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WATER IS THICKER THAN BLOOD

a study on water privatisation in South Africa

Abstract

As many countries have entered into privatisation schemes, the question of how and when privatisation can be successful is becoming increasingly important. Privatisation of water services has been a controversial and important discussion in the world since the 1980s, so also in South Africa. The aim of this thesis is to further examine the factors behind a municipality's decision to privatise and the subsequent effect on access to piped water and tariff level using cross-sectional data. The probability of privatisation has been evaluated using the Probit model and Ordinary Least Squares-method has been used to evaluate the subsequent effect of privatisation on access to piped water and tariff level. The results show that a privatisation decision might be influenced by employment rate. No evidence can be found of privatisation having any impact on infrastructure coverage or tariff level. Further research needs to be conducted to obtain results valid outside the scope of the sample.

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List of abbreviations

AMCOW	African Ministers' Council on Water
ANC	African National Congress
BOT	Build, Operate and Transfer
DWAF	Department of Water Affairs and Forestry
GEAR	Growth, Employment and Redistribution
IFC	International Finance Corporation
IMF	International Monetary Fund
NP	National Party
NRW	Non Revenue Water
OLS	Ordinary Least Squares
R	Rand
RDP	Reconstruction and Development Programme
Sida	Swedish International Development Cooperation Agency
SSA	Sub-Saharan Africa
UN	United Nations
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
WB	World Bank
WSA	Water Services Authority
WSP	Water Services Provider

Table of contents

- 1. Introduction.....4**
- 1.1 Objective 4
- 1.2 Global Water Resources 4
- 1.3 Water in South Africa.....4
- 1.3.1 Water Provision in South Africa 5
- 1.3.1.1 Institutional framework..... 6
- 1.3.1.2 Legislative framework 6
- 1.4 Water privatisation.....7
- 1.4.1 History of water privatisation7
- 1.4.2 Privatisation in developing countries; 1990 until today 8
- 1.4.3 Water privatisation in South Africa 8
- 2. Theory and empirical evidence.....9**
- 3. Methodology12**
- 3.1 Hypotheses.....12
- 3.2 Data 15
- 3.3 Models 16
- 3.4 Variables 18
- 3.4.1 Privatised 18
- 3.4.2 Access to piped water.....18
- 3.4.3 Tariff level 18
- 3.4.4 Conservative.....19
- 3.4.5 Employment..... 19
- 3.4.6 Income 19
- 3.4.7 Population density.....19
- 3.4.8 Informal dwelling..... 19
- 3.4.9 Water availability 20
- 4. Results and discussion20**
- 5. Conclusion26**
- 6. Future research suggestion.....27**
- 7. References.....28**

1. Introduction

1.1 Objective

The debate on water privatisation has been vivid; however, a regulated collaboration between the public and the private sector is believed to increase efficiency. The main objective of this study is to analyse the factors influencing a South African municipality's decision to privatise its water services and how such a decision influences access to piped water and tariff level. Further, the study aims to look at the process of privatisation and how the process affects the outcome. Lastly, the ambitious goal is to make a contribution to the current discussion on privatisation of water services.

1.2 Global Water Resources

Two-thirds of the earth's surface is covered by water. Of the two and a half per cent of total water resources made up by fresh water only one per cent is available for use (UNEP 2008). According to an estimation made by the United Nations Environment Programme (UNEP) two out of three people will experience water stress, below 1700 cubic metres of water per capita and year, by year 2025. Twenty-five countries in Africa alone are projected to experience water stress (UNICEF 2012). Water differs from other necessities as it is a scarce and excludable resource. Water infrastructure requires substantial and continued investments which creates considerable economies of scale and hinders competition (Covan, Noll & Shirley 2000). The United Nations (UN) estimates that eleven per cent of the world's population lacks access to an improved water source, defined as "less than one kilometer away from its place of use and that it is possible to reliably obtain at least twenty liters per member of a household per day". Due to programmes such as the UN's Millennium Development Goals significant improvements have been made in safe water access over the last two decades, with figures rising from seventy seven per cent in 1990 to eighty nine per cent in 2010. During the same period the use of piped water rose from forty five to fifty nine per cent. However, the increase in access is unevenly distributed between urban and rural as well as across continents. In Sub-Saharan Africa (SSA) forty per cent of the population still lacks access to an improved water source (UNICEF 2012).

1.3 Water in South Africa

As the 30th driest country in the world, receiving little more than half of the estimated world average annual precipitation of 950 millimetres, South Africa is exposed to threats of changes in seasonal rainfalls and other disturbances in the water supply (DWAf 2003, UNEP 2009, WCRP 2008). The country is using most of its available surface- and groundwater resources

and is classified as acutely water stressed by the UN (UN Water 2006). South Africa's National Water Research Strategy of 2004 projected demand to equal maximum sustainable water supply by 2025 if no action has been taken to reduce current demand and future consumption increase (National Treasury 2011). Severe droughts are affecting parts of the country leading to water shortages with considerable consequences not only for the population but also for the country's industrial- and agricultural output. Further, there is a serious concern regarding the contamination of water as acid water from exploited mines leaks into rivers. There are strict regulations on how to remove and treat acid water but problems often arise when rain water fills deserted mines and the mining companies can no longer be held responsible (Basson). An even more alarming issue might be the deterioration of the country's waste water infrastructure which causes sewage leaking into rivers before having been properly sanitised.

