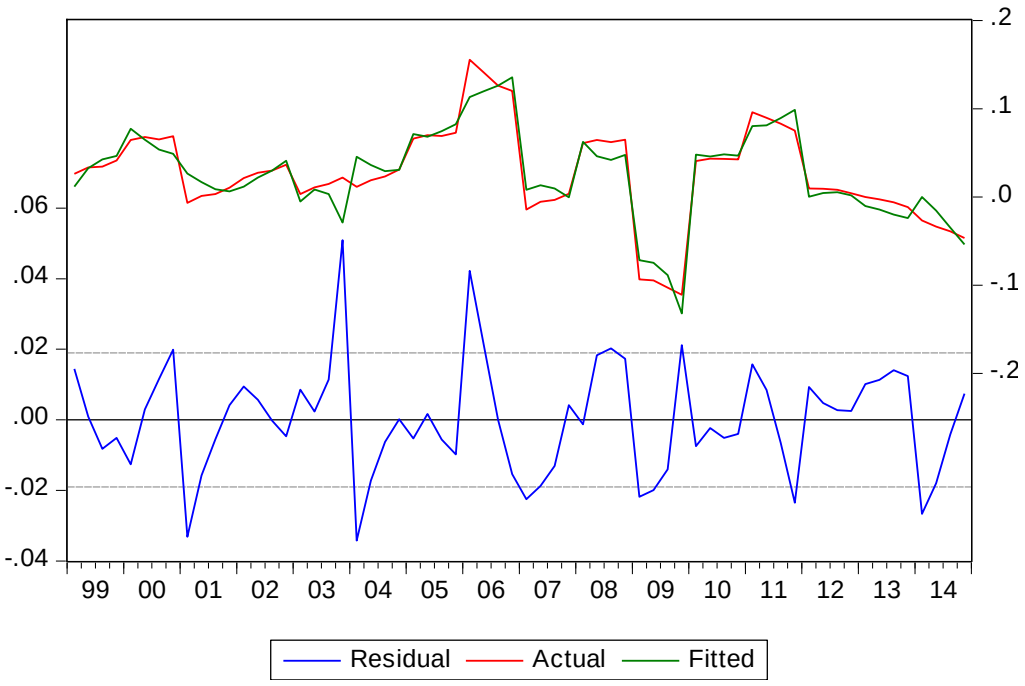


Descriptive Statistics & Histogram and Residuals over time 1998Q1-2014Q4 Source: Generated by the researcher from data utilised

The histogram of the generated residuals indicates that using the Gaussian normal distribution, the residuals are evenly distributed, converging towards zero and there are no outliers. The residuals plotted over time seem to show no pattern or trend which is a good indication of stability over time and a good fit.



Series: Residuals	
Sample 1999Q1 2014Q4	
Observations 64	
Mean	-1.79e-13
Median	8.35e-05
Maximum	0.050951
Minimum	-0.034162
Std. Dev.	0.015884
Skewness	0.406310
Kurtosis	3.968620
Jarque-Bera	4.262873
Probability	0.118667



Descriptive Statistics & Histogram and Residuals over time 1998Q1-2014Q4 Source: Generated by the researcher from data utilised

The descriptive results from the second regression seem to indicate that the residuals are not evenly distributed and there are outliers. Therefore the best regression for analysis is the one where the dependent variable has not been differenced.

Discussion

Industrialisation in South Africa dates back to between the 1930s and 1960s with the development of public enterprises such as Eskom, Iscor, Telkom, etc., to meet demand for infrastructure and services such as railways and harbours for transportation, electricity and telecommunications. Government

was therefore heavily involved in capital intensive projects which would mean that capital expenditure was very high. This would be in agreement with Adolph Wagner's view of state involvement and increased government expenditure in developing economies.

However, development and industrialisation in South Africa was not all inclusive. Some parts of the country remain underdeveloped. Thus, South Africa does not follow the typical stages of government spending as per Wagner's law.

