Satisfaction with Water Service Delivery in South Africa

The Effect of Social Comparisons

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Abstract:
This Master's Thesis investigates the role of social comparisons in determining households' satisfaction with municipal water service delivery in South Africa. We use a unique balanced panel dataset for the years 2009-2011 from the General Household Surveys conducted by Statistics South Africa. Our results show a positive effect of receiving higher water service reliability relative to a provincial reference group, but a negative effect of receiving higher water service reliability relative to a reference group defined by a smaller geographical area. Hence, we find indications of rivalry among more distant others, but altruism or risk-sharing among closer neighbors. We conclude that since satisfaction with water service delivery seems to be strongly influenced by psychological and behavioral factors such as social comparisons, satisfaction surveys serve a limited purpose as a foundation for public policy.

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[1] A list of meetings can be found in Table 9.2 in Appendix.

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1 Introduction

Assessment of public service performance is important for policy-makers in designing public policy. The assessment can either be based on objective indicators from the service providers or alternatively on citizen feedback through satisfaction surveys. In South Africa, the latter method has become increasingly popular as a response to protests and dissatisfaction with public services (Akinboade, Kinfack and Mokwena, 2012). It is therefore important to understand the relevance of using these surveys as a basis for future policy. One way of acquiring more knowledge on this matter is through studies of factors that might affect satisfaction, but that are unrelated to what authorities actually can influence. Previous research has studied the effects of social comparisons of public service performance on satisfaction with the same (e.g. Deichmann and Lall, 2003; Vásquez, Trudeau and Franceschi, 2011). When social comparisons are found to have a significant effect on satisfaction, it is often taken as a sign of satisfaction being affected by psychological and behavioral factors, which for public policy-makers are difficult both to observe and influence (Deichmann and Lall, 2003). In such cases, it is not clear whom public policy should target and what the welfare effects would be of implementing policies aiming at reducing the influence of comparison effects on satisfaction. Hence, evidence of significant effects of social comparisons on satisfaction might undermine the use of satisfaction surveys as a basis for public policy making. The purpose of this thesis is therefore to investigate the following research questions:

For South African households with municipal water supply and a permanent address 2009-2011:

1. *Which factors affected satisfaction with water service delivery?*
2. *To what extent did social comparisons affect satisfaction and how did the effect vary between different definitions of reference groups?*

where reference groups are defined by ethnicity and three descending geographical levels – province, municipality and Primary Sampling Unit (PSU), the latter approximately equal to an enumerator area. Given that water in South Africa is both a scarce resource and a constitutional right, water service is a prioritized topic. In studying social comparisons effects, South Africa is particularly interesting due to the legacy from apartheid, which still divides groups in the society.

The contribution to literature is threefold. First, unlike previous studies on public service satisfaction in emerging markets/developing countries, this thesis is based on data with national coverage, allowing for identification of differences on several geographical levels (province, municipality and PSU). Second, this thesis is, to our knowledge, the first to study the effects of social comparisons on public service delivery satisfaction using panel data, rather than cross-sectional data. As such, we contribute to research by controlling for individual random effects, time fixed effects and by investigating a larger sample than in previous studies, increasing precision

of predicted estimates. Moreover, we are the first ones to use a unique panel dataset from the South African General Household Survey comprising a balanced panel for three years (2009-2011) and 11,327 households. Third, in addition to examining the role of households' relative position in terms of water service delivery, this thesis analyzes the importance of *asymmetric* (downward and upward) comparison effects, accounting for the fact that social comparisons might affect households' satisfaction differently. This has, to our knowledge, not been done previously with regard to satisfaction with public services.

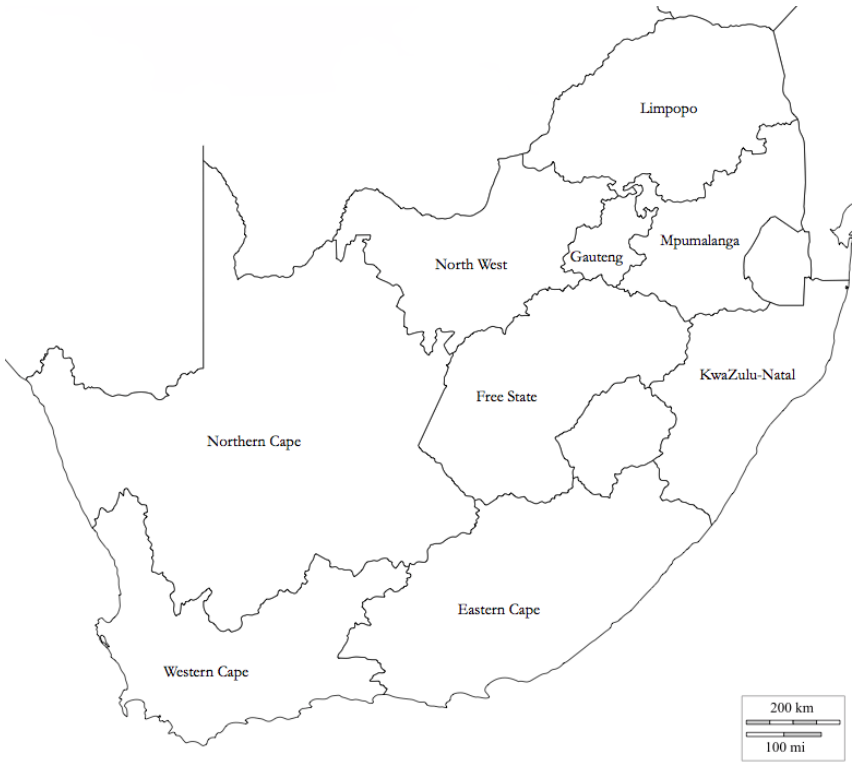
Our results suggest that social comparisons matter to households' satisfaction with water service delivery. At the provincial level, results display a positive relationship between a household's probability of being satisfied with water service delivery and its water service reliability relative to the reliability of the reference group, controlling for households' own service reliability. However, at PSU level, the effect is the opposite. This indicates that the effect of social comparisons depends on whether comparisons are made to close neighbors or to more distant others. In addition, when testing for asymmetric comparisons, we find evidence of both *upward* and *downward* comparisons at PSU level, whereas at the provincial level we only find evidence of *downward* comparisons – suggesting that social comparison effects differ between households.

The structure of this thesis is as follows. Section 2 provides background information on the South African context, Section 3 describes the theoretical framework and states the contribution of this thesis, Section 4 discusses data, limitations, method and variables, Section 5 presents the results from the bivariate probit regressions, Section 6 analyzes the results from a broader perspective and Section 7 states the conclusions and main findings of the thesis.

2 Background

Following the end of apartheid in 1994, South Africa has transformed into an open economy and emerging market. International recognition of the progress was confirmed through the acceptance into the BRICS block in 2011 (Shubin, 2013). However, in spite of economic growth and its democratic transition, South Africa still struggles with inequality and poverty. This is demonstrated by the Gini income coefficient[2] of 0.70, which suggests that South Africa is one of the world's most unequal countries (OECD, 2013). Other challenges include the high unemployment rate of 29 percent, particularly among young people, and the HIV/AIDS pandemic with devastating social and economic consequences (Seekings, 2014). In the following, we describe regional and socioeconomic differences and provide an overview of the South African water sector.

Figure 2.1: Provincial Map of South Africa



Source: Authors' own illustration

[2] The Gini-coefficient takes on a value between 0 and 1, where 0 represents a perfectly equal society and 1 represents perfect inequality (OECD, 2013).