1.3.1 Water provision in South Africa

Following South Africa's transition from apartheid to democracy in the early 1990s the newly elected African National Congress (ANC) formulated a development programme to restore the financial system, eliminate poverty, increase employment, improve education and thereby give every South African equal rights and possibilities. The government presented the Reconstruction and Development Programme (RDP) to address the inequalities and backlogs in education, health care, housing, electricity and water. Twelve million South Africans were estimated to lack access to sufficient water and the programme emphasised the importance of everyone's right to a secure water supply (South African Government 1994, AMCOW, Turton, Meissner, Mampane & Seremo 2004). In 1996 the government introduced the Growth, Employment and Redistribution (GEAR) policy. A policy based on the neoliberal ideas that had been central also to the previous government. Growth was to be achieved through export, inflation control, and free-trade agreements as well as through privatisation of state-owned enterprises and reduce the role of the public sector (South African Government 2003). Today, ninety one per cent of the South African population has access to an improved water source, in South Africa defined as the source being "within 200 meters of dwelling" (National Treasury 2011). Neither the UN's definition nor the South African definition of access to an improved water source takes into account sustainability, quality or reliability of services but defines water access as having access to a water source protected from outside contamination. Despite the considerable effort aimed at improving infrastructure and reducing the high rate of nonrevenue water South Africa is still experiencing backlogs in areas neglected during apartheid (DWAf;b 1994). South African municipalities often lack

sufficient financial means and knowledge to ensure sustainability of operation, management and maintenance of water services (AMCOW). To address this, the minister of the Department of Water Affairs and Forestry (DWAF), Edna Molewa, and the Finance Minister, Pravin Gordhan, expressed a need for private sector participation during the 6th World Water Forum in 2012.

1.3.1.1 Institutional framework

The Department of Water Affairs is the “guardian” of South Africa’s water resources and is responsible for regulating and controlling the sector (DWAF 2003). The government owns the so called Water Boards, central to the provision of bulk and reticulation services as well as to the operation of infrastructure. Water Services Authorities (WSA) are defined as the local, metropolitan and district municipalities responsible for water provision. The constitutional obligation of the authorities is to provide water services for all within their boundaries. The WSA also nominates Water Services Providers (WSP). The WSP responsibility is the operation of bulk- or retail water services. The role of the WSP can, unlike the role of the WSA, be contracted out to an external provider such as a Water Board, a neighbouring municipality or a private actor (National Treasury 2011).

1.3.1.2 Legislative framework

Following the election in 1994 the government changed existing water laws and regulation. The new framework has been presented in the Constitution and in various acts and papers. The 1994 White Paper included a full cost-recovery plan, the water tariffs were to represent marginal-and capital costs, and the introduction of block tariffs (Morris, DWAF:a 1994). The Constitution established in 1996 states every South Africans fundamental right to access to sufficient and sustainable drinking water (South African Government 2009). The Water Services Act 108 of 1997 allows for cut-offs of water services due to non-payment under certain restrictions (DWAF 1997). The 1998 White Paper on Local Government includes different approaches of outsourcing services, including corporatisation, leases and concessions (South African Government 1998). Municipal Systems Act 32 of 2000 sets out the process of privatisation and opened up for extended private sector participation in municipal water services. Any actor, public or private, is eligible to provide services under the control of the municipality (South African Government 2000). The White Paper from 2000 draws on the 1998 White Paper on Local Government as it further lays out the framework for outsourcing municipal services. To reach the goals set out in the RDP on infrastructure expansion and elimination of inequalities the paper encourages municipalities to turn to the

private sector. The paper defines some of the possible contracts with the private sector as follows;

- Service contract: for a fee a service provider manages a specific section of services for a limited period of time, usually one to three years.
- Management contract: the provider is responsible for overall management of services but not for financing usually for a period of three to five years.
- Lease contract: The provider is responsible for overall management of services, commonly for a period of seven to fifteen years. The assets are leased to the provider for a fee, responsible for “operating, repairing and maintaining” of the assets.
- Build, Operate and Transfer (BOT) - contract: The provider assumes responsibility to “design, build, manage, operate, maintain, and repair “, at own cost.
- Concession contract: The provider pays a fee to assume “management, operation, repair, maintenance, emplacement, design, construction, and financing of a municipal service facility or system” (South African Government 2000).

1.4 Water privatisation

1.4.1 History of water privatisation

As the cities in Europe grew during the 19th century, so did the need for domestic water infrastructure. Contracts were entered between the state and the private sector where private actors were made responsible, not only for building, but also operating and management of water services. The private water sector is still dominated by the companies founded in 19th century Europe, such as the Compagnie Générale des Eaux (later Veolia) and Suez, first established as Lyonnaise des Eaux et de l'Éclairage. During the late 19th - and for most of the 20th century responsibility for provision of water services was increasingly assumed by the public sector as the interests of the private sector did not coincide with those most socially beneficial (Prasad 2007, Swyngedouw 2005). During the late 1970s and early 1980s neoliberalism, globalisation, commoditisation and privatisation became increasingly popular terms in political discussions. Public services such as water, electricity, postal services and waste collection were considered as candidates for privatisation. Margaret Thatcher in the United Kingdom, Ronald Reagan in the United States and the World Bank (WB) promoted privatisation across the world during the 1980s. Thatcher reintroduced privatisation to the water sector by giving the private sector, not only responsibility for operation and management, but also ownership of public water assets. France privatised through affermage where the private sector was contracted for operation and bill collection while the municipalities remained in charge of planning and investment (Prasad 2007).

1.4.2 Water privatisation in developing countries; 1990 until today

During the 1990s and through the 2000s privatisation became an increasingly common method used in the struggle to reach sustainable and effective water services in developing countries. A number of contracts were entered between the state and the private sector across Africa, Asia, Central Europe and Latin America including Guinea, India, the Philippines, Brazil, Bolivia and Argentina (Blanc & Botton 2012, Hall & Lobina 2002). In SSA contracts were entered with the private sector during the 1990s with a considerable increase of schemes towards the end of the decade. Countries including Tanzania, Cote d'Ivoire, Chad, Mali and South Africa all awarded private companies concession contracts and lease- and management contracts for provision of water (Bayliss 2001). A driving factor behind the global increase of schemes was the conditional loans and donations given by international finance institutions such as the International Monetary Fund (IMF), the WB and its private sector arm, the International Finance Corporation (IFC). Conditions often included privatisation of the receiving country's water services (Hall & Lobina 2002). The WB's ground for the conditional loans is the belief in the private sector's superior efficiency. The WB further regards the condition as a security for loans given (Prasad 2007). Several concerns have been raised as to the potential negative effect of privatisation, such as increased tariff levels, decreased water quality, lack of incentives for infrastructure expansion to the poor and corruptive behaviour of public authorities (Hall & Lobina 2002). The opposition to water privatisation from trade unions and citizens has been fierce which has led to prevention or cancellations of privatisation schemes in numerous countries including Paraguay and Brazil (Blanc & Botton 2012, Hall & Lobina 2002). Further, as water systems are natural monopolies, privatisation requires efficient regulation and monitoring of contracts. Weak institutions in developing countries often lack incentives and instruments to regulate the often powerful, international private companies (Guriev & Megginson 2005, Danwood, Mzikenge & Chirwa). Arguments for privatisation, in addition to increased efficiency, include public sector failures of maintenance and investment as well as a lack of sufficient technical skills in developing countries (DWAF 2012).