Basic sanitation is a social or welfare need, which according to Wagner results from industrialisation followed by urbanisation. Government has a comparative advantage in the production and supply of welfare services.

The long run coefficient possesses a standard error of SE = 0.00 and the estimated coefficient is 0.00%. Furthermore, the long run effect is individually significant at 5.9% level of significance. The long run coefficient is negative indicating that in the long run, after all the shocks to the sanitation subsector, equilibrium is achieved. However, the response is very slow at a -0.00000738 pace.

The long run results are not surprising when one considers relentless demand for basic sanitation services in underdeveloped parts of KZN. Urbanisation is also increasing, resulting in housing backlogs. Thus, while Wagner's law may be applicable to most developing economies, the end is not in sight for the sanitation subsector in KZN provincial and local government. Government activities are increasing but the tax burden means that state resources are limited. The results of the study are supported by the view that applying first world solutions to third world problems is an ineffective approach. Each situation must be dealt with on its merit. So, while in the developed countries sanitation infrastructure was rolled out during the growth in industrialisation and urbanisation and economic growth and therefore the private-public partnership was commended, the same is not realised in the South African context.

Conclusion

The second objective of this study was to investigate the spill-over effects of the sanitation subsidy (expenditure) or government activities on output growth, industrialisation and urbanisation. Following Wagner's economic theory of government expenditure, Mann 1980's study was applied to estimate the long run equilibrium effects. The empirical evidence for the KZN case of sanitation expenditure showed that in the long run equilibrium is slowly approached. After all the shocks in the sanitation subsector output growth, industrialisation and urbanisation very slowly converged to equilibrium. Therefore, as the spill-over effects have proven, government's expansionary fiscal policy of high subsidy pay-outs in order to stimulate output growth and create employment in the long run is ineffective where sanitation subsidy is concerned. However, we have kept in mind that the main goals of a sanitation subsidy are to alleviate the burden of service delivery for the poor, address socio-economic inequity, improve health and hygiene and promote the environmental sustainability of sanitation systems.

Government investment on socio-economic infrastructure such as sanitation was believed by Wagner to increase industrial growth which leads to more welfare spending. This assumption is aligned to the results indication of the decline in capital expenditure and the incline in operational expenditure, however industrial growth is negative to changes in sanitation subsidies. Where government does not enjoy a comparative advantage in supplying infrastructure or service it is said that actually yields a negative impact on economic growth as this is a waste of limited resources and have a potential to displace existing water and sanitation industrial players (Bosch et al, 2002).

The sanitation infrastructure used in this study relates to the supply of toilets or hardware only and not urban networks, sewers and treatment plants. These were not included as the capital expenditure portion of the subsidy comes in a form of Municipal Infrastructure Grant and Urban Settlement Development Grant which are both aimed at poor households. So the results of the study are suggesting the ineffectiveness of the supply-side approach in to the lack of adequate sanitation scourge. A demand-driven approach, where infrastructure investments are made on increasing sanitation networks, sewers and treatment plants and hardware is left up to the users to build, at their preference and affordability, is preferred in assisting government to enjoy the comparative advantage in the supplying access to sanitation for all.

The study found that sanitation subsidy supply elasticity on operational expenditure was above 10%, 14% to be precise. Increased expenditure on the sanitation subsidy is thus directed towards operational expenditure. The operational expenditure subsidy, Equitable Share, comes from National Treasury, and is spent on the actual supply of sanitation services including salaries, operational costs, maintenance costs, and administrative and managements costs. The challenges confronting municipalities that were discussed in section three above include diminishing funds received from government, table 2 shows an increase in funds received from 2007 to 2014. The only exception is 2009 which coincides with the ripple effects of the global recession on the South African economy. This study did not investigate the issues of administration and management at municipal level. However, Tissington (2011) has identified inefficiencies as an issue.