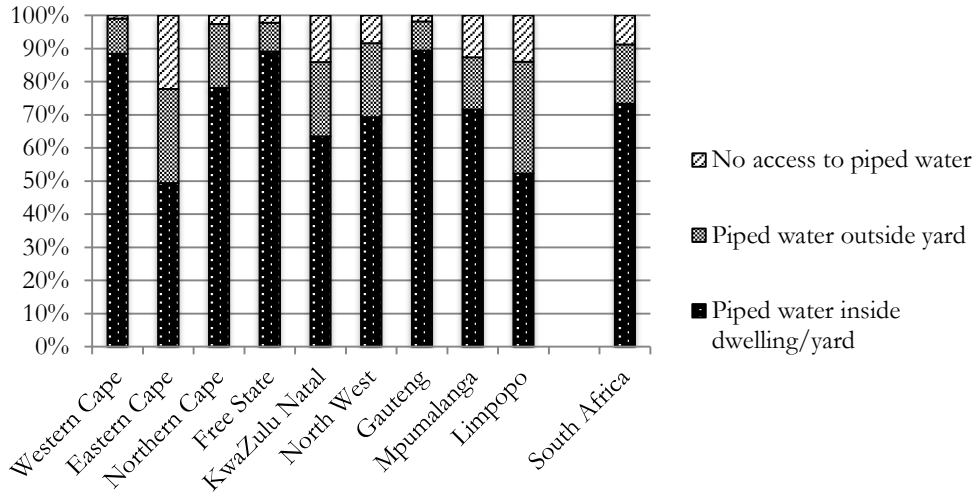
South Africa, with a registered population of 52.3 million in 2012, is divided into nine provinces (Statistics South Africa, 2013). The economy is stronger in Gauteng and Western Cape provinces while provinces comprising previous homeland areas, such as Limpopo and Eastern Cape, are substantially poorer (see Figure 2.1 for a provincial map of South Africa; Roux, 2009). There are also differences within provinces, at a municipal level, where metros such as Johannesburg (Gauteng) and Cape Town (Western Cape) attract industries and hence offer more employment opportunities (National Treasury, 2011). Socioeconomic differences also exist between ethnical groups, which since the apartheid era are categorized into black, colored[3], Asian and white – representing 79.2, 8.9, 2.5, and 8.9 percent of the population respectively (Statistics South Africa, 2012). Whites have an average annual household income of 365,134 ZAR, Asians of 251,541 ZAR, colored of 112,172 ZAR, whereas blacks only earn 60,613 ZAR (Statistics South Africa, 2012).[4] In 2011, 14 percent of the population had an income below the poverty line of 1.25 USD per day (African Development Bank, 2012). While poverty cannot be confined to one single ethnic group, black and colored South Africans constitute the most vulnerable groups (Ayo-Yusuf and Olutola, 2013).

Access to public services is relatively high on a national level. In 2012, 85.3 percent of the households were connected to electricity infrastructure and 94.6 percent were estimated to have access to toilets or bucket toilets (Statistics South Africa, 2013). Nevertheless, access to decent housing remains a challenge since 14.1 percent of the households live in informal settlements (Statistics South Africa, 2013). Focusing on the water sector, several measures have been taken to reduce the inequalities in service delivery stemming from sixty years of apartheid. Access to sufficient water became a constitutional right in the Water Services Act of 1997 and in 2001 the government adopted the policy of Free Basic Water, which provides all households with 6 kiloliters of water per month for free (Seago and McKenzi, 2007; Statistics South Africa, 2013). While investments in water infrastructure have historically been low in deprived areas, more resources have been allocated during the past twenty years of post-apartheid (Smith, 2011). As illustrated in Diagram 2.1, 91.3 percent of the households had access to piped[5] water in 2011 on a national level but considerable regional differences still exist (Statistics South Africa, 2013). In 2011, Gauteng and Western Cape, together with the Free State, provided the highest percentage of their respective populations with access to water, whereas more than 20 percent of the households in Eastern Cape lacked access to piped water (Statistics South Africa, 2013). Gauteng and Western Cape also

[3] Colored refers to South Africans of mixed ethnic origin.
[4] This corresponds to approximately $35 000, $24 000, $11 000, and $6 000 respectively.
[5] Piped water is defined as piped water inside the household's own dwelling/yard or outside the yard.

rank highest in water quality scores, followed by KwaZulu-Natal, in which another big metro, Durban, is located (DWA, 2013). These three provinces have also received the most Blue Drop Awards[6] (DWA, 2013). In particular, Western Cape distinguishes itself with better infrastructure and relatively less non-revenue water[7] than the other provinces, partly due to historical reasons of early urbanization (Lemanski, 2007; Seago and McKenzi, 2007).

Diagram 2.1: Percentage of Households with Access to Piped Water by Province



Source: Authors' own illustration, based on information from Statistics South Africa (2012)

There are several remaining challenges in the water sector. First, while a policy on Free Basic Water has been adopted, South Africa is also ranked as the 30th most water scarce country in the world (DWA, 2013). Authorities are therefore expected to implement various Water Conservation and Water Demand Management policies such as water pressure management, repair of leakage, installation of water meters, and information to the public regarding sustainable water use (Smith, 2011). The dual, and sometimes conflicting, goals of securing access to free basic water for everyone and maintaining sustainable levels of water consumption hence represent a challenge to the South African water sector (Smith, 2011). Second, migration streams put additional pressure on provision of public services such as water. Because of the higher growth rate than most other African countries, South Africa attracts legal and illegal immigrants in search for jobs and better living conditions from the rest of Africa. There is also migration from rural to urban areas within South Africa and the country's urbanization rate is higher than both the global average and that of

[6] The Department of Water Affairs (DWA) in South Africa uses a risk based management approach (Blue Drop Certification) in order to asses and certify drinking water quality at the intake and outflow of the treatment plants, in the pipelines and reservoirs, as well as at the point of use (DWA, 2013).
[7] Non-revenue water consists of both physical and commercial losses and is defined as the difference between the volume of produced water and the volume of water billed to consumers (Seago and McKenzi, 2007).

the rest of Sub-Saharan Africa (Roux, 2009). In particular, Gauteng and Western Cape had the highest urbanization rates between 1996 and 2011 and grew by 57 and 47 percent, respectively, whereas the remaining six provinces grew by 17 percent combined during the same period (Statistics South Africa, 2012). Migration from other countries to South Africa and from rural to urban areas hence creates concern for whether cities will be able to provide basic services for everyone (Roux, 2009). Third, cost recovery of water services is low. Part of this problem is due to leakage but a major problem is also non-payment of services. As pointed out by Fjeldstad (2004), this stems from inadequate billing by the municipalities as well as from citizens' inability to pay and unwillingness to pay due to governmental distrust. Finally, poverty in combination with unemployment, social inequalities and life-threatening diseases such as HIV/AIDS has contributed to an escalating trend of public protests. In 2012, protests concerning water service delivery reached levels of violence, frequency and geographical coverage never seen before (Tapela, 2013).

3 Literature Review

While satisfaction is a topic that has been extensively researched, this literature review focuses on satisfaction with public services. The first subsection provides an overview of the empirical evidence on factors associated with public service satisfaction. In addition, empirical research has shown that social comparisons, nonrelated to the service experienced by the actual service user, also determine individuals' satisfaction with public services. The second subsection therefore reviews empirical evidence on social comparisons with regard to public services. Finally, we discuss our contribution to literature and present the empirical hypotheses of the thesis.

3.1 Satisfaction

The definition of satisfaction is not clear-cut and varies between disciplines. In economics, satisfaction has often been used interchangeably with concepts such as well-being, utility and happiness (Dolan and White, 2007). Research on satisfaction with public services stems from customer satisfaction literature, which defines satisfaction as a *response* to a specific *focus* (product or service) occurring at a specific point in *time* (after consumption) (Giese and Cote, 2000). As public service providers have increasingly started to collect data on citizen satisfaction with various public services, approaches from customer satisfaction research have recently been applied to investigate public service satisfaction (Van Ryzin, 2004). One caveat with these studies, however, is that data collectors use different scales and methods for measuring satisfaction, making comparisons between studies cumbersome. In addition, while self-reported satisfaction has been shown to correlate strongly with certain factors, the mixed empirical evidence on causal direction and the lack of experimental data makes it difficult to establish causality (Dolan and White, 2007). Nevertheless, some of the relevant research investigating what factors correlate with public service satisfaction is summarized in Table 3.1, focusing on studies performed in developing countries. Even though comparability is limited when it comes to magnitude of estimates, these studies can at least give indications as to what factors are expected to correlate with public service satisfaction and in what direction.