1.4.3 Water privatisation in South Africa

Although the National Party had considered privatisation of water, and other state assets, to improve finances during the 1980s the fear of intense protests and absence of pressure from the WB the government only entered into privatisation schemes in the years leading up to the 1994 election (Danwood, Mzikenge & Chirwa). A management contract was awarded Water and Sanitation South Africa (WSSA) in Queenstown and Stutterheim in 1992 and 1993

respectively. Another contract was awarded the same company for services in Fort Beaufort but due to the municipality's inability to pay the fee the contract was after disputes cancelled. After the transformation to democracy in 1994 the African National Congress (ANC) entered into additional contracts with the private sector, including a thirty- year concession contract signed in 1999 with Siza Water Company and five other companies for services on the Dolphin Coast in eastern South Africa. In the same year Sembcorp Silulumanzi was awarded a contract to provide water services in the Greater Nelspruit Area (Sembcorp Silulumanzi 2012). In 2001 the city of Johannesburg entered into a management contract with Suez Lyonnaise Des Eaux. The contract was not renewed after its expiration in 2006 (Johannesburg Water). The opposition, in unions and communities, to privatisation of water services in South Africa has been extensive and might have the limited number of privatisation schemes (Hall & Lobina 2002).

Definition of privatisation

Different forms of contracts all have different levels of private sector participation thus, influence, responsibility, risk- and control transfer (Danwood, Mzikenge & Chirwa). Due to the absence of right-out selling of assets the term privatisation might in the context of the South African water sector be interpreted not as a change in ownership but in governance. As all contracts with the private sector introduce competition, cost-recovery and change in efficiency to an extent, the term privatisation is in this thesis therefore broadened to include all private sector participation in water services provision (Ringskog & Idelovitch 1995).

2. Theory and empirical evidence

Theory on privatisation is extensive and dates back to Adam Smith and *The Wealth of Nations* from 1776. Smith states that selling of public land would bring immediate and future revenues to “the crown” as the land would “become well improved and well cultivated” (Smith 1904). Later theory supporting privatisation emphasises gains in allocative- and productive efficiency, labour productivity, partly due an increase in lay-offs, and a stronger private sector. Macroeconomic gains are to be achieved through a reduction in governmental subsidies, increased funds and revenues through taxes, granted the private firm indeed performs better (Sheshinski & López-Calva 2003). Theory predicts that a perfectly competitive economy has a trade-off between efficiency, and thus economic growth, and equity. As developing countries can be assumed not perfectly competitive, and producing at a point underneath the production possibility frontier, there is reduced trade-off between the two. Depending on this initial point of production, privatisation may increase both equity and

efficiency. However, arguments against privatisation emphasises the problems that may arise as the public sector's incentives and objectives might differ from the ones of the private sector. The public sector takes into account, what Sheshinski and Lopez-Calva in "Privatisation and Its Benefits: Theory and Evidence" call the "social view", the social marginal cost. Privatisation of the market failure that is created by a natural monopoly must therefore be combined with a competitive bidding process, reforms assessing corruption and closing of the gap between interests of the consumer and the private sector through regulation (Kirkpatrick, Parker & Zhang 2004). Efficient regulation including tariff level and required investments, constrains the private firm without preventing the sought effects of inclusion. As mentioned in the introduction, problems arise in developing countries when weak institutions without sufficient political determination and means must regulate the private sector (Guriev & Megginson 2005). Thus, the actual impact of privatisation, on factors such as tariff levels, might not depend primarily on privatisation per se but on the privatisation process (Birdsall & Nellis 2003).

Empirical evidence

The literature on likelihood and impact of privatisation is extensive and covers case- and econometrical studies. However, the evidence is often weak and inconclusive. In "A Duration Model Analysis of Privatisation of Municipal Water Services" Miralles (2009) uses panel data and a duration model to evaluate a municipal decision to privatise water services in Spain during a period from 1980 to 2002. The duration model allows Miralles to control for factors over a time t rather than, as in cross-sectional studies, at time t . The study finds that the motives behind privatisation changes with outside factors during the observed period. Miralles observes conservatives are more prone to privatisation in certain situations. The study also concludes that there is some evidence for the hypothesis of neighbouring municipalities having an influence on privatising decision due to initial economies of scale, called a "dynamic neighboring effect" (Miralles 2009).

Countries in Latin America were among the first to embark on privatisation on a larger scale. The study "Has Private Participation in Water and Sewerage Improved Coverage? Empirical Evidence from Latin America" by Clarke, Kosec & Wallsten (2004) was conducted on water infrastructure coverage following privatisation. The study included services in Argentina, Bolivia and Brazil. Data from household surveys spanning over several years was used and a general increase in infrastructure coverage was observed, with a noticeable increase also in poor areas. The increase could not be concluded to have been caused by private sector participation however (Clarke, Kosec & Wallsten 2004).

The study "Water privatisation in Africa: lessons from three case studies" conducted in Guinea, Cote d'Ivoire and Senegal found that labour productivity and water-metering had increased as well as tariffs and initially, bill collection. The number of connections had not increased as much as expected, partly because people could not afford the connection fee (Bayliss 2001). Further, funds from donors had been used for investments but the rate of non revenue water (NRW) remains high.