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Appendix

Table 5: ARDL(p,r) to Estimate the Long Run Equilibrium Effects of Output Growth, Industrialisation and Urbanisation on Sanitation Subsidy. Results from EViews 8

Dependent Variable: SANITATIONSUBSID_D11
Method: Least Squares
Date: 11/14/16 Time: 15:11
Sample (adjusted): 1999Q1 2014Q4
Included observations: 64 after adjustments
SANITATIONSUBSID_D11 = C(1)+ C(2)*D(CAPEXINBIL_D11) + C(3)
*D(OPEXINBIL_D11) + C(4)*D(INDUSTRYGVA_D11) + C(5)
*D(URBANPOP_D11) + C(6)*D(GDPCAPITA_D11) + C(7)
*CAPEXINBIL_D11^7 + C(8)*CAPEXINBIL_D11 (-1) + C(9)
*OPEXINBIL_D11^2+ C(10)*OPEXINBIL_D11(-1) + C(11)
*CAPEXINBIL_D11(-4) + C(12)*OPEXINBIL_D11(-4) + C(13)
*INDUSTRYGVA_D11^8 + C(14)*INDUSTRYGVA_D11(-1) + C(15)
*URBANPOP_D11^4 + C(16)*URBANPOP_D11(-1) + C(17)
*URBANPOP_D11(-4) + C(18)*GDPCAPITA_D11(-1) + C(19)
GDPCAPITA_D11(-4) + C(20)(D(CAPEXINBIL_D11(-1))^2 +
D(OPEXINBIL_D11(-1))^2 + OPEXINBIL_D11(-4)^2 +
D(INDUSTRYGVA_D11(-1))^4+ D(URBANPOP_D11(-1))^2 +
URBANPOP_D11(-4)^2 + D(GDPCAPITA_D11(-1))^2 +
GDPCAPITA_D11(-4)^2 + CAPEXINBIL_D11(-2)^2 + OPEXINBIL_D11(
-2)^2 + INDUSTRYGVA_D11(-2)^4 + URBANPOP_D11(-2)^2 +
GDPCAPITA_D11(-2)^2 + CAPEXINBIL_D11(-3)^2 + OPEXINBIL_D11(
-3)^2 + INDUSTRYGVA_D11(-3)^4 + URBANPOP_D11(-3)^2 +
CAPEXINBIL_D11(-4)^2 + INDUSTRYGVA_D11(-4)^4 +
GDPCAPITA_D11(-3)^2)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1569.211	350.3343	4.479183	0.0001
C(2)	-0.118103	0.011646	-10.14069	0.0000
C(3)	14.40705	1.420546	10.14191	0.0000
C(4)	-8.759713	2.856425	-3.066670	0.0037
C(5)	-137.8116	32.63247	-4.223142	0.0001
C(6)	3.068454	0.652900	4.699728	0.0000
C(7)	7.62E-10	2.49E-11	30.65238	0.0000
C(8)	-0.110004	0.008061	-13.64629	0.0000
C(9)	-0.324100	0.034139	-9.493576	0.0000
C(10)	14.40671	1.418440	10.15672	0.0000
C(11)	0.044230	0.005213	8.484427	0.0000
C(12)	-0.300367	0.089568	-3.353505	0.0016
C(13)	5.97E-09	2.16E-09	2.761720	0.0084
C(14)	-8.840856	2.892038	-3.056964	0.0038
C(15)	0.009538	0.002276	4.189947	0.0001
C(16)	-140.9622	32.74749	-4.304518	0.0001
C(17)	2.931004	0.513034	5.713083	0.0000
C(18)	2.121217	0.431640	4.914319	0.0000
C(19)	-0.896757	0.296582	-3.023634	0.0042
C(20)	7.38E-06	3.81E-06	1.934992	0.0594

R-squared	0.999883	Mean dependent var	21.10585
Adjusted R-squared	0.999832	S.D. dependent var	0.608156
S.E. of regression	0.007886	Akaike info criterion	-6.597232
Sum squared resid	0.002736	Schwarz criterion	-5.922581
Log likelihood	231.1114	Hannan-Quinn criter.	-6.331453
F-statistic	19719.19	Durbin-Watson stat	1.522624
Prob(F-statistic)	0.000000		