3.2 Social Comparisons

Besides individual and household characteristics affecting satisfaction, social comparisons have also been found to correlate with the same. Research on social comparison effects originates from psychology and sociology literature which early acknowledged that it is human nature for individuals to operate within reference groups, i.e. the groups of people with whom individuals compare themselves (McBride, 2011). A main theory was that of the Social Comparison Theory,

Table 3.1: Summary of Public Service Satisfaction Studies

Paper	Public Service Studied	Country	Variable(s) studied	Effect on Satisfaction
			*Actual Performance**	
Deichmann and Lall (2003)	Water Service Delivery	India	Hours of water/day →	Positive and significant
Lewis and Pattinasarany (2009)	Public Education	Indonesia	School accessibility → Student-Teacher ratio → Classroom neatness →	Positive and significant Negative and significant Positive and significant
			*Perceived Performance**	
Vásquez, Trudeau and Franceschi (2011)	Water Service Delivery	Nicaragua	Hours of water/day →	Positive and significant
Van Ryzin (2004)	Urban Services in New York	USA	Rating of street cleanliness → Avaiability of busses and subways →	Positive and significant Positive and significant
			Individual Characteristics	
Deichmann and Lall (2003)	Water Service Delivery	India	Gender (female) →	Positive and sometimes significant
Bratton (2007)	Education and Health Care	18 African countries	Gender (female) → Age** → Education →	Negative (significant for health, insignificant for education) Positive (insignificant for health, significant for education) Negative and significant for both services
Vásquez et al (2011)	Water Service Delivery	Nicaragua	Age** →	Insignificant (positive in some specifications, negative in other)
De Hoog, Lowery and Lyons (1990)	Local Government Services in two counties in Kentucky	USA	Ethnicity*** (not white) →	Negative and significant

Table 3.1 continued: Summary of Public Service Satisfaction Studies

Paper	Public Service Studied	Country	Variable(s) studied	Effect on Satisfaction
Myburgh, Solanki, Smith and Lalloo (2005)	Health Care	South Africa	Ethnicity*** (not white, Asian or colored) →	Negative and significant
			Household Characteristics	
Vásquez et al (2011)	Water Service Delivery	Nicaragua	Household size →	Insignificant (positive)
			Home ownership →	Insignificant (positive in some specifications, negative in other)
Deichmann and Lall (2003)	Water Service Delivery	India	Household size →	Negative and significant
			Home ownership →	Negative and sometimes significant
			Welfare	
Deichmann and Lall (2003)	Water Service Delivery	India	Welfare status →	Positive and significant
Bratton (2007)	Education and Health Care	18 African countries	Poverty →	Negative and significant
Lewis and Pattinasarany (2009)	Public Education	Indonesia	Below average welfare →	Positive, but barely significant

*The question of whether actual or perceived performance indicators should be used in satisfaction studies has been debated in literature. Some researchers are advocating caution in using subjective quality of service measures rather than objective indicators (e.g. Lewis and Pattinasarany, 2009), while others argue that objective performance indicators will not affect satisfaction except through subjective evaluations of the same and hence the perceived measures are more relevant to include in studies of satisfaction (e.g. Van Ryzin, 2004).

** The expected sign of the correlation between age and satisfaction is ambiguous, however, since satisfaction studies looking into general life satisfaction rather than satisfaction with specific public services consequently finds a negative relation between satisfaction and age as well as a positive relation between satisfaction and age squared, suggesting a U-shaped relationship (Dolan et al, 2007).

*** De Hoog et al (1990) cannot, however, distiguish the racial aspect sufficiently from other casuses of (dis)satisfaction. Van Ryzin, Muzzio and Immerwahr (2004) manages to explain part of this "race gap" by differences in socioeconomic status, residence neighborhood and trust in government between the ethnicity groups.

where the idea is that humans have an innate drive for accurate self-evaluation. However, in the absence of objective means to evaluate their own situation, individuals compare themselves to others (Festinger, 1954). More specifically, individuals will engage in social comparisons with *similar* and *proximal* others since it is difficult to accurately compare oneself to a very different reference group (Festinger, 1954). In economics, influences from social comparisons were recognized later. The focus here has mainly been on income comparisons and the dominating finding is a negative correlation between subjective well-being and the income of a reference group to whom the individual compares herself (e.g. Blanchflower and Oswald, 2004; Clark and Oswald, 1996; Ferrer-i-Carbonell, 2005). The following section discusses the difficulties in defining reference groups, the differences between symmetric and asymmetric comparisons, as well as existing evidence on the relation between public service comparisons and satisfaction, focusing on developing countries.

There is no general consensus in literature on who constitutes an individual's reference group, since the actual interaction between the individual and the reference group is difficult to observe and since individuals usually compare themselves to different groups in different contexts (Deichmann and Lall, 2003; Kingdon and Knight, 2007). As such, reference groups could vary between population groups, change throughout an individual's life and depend on the individual's degree of social and geographical isolation (Clark and Senik, 2010; Fafchamps and Shilpi, 2008; Herrera and Roubaud, 2006). In other cases, reference groups seem to stay the same throughout life. For example, Senik (2009) shows that it is common for individuals in post-transition countries to compare their welfare to people they knew before the transition, implying that former classmates or colleagues constitute the relevant reference groups even later in life. Considering the difficulties in defining reference groups, it is common to take account of both social and geographical factors. For example, besides including racially defined reference groups, Kingdon and Knight (2007) assume reference groups based on cluster and district levels in South Africa and conclude that higher average income of the reference group is associated with higher subjective well-being when the reference group is defined on a local cluster level (close neighbors). Interestingly, this coefficient becomes negative when the reference group is defined on a broader, district, level (including strangers). Another example is Deichmann and Lall (2003), who assume that service performance comparisons take place between those with the same income level and belonging to the same ethnic group (speaking the same language) in addition to geographically constructed reference groups. Thus, both the physical and social distance between individuals and their reference groups might matter. Due to lack of knowledge on actual reference groups, most empirical studies simply assume that reference groups are exogenously given. However, there is

substantial support in the social psychology literature for the notion that people actively choose their reference standards (Falk and Knell, 2004). In response to this, a scarce number of studies have in recent years investigated the endogeneity of reference groups (e.g. Knight, Song and Gunatilaka, 2009).

Literature on social comparisons has yielded mixed empirical evidence on the sign of the relationship between subjective well-being and the performance of the reference group. When reviewing empirical evidence, it therefore becomes important to distinguish between symmetric comparison effects and asymmetric comparison effects. A majority of the literature considers *symmetric comparison effects* where a change in the reference group's mean performance affects all individuals' subjective well-being in the same way. A positive relationship between individuals' own satisfaction and the performance of the reference group, controlling for individuals' absolute performance, is often explained by positive externalities stemming from altruism or risk-sharing within the community whereas a negative relationship is hypothesized to originate from feelings of rivalry (Kingdon and Knight, 2007). The *asymmetric comparison effect* approach implies that a change in the reference group's mean performance could influence different individuals in different manners. Hence, the sign of the reference group effect on an individual's own utility might depend on the comparison direction. In other words, it matters whether the individual makes a downward, or upward, comparison to a reference group with a performance lower, or higher, than the individual's own performance. While empirical evidence is mixed, it is commonly assumed that underperforming one's reference group (upward comparisons) affects individuals' well-being more than outperforming it (downward comparisons) (Clark and Senik, 2010). However, the effect of upward and downward comparisons on individuals' well-being is still a disputed question. The following asymmetric comparison effects have been summarized by Blanco-Perez (2012). As for upward comparisons negatively affecting individuals' satisfaction, it has been hypothesized that there is an "envy" effect associated with comparisons to a high-performing reference group. Alternatively, upward comparisons could positively affect individuals' well-being due to a so called "information effect" where individuals see an improvement of the reference group's performance as a signal of their own future performance improvement. In the case of downward comparisons, there could be a positive effect from "prestige" associated with being better off than one's reference group. However, research has also shown that individuals might also feel "regret" for being better off and that downward comparisons therefore could negatively affect their well-being.