The "Water for Life: The Impact of the Privatization of Water Services on Child Mortality" by Galiani, Gertler & Schargrotsky (2005) highlights the importance of externalities resulting from an increase in access to piped water. The study is conducted in Argentina on waterborne diseases following the country's privatisation scheme in the 1990s. The study looks at impact of privatisation on variables such as "water leakages repaired per year" and "water network extension" by using a difference-in-difference approach. An increase in infrastructure coverage following privatisation could be observed with a subsequent decrease in child mortality, especially in poor areas (Galiani, Gertler & Schargrotsky 2005).

A case study emphasising the impact of regulation is "A Tale of Two Concessions" by Wu and Malaluan (2006). Conducted in Manila, the study evaluates performance of water services providers in the city before and after privatisation. The city was to be divided into two areas and contracts were to be awarded to two different companies for provision in respective parts by means of a competitive bidding process through lowest tariff level. External factors, such as political influence, regulatory structure and unforeseen events were thus controlled for. With the assistance of the IFC and the Asian Development Bank a twenty five-year concession contract was awarded Maynilad Company for the western part of the city and Manila Water was awarded a similar contract for the eastern part. A few years into the contracts Maynilad Company had gone bankrupt whereas Manila Water, after initial struggles, was profitable. The study concluded that the potential success of privatisation was not limited to external factors but internal factors must also be considered. Wu and Malaluan declare that the contract-awarding process as well as the regulation can influence governance. The process of contract negotiations is also important for the potential success of privatisation. Clarke, Kosec and Wallsten (2004) argue a high number of renegotiations of contracts, as was the case of privatisation in Guinea, Cote d'Ivoire and Senegal, are problematic as they undermine the bidding process.

3. Methodology

3.1 Hypotheses

The hypothesised effects of the independent variables on the dependent variables; privatised water services, access to piped water and tariff level are discussed below. Literature is referred to when applicable.

Factors hypothesised to influence likelihood of privatisation

The first column in Table 1 on page 15 represents the first regression on likelihood of privatisation.

Hypothesis 1: Ideology - a conservative steering party increases the probability of privatisation of municipal water services

The reviewed literature on the impact of political ideology is inconclusive. Menard and Sussier (2000) emphasise the economic importance of choice of governance. However, the study by Miralles in 2009 (see Section 2) found conservatives to be more prone to privatisation when no other alternatives could be agreed upon. It is likely that other factors dominate ideology, as was arguably the case in South Africa following the end of apartheid when rapid improvements in water services were necessary in neglected areas.

Hypothesis 2: Employment - a high employment rate increases or decreases the probability of privatisation of water services

Privatisation might be equal parts a political and economical discussion. Privatisation is in theory and empirics is often associated with gains in worker productivity, partly due to lay-offs. If the employment rate is high, politicians with a time horizon not exceeding the next election might be more willing to risk a decrease in the employment rate and therefore select to privatise. Such a decrease will have a negative impact on the municipality's total income. However, the impact on overall municipal employment, and thus income level, might be marginal and only decrease short-term employment rate (Sheshinski & López-Calva 2003). Conversely, a low employment rate is arguably a proxy variable for financial distress. From a municipal point of view, the opportunity cost of public funds is high in times of financial distress whereas the opposite is true for times of reduced financial distress. A low opportunity cost decreases the likelihood of a municipality having privatised services (Auriol & Picard). From the perspective of the private sector however, economic uncertainty would reduce the likelihood of entering into an agreement with the public sector for two reasons mainly. First of all a public sector in financial distress might not have secure funding for such a scheme and second of all the willingness of the private sector to invest in new schemes in times of

uncertainty is arguably lower than in times of financial boom. It is difficult to predict which of the mentioned effects is dominant.

Hypothesis 3: Population density- a densely populated city increases the probability of privatisation of water services

The potential revenue in a densely populated city is higher per metre of piping, making private sector interest more likely. On the contrary, high population density might be indicative of a larger city. It is likely that larger cities attract more skilled politicians with internal instruments to utilise to improve services rather than privatisation. The positive effect of potential revenue is believed to be the prevailing however.

Factors hypothesised to influence access to piped water

The second column in Table 1 below represents the second regression that will be run on access to piped water. The variable of main interest is privatised.

Hypothesis 4: Privatised- privatised water services increases access to piped water

The literature reports privatisation as having varying effects on infrastructure coverage, often believed to be dependent on incentives and regulation. The hypothesis is an increase in access to piped water for two reasons mainly. Firstly, increased infrastructure coverage leads to increased revenue in financially profitable areas which is an incentive for private firms to invest in infrastructure (Auriol & Picard). Secondly, as concern has been raised as to the public sector's competence to maintain and expand infrastructure in South Africa the municipalities might be inclined to involve the private sector for technical assistance (AMCOW).

Hypothesis 5: Income and income squared- higher income increases access to piped water

Persons with higher income will to a larger extent pay the fixed cost of connection. Further, investments in infrastructure can be financed by tariffs to a larger extent in high-income areas (Auriol & Picard). The income effect is expected to decline with higher levels of income.

Hypothesis 6: Population density- a high population density increases access to piped water

For every metre of piping a larger number of persons gain access to piped water in densely populated areas compared to the ones with lower population density. Potential revenue is therefore higher in densely populated areas and costs for maintenance and investment per metre of piping per person is lower. The incentive for investments in infrastructure in a highly populated area must thus be higher than in the opposite. It should be noted however that as the size of a city grows so does the likelihood of illegal connections and levels of NRW and risking the financial sustainability of services.

Hypothesis 7: Informal dwelling- a large number of informal dwellings increases access to piped water

Informal dwelling can be expected to be positively correlated with population density. In areas with a large number of informal households the cost per connection is drastically reduced. However, backlogs have historically been a problem in areas with a large number of informal dwellings and backlogs are still prevalent. The actual impact is difficult to predict.

Factors hypothesised to influence tariff level

The third column in Table 1 below represents the third regression that will be run on tariff level. The variable of main interest is privatised.