Dependent Variable: D(SANITATIONSUBSID_D11)
Method: Least Squares
Date: 11/14/16 Time: 15:16
Sample (adjusted): 1999Q1 2014Q4
Included observations: 64 after adjustments
D(SANITATIONSUBSID_D11) = C(1)+ C(2)*D(CAPEXINBIL_D11) + C(3)
*D(OPEXINBIL_D11) + C(4)*D(INDUSTRYGVA_D11) + C(5)
*D(URBANPOP_D11) + C(6)*D(GDPCAPITA_D11) + C(7)
*CAPEXINBIL_D11^7 + C(8)*CAPEXINBIL_D11 (-1) + C(9)
*OPEXINBIL_D11^2+ C(10)*OPEXINBIL_D11(-1) + C(11)
*CAPEXINBIL_D11(-4) + C(12)*OPEXINBIL_D11(-4) + C(13)
*INDUSTRYGVA_D11^8 + C(14)*INDUSTRYGVA_D11(-1) + C(15)
*URBANPOP_D11^4 + C(16)*URBANPOP_D11(-1) + C(17)
*URBANPOP_D11(-4) + C(18)*GDPCAPITA_D11(-1) + C(19)
GDPCAPITA_D11(-4) + C(20)(D(CAPEXINBIL_D11(-1))^2 +
D(OPEXINBIL_D11(-1))^2 + OPEXINBIL_D11(-4)^2 +
D(INDUSTRYGVA_D11(-1))^4+ D(URBANPOP_D11(-1))^2 +
URBANPOP_D11(-4)^2 + D(GDPCAPITA_D11(-1))^2 +
GDPCAPITA_D11(-4)^2 + CAPEXINBIL_D11(-2)^2 + OPEXINBIL_D11(
-2)^2 + INDUSTRYGVA_D11(-2)^4 + URBANPOP_D11(-2)^2 +
GDPCAPITA_D11(-2)^2 + CAPEXINBIL_D11(-3)^2 + OPEXINBIL_D11(
-3)^2 + INDUSTRYGVA_D11(-3)^4 + URBANPOP_D11(-3)^2 +
CAPEXINBIL_D11(-4)^2 + INDUSTRYGVA_D11(-4)^4 +
GDPCAPITA_D11(-3)^2)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	978.4304	844.4220	1.158698	0.2528
C(2)	0.090347	0.028072	3.218409	0.0024
C(3)	-6.007314	3.423988	-1.754479	0.0863
C(4)	9.310648	6.884933	1.352322	0.1832
C(5)	-105.6687	78.65510	-1.343444	0.1860
C(6)	5.371820	1.573706	3.413483	0.0014
C(7)	2.05E-11	5.99E-11	0.342798	0.7334
C(8)	0.041982	0.019430	2.160687	0.0362
C(9)	0.146829	0.082286	1.784379	0.0813
C(10)	-6.346333	3.418912	-1.856243	0.0701
C(11)	0.008165	0.012565	0.649819	0.5192
C(12)	0.093592	0.215889	0.433518	0.6668
C(13)	-8.38E-09	5.21E-09	-1.609084	0.1148
C(14)	11.60264	6.970773	1.664470	0.1031
C(15)	0.006468	0.005487	1.178817	0.2448
C(16)	-92.96107	78.93233	-1.177731	0.2452
C(17)	0.370423	1.236582	0.299554	0.7659
C(18)	0.426952	1.040396	0.410375	0.6835
C(19)	-0.525301	0.714862	-0.734829	0.4663
C(20)	-1.88E-05	9.19E-06	-2.048433	0.0465

R-squared	0.910543	Mean dependent var	0.026429
Adjusted R-squared	0.871914	S.D. dependent var	0.053109
S.E. of regression	0.019007	Akaike info criterion	-4.837703
Sum squared resid	0.015896	Schwarz criterion	-4.163052
Log likelihood	174.8065	Hannan-Quinn criter.	-4.571924
F-statistic	23.57148	Durbin-Watson stat	1.647144
Prob(F-statistic)	0.000000		