Turning to the scarce empirical evidence on the relationship between well-being and public service provision in developing countries, Lewis and Pattinasarany (2009) use Indonesian data on local public education to show that households with welfare relatively lower than other households in the village are more likely to be satisfied, whereas households with relatively higher welfare are less likely to be satisfied. To explain these somewhat counterintuitive findings, the authors discuss the possibility of courtesy bias, low expectations and optimistic predispositions. Furthermore, to our knowledge, at least two other studies have focused on social comparisons with respect to water services. First, Deichmann and Lall (2003) analyze household survey data for two major cities in India, Bangalore and Jaipur, and conclude that households' satisfaction with water service delivery is correlated to households' relative water service position. Hence, households' satisfaction with water service delivery is likely to be higher when the reference group receives equal or worse water services, controlling for the households' absolute water service level. Second, Vásquez et al (2011) examine the effect of relative water service quality on citizens' satisfaction with water service delivery in León, Nicaragua, by conducting a survey where citizens were explicitly asked to compare their water service performance to other households. In line with the findings of Deichmann and Lall (2003), citizens' satisfaction with water services appears to be higher when individuals perceive that their water service performance is superior relative to that of their reference group.

3.3 The Contribution of this Thesis

As discussed, a substantial number of studies have demonstrated that social comparisons matter to individuals' subjective well-being. However, focus of prior research has been on, mainly symmetric, income comparisons and scant attention has been devoted to relative positions in relation to performance of a public service (Cuesta and Budría, 2012). In particular, empirical evidence for social comparison effects in developing nations is still scarce. This thesis examines how social comparisons affect South African households' satisfaction with water service delivery. This is particularly interesting since water is defined as a constitutional right in South Africa. While income is often related to one's socioeconomic status and personal achievement, such as education and occupation, a constitutional right concerns all citizens in the nation given that everyone is equal before the law. We hypothesize that the latter could imply a stronger driving force behind social comparisons, since a right defined by the constitution implies that the government is obliged to enforce the law *equally for all citizens* in the society.

The contribution to literature of this thesis is threefold. First, we investigate the role of social comparisons with regard to a public service in an emerging market/developing country and to our

knowledge only two similar studies exist (Deichmann and Lall, 2003; Vásquez et al, 2011). In contrast to these studies, this thesis uses data with national coverage, allowing for identification of differences on several geographical levels (province, municipality and PSU). Second, unlike the two previously discussed studies, based on cross-sectional data, we use a unique panel dataset from the South African General Household Survey comprising a balanced panel for three years (2009-2011) and 11,327 households. Analysis of such two-dimensional data allows for consideration of effects that cannot be observed in pure cross-sectional or times-series datasets, such as accounting for individual specific effects. Third, to date, research on social comparisons has tended to focus on s*ymmetric* comparison effects, meaning that all individuals are similarly affected by changes in the reference group. Such analysis does not take account of the fact that changes in the reference group might affect different households' satisfaction differently – implying an *asymmetric* comparison effect. In addition to solely examining whether households' relative position in terms of water service delivery matters, we investigate the importance of such asymmetric comparison effects. While existing empirical evidence on asymmetric comparison effects has focused on asymmetry for income comparisons, this thesis is concerned with asymmetric comparisons with regard to a public service, and constitutional right, such as water service delivery.

In conclusion, this thesis bridges the gap between insights on social comparisons in psychology and sociology literature and the empirical research predominating in economics. Findings contribute to an understanding of the role of social comparisons for households' satisfaction with water service delivery in the context of a socially and economically divided emerging market such as South Africa.

Given the theoretical framework presented above, we expect the effect of relative water service delivery to be in line with results by Kingdon and Knight (2007). We thus hypothesize that social comparisons will have different effects on satisfaction depending on at which level the reference group is defined. At the lowest (PSU) level we hence expect to see a negative effect of relative water service reliability, whereas at the higher levels (municipal and provincial), where reference groups include more distant others, we expect to see the opposite, controlling for households' own water service reliability. Regarding the asymmetric comparison effect, hypothesized effects are in line with the downward and upward comparisons described by Blanco-Perez (2012). At the provincial and municipal levels, we thus hypothesize positive downward comparisons and negative upward comparisons. However, at the PSU level, we expect upward comparisons to be positively correlated to satisfaction, and downward comparisons to have no significant effect. Besides motivated by theory, this last hypothesis is also anchored in contextual factors. Since clean water

is a constitutional right in South Africa, we expect upward comparison to be the most relevant effect. In summary, this thesis empirically tests the following hypotheses:

H1: The reference group *ratio* (own water service reliability divided by the reference group's water service reliability) has a *positive* and significant correlation with the probability of being satisfied with water services at a ***provincial and municipal level***, controlling for households' own water service reliability.

H2: The reference group *ratio* has a *negative* and significant correlation with the probability of being satisfied with water services at a ***PSU level,*** controlling for households' own water service reliability.

H3: *Upward* comparisons with regard to water service reliability at a ***provincial and municipal*** level will be *negative* and significant whereas *downward* comparisons will be *positive* and significant, controlling for households' own water service reliability.

H4: *Upward* comparisons with regard to water service reliability at a ***PSU level*** will be *positive* and significant whereas *downward* comparisons will be insignificant, controlling for households' own water service reliability.

4 Data and Method

The data and method used to investigate the validity of the presented hypotheses are described and discussed in the following.

4.1 Data Description

This thesis uses the General Household Survey data collected by Statistics South Africa. The scope is national coverage, with province as the lowest geographical unit of identification. Surveys have been conducted on an annual basis since 2002 with the objective of measuring the living standards of South African households (Statistics South Africa, 2013). Consequently, questionnaires focus on six areas: education, health and social development, housing, household access to services and facilities, food security, and agriculture. Since 2002, the survey samples have been drawn using three different master sample frames (the three used for 2002-2004, 2005-2008 and 2009-2013 respectively) which each comprises approximately 3070 Primary Sampling Units (PSUs). A PSU approximately corresponds to an enumerator area and contains between 100-500 dwellings depending on the density of the area.[8] An average of ten dwelling units has been drawn from each PSU for a sample of approximately 30,000 dwelling units in the final sample. Due to the unlikelihood of different master samples covering the same dwelling units, it is usually not possible to find and compare the same dwelling units across master sample years. However, the master sample frame of 2009-2011 differs from the others since approximately two thirds of the dwelling units have accidently remained in the sample during the whole period. Out of these dwellings, approximately 15,000 dwellings received municipal water all three years, which is a prerequisite for studying water service delivery satisfaction. Since a majority of dwelling units remained in the sample all three years, it is possible to create a balanced panel by using the unique number identifier of each dwelling unit as well as the name and surname of the head of the household. By doing this for the 15,000 observations that received municipal water all three years, we obtain a balanced panel for 2009-2011 with 11,327 households. Additionally, while province is the lowest geographical unit of identification in the data available to the public, access to municipality and PSU group data has been granted by Statistics South Africa for the purpose of this thesis. This information enables testing of social comparisons at three different levels – provinces, municipalities and PSU groups. In summary, we use a unique balanced panel dataset with 11,327 households using water provided by municipalities for 2009-2011, adding up to 33,981 panel observations. This thesis is the first to present results based on this dataset.

[8] The approximate average size of a PSU is 12 square kilometers (estimated by dividing the size of South Africa with the number of enumerator areas).

4.2 Data Limitations

The limitations of the dataset used in this thesis are of two kinds. First, there are general limitations that apply to all empirical studies using similar datasets. Second, there are specific limitations emerging from the collection and merging methods used for this particular dataset.

As regards general drawbacks, since data is of observational character, causal relationships cannot be inferred and this thesis therefore focuses on investigating correlations between satisfaction and relevant variables. To establish causality in studies of human behavior, experimental data would be preferable (Van Ryzin, 2004). As argued by Frey and Stutzer (2002), determining causality in satisfaction studies also remains a challenge due to the fact that causality could run both ways between control variables and satisfaction, for example between income and satisfaction. A further data concern is recall bias, which implies difficulties for respondents in recalling the facts asked for. Consequently, asking the head of a household to recall how many disruptions in water service delivery he/she has experienced during the last twelve months might stage an ad hoc answer. A related problem is that of obsequiousness bias, the risk of respondents reporting what he/she thinks that the interviewer wants to hear. One possible reason for this could stem from the respondent perceiving the interviewer as coming from a governmental authority and hence concluding that "wrong" answers might negatively affect chances of later receiving state grants or other benefits. Another potential data problem is also that of timing effects. While the General Household Survey was collected during the same period of the year (June-September) for all three years studied, this only controls for the short-term timing effect such as seasonal rainfall or migration. Hence, the timing effect from a long-term perspective, for example effects of election years and infrastructure investments, should still be kept in mind. To account for such effects, we include fixed year effects.