Hypothesis 8: Privatised- privatised water services leads to a higher tariff level

The reviewed literature, including Bayliff's study in Africa in 2001, establishes a positive correlation between privatisation and higher tariff levels. The hypothesis is thus a higher tariff level in municipalities with privatised water services. Theory predicts that both sectors have a competitive advantage; the public sector through not paying governmental fees and taxes and the private sector through specialisation and gains in efficiency. However, the private sector has incentives different to the ones of public sector to recover full cost of production and maximise profit. The public sector must weigh attempts to recover cost with a tariff level that is socially beneficial. The predicted increase is dependent on the initial level of the municipality's cost-recovery, the contract and the regulation.

Hypothesis 9: Population density- high population density leads to a lower tariff level

The argument for a decrease in tariff level in densely populated areas follows the arguments made in hypotheses 3 and 7 for the probability of privatisation and infrastructure coverage respectively. A larger number of people share the cost of operation, the cost per tap and household is reduced, and thus tariff level to recover costs.

Hypothesis 10: Water availability- availability of water leads to a lower tariff level

According to DWAF recommendations, tariffs are to be set higher in areas with poor water availability to control demand. The cost of dams and extraction will increase if water is scarce as will the required investments, skill and research. Presumably, an area with a ratio of rainfall to runoff below average requires higher levels of these three factors compared to an area with an above average ratio. Higher cost of operation is expected to have a positive influence on tariff level (Ménard & Saussier 2000).

To summarise, three regressions will be run with privatised water services, access to piped water and tariff level as the dependent variables. The aim of the first regression is to evaluate

the probability of a municipality having private water services. The second regression seeks to assess the relationship between privatised water services and access to piped water. The third regression will estimate privatised water services impact on water tariffs. Below follows a summary of the hypothesised signs.

Table 1 Hypotheses

Independent variables	Privatised	Access piped water	Tariff level
Privatised	-	<i>positive</i>	<i>positive</i>
Conservative	<i>positive</i>	-	-
Employment	<i>positive</i>	-	-
Income	-	<i>positive</i>	-
Income^2	-	<i>negative</i>	-
Population density	<i>positive</i>	<i>positive</i>	<i>negative</i>
Informal dwelling	-	<i>negative</i>	-
Water availability	-	-	<i>negative</i>

3.2 Data

Data has been collected during a three-month field study in Cape Town, South Africa from January to April of 2013. The main data set has been obtained through DataFirst at the University of Cape Town. The data is derived from the 2007 Community Survey, a ten per cent random sample survey conducted in February of 2007 by Statistics South Africa. The survey covered all nine provinces and is the latest nationwide survey available at the time of the study (Statistics South Africa 2007). The survey questions include household characteristics such as income, information on type of dwelling and access to basic services.

Of South Africa’s approximately 230 local municipalities, 101 are included in the study. In 82 of the local municipalities water services are public and 19 have entered into contracts with private actors. Information regarding private sector participation is obtained through the local municipalities as well as through contact with contracted private companies. All public municipalities where the WSP has been verified are included. Due to the limited private sector participation in the water services sector all municipalities with confirmed contracts with the private sector before February of 2007 are included. As a few contracts were initiated in January 2007 it is likely the results underestimate the possible effect of privatisation of water services. The selection of municipalities is a cause for concern as the

decision to privatise in the observed municipalities might be correlated with some unobserved characteristic affecting probability and impact of privatisation (Wooldridge 2008).

The result of the 2006 Municipal Election has been provided after contact with the independent Electoral Commission (Electoral Commission 2012). Due to data limitations figures on tariff levels dates from July 2011 to July 2012 and is collected through annual municipal reports. Data on tariff levels is only available for 50 of the 101 municipalities. Figures on aridity are obtained through UNEP. As the figures on aridity are on provincial level the variables explanatory value can be considered relatively weak but as water availability is expected to be important the variable is included (UNEP 2006). A summary of the data follows in Table 2 below.

Table 2 Descriptive statistics

	Observations	% of sample		
Privatised	101	18.8		
Access piped	100	60.9		
Conservative	101	5.6		
Employment	101	48.7		
Informal dwelling	101	9.4		
Water availability	101	18.5		
	Mean	Standard deviation	Minimum	Maximum
Tariff	137.9	86	37	436
Population density	63.4	101.3	1	747
Income	7256	4811	1341	35706

3.3 Models

The Probit model

The explanatory variable of privatisation is a binary variable, taking on the value of 0 or 1, the Probit model is used. The Logit model and the Probit model are both extensively used to evaluate the marginal effects of explanatory variables on a dependent binary variable. Despite the two models similarity the Probit model is often preferred by economists, partly because of the Probit model's assumption of normal distribution of the errors. The Probit model produces robust estimates and enables controlling for factors affecting privatisation (Wooldridge 2008). The parameters will be estimated using the maximum likelihood of success. The interpretation will be the maximum likelihood of privatisation given the three independent variables of

conservative, employment and population density. Below is the true model on which the regression will be run where $\Phi(\cdot)$ refers to probability and Φ is the Cumulative Distribution Function of the standard normal distribution.

$$\ln(\text{tariff}_i) = \beta_0 + \beta_1 \text{priv}_i + \beta_2 \text{income}_i + \beta_3 \text{income}_i^2 + \beta_4 \text{popden}_i + \epsilon_i$$

Ordinary Least Squares method

The Ordinary Least Squares (OLS) method is suitable to evaluate the effects of privatisation on the continuous variables of tariff level and access to piped water while controlling for other factors (Wooldridge 2008). The regressors hypothesised to influence access to piped water are privatised, income, income² and population density. Below is the true model on which the regression will be run.

$$\ln(\text{tariff}_i) = \beta_0 + \beta_1 \text{priv}_i + \beta_2 \text{income}_i + \beta_3 \text{income}_i^2 + \beta_4 \text{popden}_i + \epsilon_i$$

The third and final regressors, expected to influence tariff level, are privatised, population density and water availability. Below is the true model on which the regression will be run.

$$\ln(\text{tariff}_i) = \beta_0 + \beta_1 \text{priv}_i + \beta_2 \text{popden}_i + \beta_3 \text{water}_i + \beta_4 \text{water}_i^2 + \epsilon_i$$

Caveat

To enable the study there are some cautions and assumptions to be observed, apart from the assumptions implied by using the Probit model and the OLS method. First of all, a few issues arise as the data set is cross-sectional as a cross-sectional study only enables an analysis of why services are privatised at time *t*. Although the contracts have been entered over a twenty year period the privatisation decisions need to be evaluated as if made at the time of the survey, based on steering party, employment rates and population density at that time. Therefore the rather strong assumptions must be made of a continuous privatisation decision by steering politicians (Miralles 2009). In practice the option to reverse a privatisation

decision is highly unlikely. It follows that the impact of the independent regressors on access to piped water and tariff levels at time t must be assumed to have been a result of privatisation. Secondly, it is difficult to with certainty claim despite statistical significance, that privatisation is the cause of an observed difference in access to piped water and tariff level. The issue of reverse causality is to be discussed further as the results are presented.

3.4 Variables

Dependent variables

3.4.1 Privatised

Privatised is a binary variable taking on the value of 1 in case of “success”, private water services, and the value of 0 in case of public water provision. As mentioned above the assumption of a continuous privatisation decision in the municipalities must be made (Miralles 2009). Further, the variable might not estimate probability and impact of privatisation as a number of contracts were entered only a few months before the survey was conducted. This might be especially important to consider when analysing the impact of privatisation on access to piped water.

3.4.2 Access to piped water

The dependent variable in the second regression is access to piped water, measured as the ratio of the number of people with access to piped water and total population in each municipality. More than ninety per cent of the South African population has access to piped water according to the country’s definition (National Treasury 2011). To enable a comparison between public and private services the definition of availability in the study is therefore restricted to tap being inside dwelling or yard. An increase in access to piped water is associated with many positive externalities. High infrastructure coverage not only drastically reduces time spent to collect water but also affects factors such as the risk of spreading of waterborne diseases and reduces child-mortality (Galiani, Gertler & Schargrotsky 2005). To estimate the impact of privatised water services on access is thus important, not only from an economical perspective.

3.4.3 Tariff level

Tariff level is a continuous variable based on data from each municipality on its tariff level from July 2011 to July 2012. The pricing of water is very complex for several reasons, not least because water is a natural resource and a necessity. As water tariffs in South Africa are to be charged in increasing block rates to control demand, the average water bill per month for an average sized household has been calculated for each municipality, using average normal consumption of 250 litres per person and day for the average household of 3.6 people

(Statistics South Africa 2007, DWAF;b 1994). The calculation will enable a tariff comparison between public and private service delivery regardless of household consumption and household size. It is difficult to draw any conclusions on a causal relationship between tariff level and privatisation as a possible increase in the former might not be due to private sector participation but rather due to corruptive behaviour during the contract awarding process. Tariff levels determine not only if access to piped water is affordable but also the consumption pattern of the population. Higher tariff levels are expected to reduce consumption, which makes tariff setting an important tool for the local governments in the water scarce country of South Africa. More aggravating, a high tariff level might induce household to choose to not connect to piped water but rather to use an unsafe water source. An attempt of evaluating the impact of privatised services on the dependent variable of tariff level is therefore of high importance.

3.4.4 Conservative

Conservative is constructed as a binary variable taking on the value of 1 if the municipal steering party is conservative and 0 for all other ideologies.

Socio-economic variables

3.4.5. Employment

The continuous variable of employed is based on data on the employment rate in every municipality. Employed has been extended to include all options in the survey except "unemployed", that is "employed" and "not economically active".

3.4.6. Income

Income is constructed as an ordinal variable, taking on the value 1, "low" to 12, "high". The variable is also included as squared to enable observation of the change in piped water access as income increases. Income is included to control for the difference of infrastructure coverage in high-and low income municipalities that is not due to privatisation.

3.4.7 Population density

The continuous variable has been constructed by dividing municipal population figures from the 2011 Census survey by its municipal area, measured in square kilometres (Statistics South Africa 2011).

3.4.8 Informal dwelling

The continuous variable of informal dwelling is based on the number of informal dwellings in every municipality (Statistics South Africa 2007).

3.4.9 Water availability

Water availability is constructed as a binary variable taking on the value of 1 for a ratio rainfall to runoff above average and the value of 0 for a below average ratio. It would be preferable to have access to continuous or ordinal data but only binary data has been obtained. Further, data on water availability has only been obtained on provincial level which will affect the validity of the variable (UNEP 2006). According to UNEP, South Africa is at risk of being among the countries to be most severely affected by climate change (UNEP 2013). Water availability is therefore believed to be an important driver of cost and included despite limitations in data.

Factors not included in the analysis

It is not possible to control for all the factors influencing a municipality's decision to privatise, partly due to limitations in data and partly due to the variable being unobservable. Some of the excluded, but believed influential, factors are listed below.

An important factor in determining impact of privatisation is quality of services, measured as number of stops per month and time for reparation. However, there were no questions on interruptions in the 2007 Community Survey.

A factor behind privatisation in other countries has been pressure from the WB and other international organisations (see Section 1).

The age of the infrastructure can be expected to determine cost of investments, accessibility and quality of services.

Labour movements hold a strong position in South Africa and have had a negative effect on the probability of privatisation (see Section 1).

Lastly, theory and literature have emphasised the considerable impact of internal factors on the performance of water services providers. The culture and governance in municipalities as well as in private companies highly influence the outcome (for example, see Wu & Malaluan in Section 2).

4. Results and discussion

The results below show the probability of privatised services and privatised services subsequent impact on access to piped water and the tariff level conditional on certain independent variables at the point of time of the survey. The coefficients of the regression on probability of privatisation are estimated using marginal effects. The second and third regressions on access to piped water and tariff level respectively are included with robust and

non-robust standard errors. The robust standard errors in regression 3 should be interpreted with caution however as only 50 municipalities are included in the regression.