In terms of the specific drawbacks with the dataset used in this thesis, three main aspects must be considered. First, organizing panel data from repeated cross-sectional data posits certain concerns of representativeness. Since the households interviewed for all three years are randomly selected in 2009, and there are changes in dwelling composition during the three years, representativeness declines over time. Hence, a random sample in 2009 might not be so in 2010 or 2011, even though drawn from the same sample frame. Moreover, since only respondents receiving municipal water were asked about water issues, the potential sample for us to use is further reduced in representativeness. Since we reduce the sample size even further by only studying dwelling units with the same household living in it for the three years studied, it is important to understand how much we lose in representativeness. In order to see how representative our sample is in relation

to the whole sample of respondents receiving municipal water, we compare the means of main variables of interest to those of the municipal water sample by use of t-tests (these can be seen in Table 9.1 in Appendix). Our conclusion is that the studied group seems to be slightly over-representing blacks, females, big households, less educated, older respondents, respondents owning their own house, and respondents from Limpopo province. Also, respondents from KwaZulu-Natal and Gauteng provinces are slightly underrepresented. Most importantly, the group studied seems to be less satisfied with water services and have more and/or longer interruptions in the water services received compared to the whole municipal sample. Even though this should not cause any severe problems with internal validity, caution must be taken when extrapolating the results and one must remember that they are only valid for South Africans with a permanent address and municipal water supply. Even so, the choice of dropping observations that do not represent the same household for 2009-2011 is still necessary, since the benefits of a balanced panel are vast. If we chose to keep all dwelling units that were present in the sample for the three consecutive years, we would not be able to use the panel characteristics of the data. This is due to the fact that some dwelling units would then represent different households in different years (since observations relate to dwellings and not to households), which in turn would make it impossible to correct for individual and household time invariant effects. Controlling for time-fixed individual and household effects is important when investigating behavioral and highly subjective factors such as social comparisons and satisfaction, since they are likely to influence results to a high degree. The benefits of using panel data methods hence, in our view, overrule the drawbacks of a less representative sample. Second, the use of secondary data implies limitations to available information. For that reason, since we have no information on which groups households compare themselves to, the analysis of social comparisons must assume reference groups as exogenously given. In addition, surveyed households were not asked to evaluate their water service reliability in relation to a specific reference group. In line with previous research, we therefore use the mean value of water service reliability for the assumed reference group as reported by the reference group households themselves, and not as apprehended by the household in question, when computing the relative water service reliability. Moreover, households' satisfaction with water service delivery is likely to be influenced by variables for which we cannot control. For example, households' satisfaction with water and sanitation could be interrelated and the fact that there is no suitable data available on the quality and reliability of sanitation services might cause concerns of omitted variable bias. Third, there might be concerns of measurement error due to reported measures not representing true values and due to missing values. Regarding the relevance of reported measures, there has been a great debate in economics regarding the

relevance of using self-reported measures. One challenge that self-reported data posits is separation of the dependent variable from the independent ones. For example, while our dependent variable, based on the rating of overall water services, is often used by Statistics South Africa as a proxy for water service satisfaction, it is possible that it reflects the same perception as the two control variables of water service performance (*Perceived Water Quality* and *Perceived Service Reliability*). However, since our data consists only of such subjective measures, we make the assumption that they, at least in part, reflect the actual values of what is asked for. Moreover, survey answers from the household head are interpreted as representing the opinions of the whole household, meaning that there is a risk of reported values reflecting the respondent's personal, rather than the whole household's, values. To address this concern, we include individual characteristics of the head of the household as control variables in the model specification. Finally, with regard to missing values, this is a minor concern since, with the exception of missing values for *Household Income*, which comprise 4 percent of the sample, missing values for each of the remaining variables represent no more than 0.5 percent. The missing values of *Household Income* are assumed to be missing at random, such that the missing values do not correlate with *Household Income* itself but might correlate with explanatory factors of this variable. Consequently, no observations are dropped due to missing values.

In conclusion, this thesis is subject to a few data limitations, of which most are controlled for in various ways. The potential effects of the limitations that we cannot remedy, however, will be discussed further in Section 6. As previously discussed, we make certain assumptions in using this data. First, reference groups are assumed to be exogenously defined according to ethnicity and geographical proximity. Second, households' perception of their reference group's water service reliability is equivalent to the service reliability perceived by the reference group themselves. Third, subjective measures are assumed to reflect actual values. Finally, missing values are assumed to be missing at random.

4.3 Model Specification

The model specification used in this thesis takes its starting point in the utility function of Deichmann and Lall (2003) in which utility (U) of public services depends on a function of a vector of actual quality and reliability performance indicators (A) as well as on a vector of individual and community characteristics forming expectations (E), as can be seen in equation (1):

$$U = f(A, E) \tag{1}$$

Deichmann and Lall (2003) develops this simple model into a specification of service delivery of water (2), in which satisfaction with water service delivery (S_i*) depends on the household's received performance (P_i) and on a relative measure of the performance received by the household in relation to what the household's reference group receives on average (P_i/P*)[9]. Moreover, satisfaction depends on individual and household characteristics (I_i), as well as on the benefit from consumption of other goods and services than water (Y_i):

$$S_i^* = \alpha' P_i + \tau' \left(\frac{P_i}{P^*}\right) + \delta' I_i + \gamma' Y_i + \varepsilon_i \qquad (2)$$

Thus, the household's satisfaction increases with its own improved service performance (α') as well as from receiving better service performance than its reference group (τ'), that will say when $P_i > P$*. However, if the reference group receives better service performance than the household ($P_i < P$*), the relative performance ratio (P_i/P*) decreases and the household is less satisfied. The error term (ε_i) follows a normal distribution with mean equal to zero and variance equal to σ^2.

While this thesis is based on equation (2), it makes four important modifications. First, to account for changes that are constant across individuals but vary across time, fixed time effects (T_i) are included. Examples of such changes include inflation, elections, extreme weather patterns as well as unemployment and migration booms. Second, this thesis applies the method first developed by Mundlak (1978), now frequently used in satisfaction studies, to control for the fact that individuals are different when it comes to characteristics such as optimism or how they cope with difficult times (e.g. Blanco-Perez, 2012; Cuesta and Budría, 2012; Ferrer-i-Carbonell 2005). Since this thesis is based on self-reported data, omitted variable bias comprising unobserved individual characteristics, such as personality traits and attitude, that are correlated to our control variables is a valid concern. As suggested by econometric theory and previous studies, the optimal way to address this potential bias would be to run a fixed effect model, factoring out this time-invariant unobserved heterogeneity. The drawback of doing this, however, is that results would be solely based on within group variation and in our case, considering that we use several bivariate variables, it would mean a vast exclusion of observations. Controlling for random effects could hence be more suitable since this would allow for individual effects in the error term but, assuming these are randomly distributed and not correlated to the controls, would not exclude observations due

[9] While it is common to include individuals' own performance relative to the mean of the reference group, as suggested by Deichmann and Lall (2003), some studies include the mean of the reference group's performance as a separate control variable in the regression (e.g. Clark and Oswald, 1996).

to no within group variation. To formally compare the random effects model to the fixed effects model, a Hausman test is conducted. Since we cannot reject the null hypothesis, the Hausman test suggests that the random effects model is the efficient estimation method. This result is, however, counter-intuitive since it is reasonable to believe that the unobserved individual characteristics, e.g. attitude, correlates with control variables such as income and education. Therefore, the key assumption in the random effects model of the unobserved heterogeneity being uncorrelated with the control variables could be violated. In the light of these challenges, we use a random effects model with Mundlak corrections as commonly used in literature, controlling for a possible correlation between specific control variable means and the unobserved individual characteristics.[10] Hence, based on the assumption that the error variable ($\varepsilon_{i,t}$) consists of two parts – one that varies by individual effects (v_i) and one that has zero correlation with the independent variables ($\eta_{i,t}$):

$$\varepsilon_{i,t} = v_i + \eta_{i,t} \qquad (3)$$

the Mundlak method, as described in Ferrer-i-Carbonell (2005), assumes the following correlation between the individual random effect (v_i) and a subset of the independent variables ($z_{j,i}$):

$$v_i = \Sigma_j \lambda_j \bar{z}_{j,i} + w_i \qquad (4)$$

The individual random effect (v_i) hence consists of one part that is correlated with the mean of a subset ($\bar{z}_{j,i}$) of the independent variables ($I_{k,i}$) where $k>j$, whereas the second part (w_i) has zero correlation with the independent variables. In this thesis, the chosen subset of independent variables ($z_{j,i}$) includes the natural logarithm of the household's monthly income, squared years of education of the household head, and the natural logarithm of household size. Our third amendment to equation (2) is the meaning of variable ($Y_{i,t}$). Due to contextual factors, rather than estimating the benefit from consuming other goods and services than water, we use a binary variable specifying whether the household pays for water or not. Hence, due to the Free Basic Water policy as well as non-payment of water services in South Africa, the ability to consume other goods and services is for most people not affected by water purchases. It is therefore more interesting to see what the effect of paying for a service that most people get for free has on satisfaction. Finally, the fourth and last modification of equation (2) is the inclusion a second performance variable. Whereas Deichmann and Lall (2003) only study the *reliability* of water supply

[10] As benchmarks, Table 5.1 also reports the pooled OLS as well as the traditional random effects model.

(P_i) when controlling for actual performance, we argue that satisfaction with water service delivery is also influenced by actual *quality* of the water, which is confirmed by Vásquez et al (2011). Hence, a second performance variable for quality (P^q_i) is included in our specifications. We only look at relative performance with regard to the reliability variable, however, since we assume that other households' water *quality* is less observable to others than their water *reliability*.

In conclusion, we add time fixed effects, Mundlak corrections (equation (4)), a bivariate variable for payment of water, and a second performance variable to equation (2), presented in Deichmann and Lall (2003). Our first model specification thus becomes:

$$S^*_{i,t} = \alpha' P_{i,t} + \pi' P^q_{i,t} + \tau' \left(\frac{P_{i,t}}{P^*_t}\right) + \delta' I_{i,t} + \gamma' Y_{i,t} + \varphi' T_t + \Sigma_j \lambda_j \bar{z}_{j,i} + w_i + \eta_{i,t} \qquad (5)$$

where (S^*) is satisfaction with water service delivery, ($P_{i,t}$) is the reliability of water services, ($P^q_{i,t}$) is quality of water services, ($P_{i,t}/P^*_t$) is relative reliability of water services, ($I_{i,t}$) is a vector of individual and household characteristics, ($Y_{i,t}$) is a bivariate variable indicating whether the household pays for water, (T_t) is time fixed effects, and ($\Sigma_j \lambda_j \bar{z}_{j,i} + w_i + \eta_{i,t}$) is the error term. The parts of the error term not correlated with individual characteristics (w_i and $\eta_{i,t}$) are assumed to follow a normal distribution with mean equal to zero and variance equal to σ^2.

In order to test for the existence of asymmetric reference group effects, a second model specification is added in the spirit of the income comparisons study by Ferrer-i-Carbonell (2005). Hence, in specification (6), we include two variables, measuring the effect of receiving more or less reliable water services than the mean service of the reference group. The variables, here referred to as More (M_i) and Less (L_i), are created to account for downward and upward comparisons respectively. These variables are defined as follows:

$$If\ P_i > P^*\ then\ M_i = P_i - P^*\ and\ L_i = 0$$
$$If\ P_i < P^*\ then\ M_i = 0\ and\ L_i = P^* - P_i$$
$$If\ P_i = P^*\ then\ M_i = 0\ and\ L_i = 0$$

Our second specification includes these two variables instead of the relative reliability variable ($P_{i,t}/P^*_t$) included in (5), and hence becomes:

$$S^*_{i,t} = \alpha' P_{i,t} + \pi' P^q_{i,t} + \theta' M_{i,t} + \mu' L_{i,t} + \delta' I_{i,t} + \gamma' Y_{i,t} + \varphi' T_t + \Sigma_j \lambda_j \bar{z}_{j,i} + w_i + \eta_{i,t} \qquad (6)$$

The vector of individual and household characteristics ($I_{i,t}$) in equation (5) and (6) includes gender, age, years of education, years of education squared, ethnicity, the natural logarithm of household size, the natural logarithm of household income, whether or not the household owns its own home and whether or not the household lives in a metro. Moreover, in line with Deichmann and Lall (2003), we also include fixed effects for main source of drinking water. Besides this, fixed effects for locality type and province are included. These variables will, together with all other variables, be described in detail in the following section.

4.4 Variables

Table 4.1 describes all variables used in the regressions, reporting the number of observations, mean values and standard deviations. In line with statistical publications by Statistics South Africa, the rating of overall water services is used as a proxy for the dependent variable *Satisfaction with Water Service Delivery* (e.g. Statistics South Africa, 2013). The score, constructed by Statistics South Africa, can take on values 1-3 with 1="poor", 2="average", and 3="good" water services. However, this ordinal variable is redesigned into a bivariate variable for satisfaction that takes on value=1 if the rating is "good", and value=0 if the rating is "average" or "poor". Hence, we consider those that rate services as "good" to be satisfied and those that rate services as "average" or "poor" to be dissatisfied. This transformation of the dependent variable is done to obtain more straightforward interpretations of the regressions. Since an ordinal scale does not reflect mathematically equal steps, it is not obvious that the step from "poor" to "average" is the same as the step from "average" to "good". Addressing this issue by transforming the ordinal variable into a bivariate one is a common method used in similar studies (e.g. Deichmann and Lall, 2003; Lewis and Pattinasarany, 2009; McBride, 2001). This enables the use of a bivariate probit model to test equations (5) and (6).[11]

Regarding performance variables, we construct both a reliability score and a quality score to control for perceived water service performance, and we hypothesize a positive correlation between both scores and households' probability of being satisfied with water service delivery. First, the *Perceived Water Service Reliability* score can take on values 1-4 and is constructed in line with the Household Food Insecurity Access Scale for measurement of household food access (Coates, Swindale and Bilinsky, 2007). The idea is that bivariate responses to occurrence and frequency of interruptions can be summarized in a scale to provide a continuous measure of households'

[11] We do, however, also run the ordered probit model in order to see if results differ.

Table 4.1: Description of Variables and Summary Statistics

Variable	Definition	Obs.	Mean	Std. Dev.
Dependent variables				
Satisfaction	1="Good", 0="Average" and "Poor"	33818	0.58	0.49
Independent variables				
Water-related factors				
Perceived Water Quality	Quality Score, 1-5 (see Figure 9.2 in Appendix)	33928	4.83	0.69
Perceived Water Service Reliability	Reliability Score, 1-4 (see Figure 9.1 in Appendix)	33849	2.99	1.16
Pays for Water	1="Pays for water", 0=Otherwise	33891	0.52	0.50
Individual characteristics				
Female	1="Female", 0="Male"	33981	0.46	0.50
Age Household Head		33981	50.55	15.06
Squared Age		33981	2782.48	1603.64
Years of Education Household Head		33906	7.90	4.33
Squared Years of Education		33906	81.22	62.43
Ethnicity	Dummies for *Black*, *Colored*, *Asian* and *White*	33981	-	-
Household characteristics				
Log of Household Size		33981	1.25	0.61
Log of Household Income	Household income includes earned income as well as social grants, remittances and private pensions.	32456	7.93	1.09
Owns Home	1="Owns home", 0=Otherwise	33971	0.81	0.40
Lives in Metro	1="Lives in metro", 0=Otherwise	33981	0.31	0.46
Reference groups				
Relative Reliability	Reference group defined by Province and Ethnicity	33849	1.00	0.38
Relative Reliability	Reference group defined by Municipality and Ethnicity	33849	1.00	0.37
Relative Reliability	Reference group defined by PSU level	33849	1.00	0.33
More Reliable Water Service than Prov/Mun/PSU Reference Group	Effect of having more reliable water services than the mean reference group reliability	33849	0.42/0.35/ 0.30	0.52/0.49/ 0.46
Less Reliable Water Service than Prov/Mun/PSU Reference Group	Effect of having less reliable water services than the mean reference group reliability	33849	0.42/0.35/ 0.30	0.64/0.56/ 0.50
Fixed effects				
Geotype	Dummies for *Urban Formal*, *Urban Informal*, *Tribal Area* and *Rural Formal*	33981	-	-
Year	Dummies for *2009*, *2010* and *2011*	33981	-	-
Province	Dummies for *Western Cape*, *Eastern Cape*, *Northern Cape*, *Free State*, *KwaZulu-Natal*, *North West*, *Gauteng*, *Mpumalanga* and *Limpopo*	33981	-	-
Drinking Water	Dummies for *Piped Water in Dwelling*, *Piped Water in Yard*, *Borehole on Site*, *Rainwater Tank*, *Neighbor's Tap*, *Public Tap*, *Water-carrier*, *Borehole off Site*, *Flowing Water*, *Dam/Pool*, *Well*, *Spring*, *Other*	33981	-	-