Table 3 Water privatisation in South Africa

	Regression 1	Regression 2	Regression 2	Regression 3	Regression 3
	Probit marginal effects	OLS non-robust st. err.	OLS robust st. err.	OLS non-robust st. err.	OLS robust st. err.
Independent variables	Privatised	Access piped water	Access piped water	Tariff level	Tariff level
Privatised	-	7.83×10^{-7}	7.83×10^{-7}	0.00086	0.00086
	-	(0.502)	(0.353)	(0.889)	(0.862)
Conservative	-1.83×10^{-6}	-	-	-	-
	(0.976)	-	-	-	-
<i>Socio-economic variables</i>					
Employment	0.0000948	-	-	-	-
	(0.077)*	-	-	-	-
Income	-	-2.95×10^{-6}	-2.95×10^{-6}	-	-
	-	(0.001)***	(0.000)***	-	-
Income ²	-	3.67×10^{-7}	3.67×10^{-7}	-	-
	-	(0.002)***	(0.005)***	-	-
Population density	0.0007968	-0.0000411	-0.0000411	0.39	0.39
	(0.156)	(0.089)*	(0.010)***	(0.000)***	(0.000)***
Informal dwelling	-	6.87×10^{-6}	6.87×10^{-6}	-	-
	-	(0.368)	(0.261)	-	-
Water availability	-	-	-	-0.018	-0.018
	-	-	-	(0.039)**	(0.013)**
Municipalities	101	100	100	50	50

Explanation: in parentheses standard error:***significant 1%,**significant 5%,*significant 10%

Results of regression on privatised water services

The first regression was run on the probability of a municipality having privatised services using a Probit model. As Miralles (2009) remarks, a rather strong assumption of a constant decision-making on privatisation is required to determine why municipal services were privatised at the time of the survey. That is, a politician has the option of reversing a decision to privatise, which is not always possible in practice. The first regressor is conservative. The coefficient is negative, contrary to the predicted. The coefficient implies that conservative generates a lower likelihood of a municipality having privatised water services by 1.83×10^{-6} percentage points. However, the coefficient is insignificant and the hypothesis of conservative having an impact on likelihood of

privatisation is rejected in the regression. Thus, no conclusions can be drawn on ideology having any influence on likelihood of privatisation in the sampled municipalities. This is conclusive with several studies where only a few indications of privatisation being more or less likely in conservative municipalities have been found (Miralles 2009, Ménard & Saussier 2000).

The second hypothesis of employment having an effect on likelihood of privatised water services is not rejected. The coefficient on employment is positive and significant at the 10 per cent level. The positive and significant coefficient indicates that at the time of the survey employment rate had a positive impact on the probability of privatisation in the sampled municipalities. The second hypothesis predicted two different effects of high employment rates, one positive and one negative. It would seem the first prediction, of politicians being more willing to privatise if employment rates were high, dominated the hypothesis of opportunity cost in this sample of municipalities at the time of the survey. The evidence should be viewed with caution however as the coefficient is only significant at the rather weak 10 per cent level.

The third hypothesis predicted population density has a positive impact on probability of privatisation. The coefficient is positive but not statistically significant. In the sample of municipalities, population cannot be claimed to have affected the likelihood of privatisation.

Results of regression on access to piped water

The second regression was run on access to piped water using the OLS method. The independent variable of privatised is of main interest. The coefficient was hypothesised to be positive according to theory's prediction and empirical evidence of private sector's different incentives to those of the public. The resulting coefficient implies that privatised services, holding the other independent factors constant, would increase the number of people with access to piped water by $7.83 * 10^{10}$ persons per square metre. The small coefficient constitutes a marginal economic significance. The estimated coefficient is positive, however, the result does not support the hypothesis as the coefficient is insignificant. Thus, in the sample, the municipalities with privatised water services were at the time of the survey not associated with increased infrastructure coverage. The result does not follow the conclusion on increased infrastructure coverage due to privatisation made by Galiani, Gertler and Schargrodsky (2005) in the study on child mortality.

The coefficient on income is negative, contrary to the hypothesis. The coefficient is significant at the 1 per cent level. In this sample, increased income leads to a

decrease in infrastructure coverage, which is not the expected outcome and inconclusive with previous evidence obtained by Bayliss (2001) of a positive relationship between income and piped water. The coefficient on income squared is positive, which is the opposite sign of the hypothesised. The coefficient is significant at the 1 per cent level.

The third variable, population density, was expected to be positive as cost per metre of piping decreases with increased density. The null-hypothesis is rejected as the negative coefficient is statistically significant, albeit just, at the 10 per cent level. In the sample of municipalities at the time of the survey, population density had a negative impact on the number of connections. The evidence is weak however and the economic importance is marginal.

The fourth and last independent variable is informal dwelling. The hypothesis was inconclusive on the effect of informal dwelling on access to piped water. The estimated coefficient is positive but insignificant. Thus, the number of informal dwellings cannot be concluded to have any impact on infrastructure coverage in the sampled municipalities.

Results of regression on tariff level

The dependent variable of the third regression is tariff level and estimated using the OLS method. The main independent variable of interest is privatised, as in the second regression. The hypothesis, drawn on theory and literature, predicted a higher tariff level in municipalities with private water services. The regression produced a positive variable implying a tariff level increase by R 0.00086 if private water services provision, holding the other factors constant. The economic significance is again marginal. Assuming a municipality with private water services, water availability above average and population density at mean would be associated with a tariff increase by 0.0035 per cent relative to the base group of public water services provision. However, the variable is insignificant. The null-hypothesis of privatised having no impact on tariff level is not rejected in this study. Thus, in the sampled municipalities, empirics do not coincide with theory and no conclusion can be drawn of an impact of privatised water services on tariff level.

The second regressor, population density, was expected to have a negative impact on tariff level. The estimated coefficient is significant at the 1 per cent level. The hypothesis of population density affecting tariff level can thus not be rejected. Contrary to the hypothesised negative effect, the impact is positive. For the municipalities included it can thus be concluded that the tariff level for an average household with a normal monthly consumption of water increases as population density increases.

The third and last independent variable is water availability. Hypothesis 10 predicted a negative impact on water tariff due to lower cost of “production”. The hypothesis is not rejected; the estimated coefficient is positive and significant at the 5 per cent level. Above average water availability has a negative impact on tariff level in the sampled municipalities.