perceived water quantity in terms of interruptions (see Figure 9.1 in Appendix for an illustration). Thus, the lowest score (1) was assigned to those reporting interruptions in their water supply during the last twelve months, with at least one lasting for longer than two days, and with the total interruptions amounting to more than fifteen days without water. The second lowest score (2) is assigned to respondents who had interruptions that either amounted to a total of fifteen days or where at least one interruption lasted for two days. Next, the second to highest score (3) is assigned to respondents who reported interruptions, but where none of the interruptions lasted for two days or longer and where the total time without water during the last twelve months did not exceed fifteen days. The highest score (4) is assigned to respondents reporting no interruptions. Table 4.2 gives an overview of the distribution of the reliability score and satisfaction.

Table 4.2: Distribution of Satisfaction and Reliability Score

Satisfaction	Dissatisfied	Satisfied		
	41.67%	58.33%		
Perceived Water Service Reliability Score	1	2	3	4
	18.60%	11.35%	22.38%	47.67%

Second, the *Perceived Water Quality* score ranges from 1-5 and is similarly constructed from four bivariate questions on whether the water received was safe to drink, clear (had no color and was free from mud), good in taste, and free from bad smells. The lowest score (1) is given to respondents that answered no to all of these questions, the next to lowest score (2) is given to respondents who answered yes to one of the questions and so on, up to the highest score (5) which is given to respondents that answered yes to all of these questions (see Figure 9.2 in Appendix for an illustration).

The *Relative Reliability* is constructed by the reference group ratio, defined as the household's perceived water service reliability divided by the mean perceived water service reliability of the households' assumed reference group. Since reference groups are defined exogenously, we construct these by sorting respondents into groups according to geographical proximity (Province, Municipality and PSU) and ethnicity (*Black*, *Colored*, *Asian*, *White*). The reasons for this are as follows. First, given that the Social Comparison Theory hypothesizes that individuals compare themselves to similar others, previous literature commonly defines reference groups both socially and geographically (Deichmann and Lall, 2003). Second, this reference group construction is in line with the paper by Kingdon and Knight (2007) for South Africa, who consider the ethnical and idiomatic differences to be important factors in the construction of reference groups due to the

legacy from apartheid. Table 4.3 presents the definitions of the reference groups, number of total reference groups in our sample and approximate number of households per reference group in our sample. Note that reference groups for the PSU level are only based on geographical proximity, not ethnicity, given the small approximate number of households in each PSU group in our sample.

Table 4.3: Construction of Reference Groups

Reference group definition	Reference groups	Households/reference group
Provincial: *Ethnicity* (Black, Colored, Asian, White) and *geographical proximity* (9 Provinces)	36	315
Municipal: *Ethnicity* (Black, Colored, Asian, White) and *geographical proximity* (211 Municipalities)	844	13
PSU: *Geographical proximity* (2330 PSUs)	2330	5

The asymmetry variables *More Reliable Water Service than Reference Group* and *Less Reliable Water Service than Reference Group* indicate whether the household perceives its water service to be more or less reliable than the mean perceived water service reliability of the reference group. In addition to perceived water service performance and reference group variables, we also include additional control variables. The expected results of these are reported in Table 4.4.

Table 4.4: Expected Results of Additional Control Variables

Control Variable	Hypothesized Correlation with *Satisfaction with Water Service Delivery*	Basis for Hypothesis/Explanation
Water-related factors		
Pays for Water	Insignificant	Positive effect from receiving better water service delivery, negative effect from paying for a service that many do not pay for.
Individual characteristics		
Female	Ambiguous	Bratton (2007); Deichmann and Lall (2003)
Age Household Head	Positive	Bratton (2007)
Years of Education	Negative	Bratton (2007)
Ethnicity	Black (omitted), Colored (+), Asian (+), White (+)	Myburgh et al (2005)
Household characteristics		
Log of Household Size	Negative	Deichmann and Lall (2003)
Log of Household Income	Positive	Deichmann and Lall (2003)
Owns Home	Negative	Deichmann and Lall (2003)
Lives in Metro	Ambiguous	Depending on whether the household lives in a formal or informal settlement.
Fixed effects		
Geotype	Urban Formal (omitted), Urban Informal (-), Rural Formal (+), Tribal Area (-)	Bratton (2007). Also depending on whether the household lives in a formal or informal settlement.
Province	Western Cape (omitted), Gauteng (insignificant), other provinces (-)	Due to regional growth differences and historical reasons discussed in Section 2.

5 Results

The hypotheses of this thesis are empirically tested with bivariate probit models of equations (5) and (6), assuming normal distribution of standard errors, and controlling for variables presented in Table 4.1. Since estimates of the non-linear probit model are difficult to interpret, results are reported in average marginal effects. The reason for using average marginal effects, rather than marginal effects computed at a fixed point such as the mean, is that these include all observations. By averaging the marginal effect of all observations, and not just the ones around a fixed point, average marginal effects can be argued to display a more realistic picture (Bartus, 2005). Moreover, standard errors are adjusted for clustering at the PSU level, allowing for within PSU group correlation and as outlined before, dummies for *Drinking Water*, *Province*[12], *Geotype* and *Year* are included to account for fixed effects. Tables 5.1 and 5.2 summarize average marginal effects of the probit model testing hypotheses H1 and H2 by controlling for the three differently defined reference group comparison effects. Finally, Table 5.3 displays the average marginal effects of the probit model controlling for asymmetric comparisons, testing hypotheses H3 and H4.

Table 5.1 presents the average marginal effects of relative water service reliability on satisfaction with water service delivery at a provincial level for three different specifications: pooled probit, random effects probit and random effects probit with Mundlak corrections[13]. Prior to interpreting the variables of interest, similarities and differences between these specifications will be discussed. The reported Wald Chi-square test rejects the null hypothesis that all coefficients are jointly equal to zero for all three specifications, indicating high overall significance of included control variables. While most estimates in all three specifications are similar in significance, insignificant estimates of variables such as *Pays for Water* and *Age of Household Head Squared* obtained from the pooled model, become significant in the random effects and Mundlak specifications. Moreover, the estimate of *Log of Household Size* is only significant for the random effects specification at the ten percent significance level. With regard to the fixed effects for provinces and years, all dummy effects are highly significant at the one percent significance level. For fixed province effects, the omitted reference category is Western Cape, meaning that in comparison to Western Cape, living in the other provinces is associated with a decreased probability of being satisfied with water service

[12] Including municipal fixed effects yielded very similar results.

[13] Note that alternative specifications including ordered probit specifications (Satisfaction: 3=Good, 2=Average and 1=Poor), logit specifications and specifications using the mean of the reference group's performance as a separate control variable ($\bar{x}$) yielded similar results to all bivariate probit specifications. Results from these alternative models are available on request.