Discussion

The first regression assessed what factors influenced the likelihood of the sampled municipalities having privatised water services at one point in time. The second and the third regression evaluated the difference between the sampled municipalities with privatised water provision and the sampled municipalities with public services, at one point in time. The results are to various extents in line with theory’s prediction, empirical evidence and the hypothesised effects. Several variables were insignificant and no impact on the dependent variables could be concluded. Further, the economic impact of the significant variables can be questioned.

Some caution should be taken when interpreting and applying the results. First of all, it is important to note the difficulty in comparing performance of services provision between the public sector and the private. The two sectors act under different laws and regulation, which has been concluded to highly influence privatisation schemes.

Secondly, the independent variables included in the regressions are very limited. The aim of the first regression was to predict the impact of conservative, employment and population density on the likelihood of privatisation, where only employment was statistically significant. Holding privatised constant, it is highly likely a variable such as economic shock influences both a potential decision to privatise and the variable of employment rate. The same can be argued for the second regression where the omitted variable of topography is likely to be a driver of both access to piped water and water availability. In regression three, most of the variation in dependent variables cannot be explained by income, informal dwelling and population density. It is probably that factors such as age of infrastructure and quality of water is correlated to both privatised and tariff level. The unobserved factor of regulation is also believed to influence infrastructure coverage, tariff level and several of the regressors. To omit causal variables produces a positive or negative bias in one or several of the included regressors. It is possible to determine the direction but not the size of the bias. For instance, the variable of employment is expected to be negative biased due to the exclusion of the variable economic shock. Economic shock has arguably a positive influence

on a privatisation decision as the opportunity cost of public funds increases in times of financial distress. Further, economic shock is likely negatively correlated with the variable of employment rate. Omitting the variable of economic shock thus causes the included variable of employment to be too small on average. Determining the direction of a bias is only a solution to some extent, to get an accurate coefficient would require further data, either on the variables omitted or if such data is unavailable; suitable proxy- or interaction variables.

Thirdly, it is further difficult to conclude that privatisation causes no actual improvement in access to piped water or that privatisation of water services has no impact of tariff level. As it is in the political interest to privatise municipalities where it would be most beneficial but in the private sector interest to invest in a municipality with high infrastructure coverage, a positive coefficient in regression two might be due to reverse causality. Thus, an estimated positive effect of privatised services on infrastructure coverage cannot be determined to be caused by privatisation of services. There are at least two issues present in this study that requires assessment before any causal relationship between the independent and the dependent variables can be claimed. The first is a careful selection process to enable a comparison between municipalities with similar characteristics. The municipalities included have not been selected on the basis of characteristics but rather on information available due to time constraint, which is likely to have caused a selection bias. The second solution would be to use a large data set which would enable controlling for multiple variables likely to influence the dependent variables (Guriev & Megginson 2005). The two alternatives above, by themselves or combined would produce less biased results. As this study includes neither of the two the results should be interpreted and implemented with caution.

Lastly, as mentioned above the obtained results coincide to varying degrees with the ones predicted by theory and empirical evidence. The variables of main interest; conservative in the regression 1 and privatised in regression 2 and 3 were all insignificant. Thus, no conclusion can be made on any impact of the three independent variables on the respective dependent variables. The findings of this study are to some extent applicable to the limited number of sampled municipalities. Validity outside the premises unique to this study is difficult to argue. Further studies are required to potentially find and establish a significant, causal relationship between factors influencing a decision to privatise and the subsequent impact. Evidence is important as access to piped water brings countless benefits just as an increase in tariff level might bring an equal number of disadvantages for the population. Access to piped water brings great externalities through reduced risk of spreading of waterborne diseases as well as a lower rate of child mortality (Galiani, Gertler &

Schargrodsky 2005). A high tariff level might exclude people from access (Bayliss 2001). A discussion on privatisation might therefore be altogether above that of both political and economical arguments.

5. Conclusion

Despite an increasing world population effectively reduces the amount of water per person, access to sufficient water remains a local and not a global issue. Over the last decades governments have in attempts to address severe backlogs in water infrastructure and costly subsidies converted water from being a human right to a commodity. People across the all continents have been left relishing the benefits or suffering the downside as privatisation has meant increased water infrastructure coverage, increased tariff levels and increased service quality, as well as the opposite. South Africa has identified water access and affordability as crucial contributing factors as the country strives to eradicate poverty and reduce inequalities. This study was conducted using a cross-sectional data set on a limited number of South African municipalities. The results imply that a municipality steered by a conservative party was no more likely to privatise water services than a municipality ruled by a non-conservative party. Evidence of employment rate having a positive effect on the probability of privatisation was found however. The results provided no indication of privatised water services affecting access to piped water or tariff levels. The results are difficult to apply however as the data set inflicted restrictions. The limited number of municipalities with private water supply makes the results further difficult to use to explain probability of privatisation and the differences in access to piped water and tariff levels in municipalities with public water provision and municipalities with private water provision. In year 2025 maximum sustainable water supply is predicted to meet demand in South Africa if no action is taken to reduce current demand and future consumption. As reliable and affordable water services are the foundation for the life of every South African as well as the foundation for the country's industry, further research need to be conducted on how to best manage and guard South Africa's scarce and declining water resources. It might just be that a regulated and mature collaboration between the private sector and public sector can bring together the better of two poles and constitute a solution.

6. Future research suggestion

Further studies on water privatisation in South Africa are important and could provide guidance in decision making processes. The results of the 2011 Census are available which would provide data on the entire population. A number of municipalities have privatised their water services since 2007 which would further improve the foundation of the study. The survey includes questions on service interruptions which enables analysis of quality. Both factors would provide more valid results than the study conducted. It would also be valuable to obtain data on terrain, such as topography. The variable on terrain included, the binary variable of water availability, includes no real information and as water availability is believed to be increasingly stressed in the future it is an important variable to consider. Moreover, as the outcome of privatisation is expected to vary greatly with type of contract, future studies might focus on the impact of different forms of privatisation. To evaluate the impact of various degrees of private sector participation, such as management-, lease and concessions contracts, would be very useful guidance for South African municipalities in their decision on water services provider.

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