Table 5.1: Comparison of Bivariate Probit Model Specifications (Average Marginal Effects)

Variables	(1) Pooled Probit	(2) Random Effects	(3) Mundlak Random Effects
Relative Reliability	0.197***	0.206***	0.206***
	(0.0459)	(0.0317)	(0.0317)
Perceived Water Quality	0.136***	0.139***	0.139***
	(0.00679)	(0.00446)	(0.00446)
Perceived Water Service Reliability	0.0361**	0.0362***	0.0362***
	(0.0168)	(0.0119)	(0.0119)
Female	0.000368	0.000101	-0.000246
	(0.00551)	(0.00564)	(0.00567)
Log of Household Size	-0.00802	-0.00856*	-0.0108
	(0.00489)	(0.00485)	(0.00963)
Log of Household Income	0.00527*	0.00568*	0.00760*
	(0.00306)	(0.00301)	(0.00452)
Age Household Head	-0.00219**	-0.00242**	-0.00240**
	(0.00104)	(0.00106)	(0.00106)
Squared Age	1.47e-05	1.69e-05*	1.68e-05*
	(9.69e-06)	(9.85e-06)	(9.86e-06)
Years of Education Household Head	-0.00404*	-0.00408*	-0.00420*
	(0.00209)	(0.00213)	(0.00214)
Squared Years of Education	0.000157	0.000159	0.000175
	(0.000148)	(0.000151)	(0.000154)
Owns Home	-0.00274	-0.00253	-0.00264
	(0.00856)	(0.00715)	(0.00716)
Pays for Water	0.00975	0.0117*	0.0120*
	(0.00864)	(0.00707)	(0.00709)
Lives in Metro	0.00614	0.00745	0.00749
	(0.0142)	(0.00896)	(0.00896)
Colored	-0.00572	-0.00414	-0.00395
	(0.0163)	(0.0122)	(0.0122)
Asian	0.104***	0.108***	0.108***
	(0.0280)	(0.0212)	(0.0213)
White	0.105***	0.109***	0.110***
	(0.0207)	(0.0163)	(0.0164)
Urban Informal	-0.00678	-0.00647	-0.00650
	(0.0163)	(0.0111)	(0.0111)

Table 5.1 continued: Comparison of Bivariate Probit Model Specifications (Average Marginal Effects)

Tribal Area	-0.0295**	-0.0311***	-0.0311***
	(0.0145)	(0.00956)	(0.00957)
Rural Formal	0.0177	0.0182	0.0181
	(0.0523)	(0.0346)	(0.0346)
Eastern Cape	-0.152***	-0.158***	-0.158***
	(0.0225)	(0.0154)	(0.0155)
Northern Cape	-0.130***	-0.136***	-0.136***
	(0.0258)	(0.0159)	(0.0159)
Free State	-0.162***	-0.169***	-0.169***
	(0.0212)	(0.0153)	(0.0153)
KwaZulu-Natal	-0.163***	-0.169***	-0.169***
	(0.0216)	(0.0155)	(0.0155)
North West	-0.207***	-0.215***	-0.215***
	(0.0251)	(0.0171)	(0.0171)
Gauteng	-0.153***	-0.159***	-0.159***
	(0.0168)	(0.0130)	(0.0130)
Mpumalanga	-0.257***	-0.269***	-0.269***
	(0.0340)	(0.0229)	(0.0229)
Limpopo	-0.244***	-0.254***	-0.254***
	(0.0317)	(0.0217)	(0.0217)
2010	0.0699***	0.0726***	0.0727***
	(0.00906)	(0.00612)	(0.00613)
2011	0.0354***	0.0366***	0.0367***
	(0.00937)	(0.00614)	(0.00614)
Fixed effects	Yes	Yes	Yes
Mundlak corrections	No	No	Yes
Rho	-	0.1169	0.1169
Wald Chi-Sq (df)	2282.42***(38)	4512.76***(40)	4513.63***(42)
Likelihood-ratio test (rho=0)	-	122.38***	122.38***
Observations	31,984	31,989	31,989

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors (shown in parentheses) are adjusted for clustering at the PSU level. Dependent variable is *Satisfaction with Water Service Delivery*. *Urban Formal* and *Black* for *Geotype* and *Ethnicity*, respectively, are the reference categories and therefore omitted from the estimation. Fixed effects include *Drinking Water*.

delivery. Results for fixed year effects, capturing the time trend in the probability of being satisfied, suggest a positive trend, with a peak in 2010 and a slightly lower effect in 2011, compared to the omitted reference category 2009. Given that fixed effects for province and year display similar average marginal effects for all probit model specifications in this thesis, these will henceforth not be reported in detail. Further, the panel probit model is compared to the pooled probit model. The estimate of Rho indicates the contribution of the panel level component to the total variance. In our case, 12 percent of the total variance is due to variation across panels. While this is a relatively small proportion, the reported likelihood ratio test with the null hypothesis that Rho equals zero is rejected, which indicates that the panel probit model is significantly different from the pooled probit model. Hence, the panel level variance component is important. Finally, to determine justification of the Mundlak specification, we test for joint significance of the chosen sub-sample of independent variables believed to correlate with the error term (*Mean Log of Household Income*, *Mean Years of Education Squared* and *Mean Log of Household Size*) but the null hypothesis, that estimates are jointly equal to zero, cannot be rejected. This suggests that unobserved heterogeneity is uncorrelated with the chosen sub-sample of independent variables and there is hence no support for the Mundlak specification being superior to the traditional random effects model. Therefore, in the analysis that follows, the thesis relies on the random effects probit specifications.

Average marginal effects of relative water service reliability on satisfaction with water service delivery at a provincial, municipal and PSU level are reported in column 1, 2 and 3 of Table 5.2, respectively. In the following we interpret the results for the variable of interest, the performance variables, and the control variables in turn. In terms of the main variable of interest, results show significant estimates for *Relative Reliability* at the provincial and PSU level whereas the effect at the municipal level is insignificant. As for the provincial level, results are in line with hypothesis H1 since the estimate of *Relative Reliability* is positive and significant at the one percent significance level, implying that higher perceived water service reliability relative to the reference group is associated with increased probability of being satisfied with water service delivery. More specifically, a one unit increase in the reference ratio correlates with an average increase of 21 percentage points in the probability of being satisfied with water service delivery, controlling for households' own water service reliability. However, with regard to the municipal level, this thesis finds no evidence for a significant effect of *Relative Reliability* on the probability of being satisfied with water service delivery, contradicting the hypothesized outcome for municipal reference groups in H1.

Table 5.2: Bivariate Probit Specifications with Random Effects (Average Marginal Effects)

Variables	(1) Provincial level	(2) Municipal level	(3) PSU level
Relative Reliability	0.206***	-0.0221	-0.0869***
	(0.0467)	(0.0229)	(0.0196)
Perceived Water Quality	0.139***	0.139***	0.138***
	(0.00706)	(0.00708)	(0.00705)
Perceived Water Service Reliability	0.0362**	0.119***	0.136***
	(0.0170)	(0.00836)	(0.00674)
Female	0.000101	0.000302	0.00120
	(0.00529)	(0.00529)	(0.00527)
Log of Household Size	-0.00856*	-0.00820*	-0.00760
	(0.00473)	(0.00473)	(0.00470)
Log of Household Income	0.00568*	0.00553*	0.00547*
	(0.00302)	(0.00303)	(0.00302)
Age Household Head	-0.00242**	-0.00232**	-0.00229**
	(0.00102)	(0.00102)	(0.00101)
Squared Age	1.69e-05*	1.63e-05*	1.61e-05*
	(9.50e-06)	(9.48e-06)	(9.44e-06)
Years of Education Household Head	-0.00408**	-0.00406**	-0.00414**
	(0.00195)	(0.00195)	(0.00194)
Squared Years of Education	0.000159	0.000165	0.000165
	(0.000142)	(0.000142)	(0.000141)
Owns Home	-0.00253	-0.00427	-0.00425
	(0.00846)	(0.00848)	(0.00844)
Pays for Water	0.0117	0.0135	0.0104
	(0.00822)	(0.00826)	(0.00821)
Lives in Metro	0.00745	0.00196	-0.00147
	(0.0146)	(0.0147)	(0.0145)
Colored	-0.00414	-0.0364**	-0.0389***
	(0.0156)	(0.0147)	(0.0146)
Asian	0.108***	0.0653**	0.0636**
	(0.0273)	(0.0258)	(0.0253)
White	0.109***	0.0663***	0.0628***
	(0.0207)	(0.0189)	(0.0187)
Urban Informal	-0.00647	-0.00736	-0.0102
	(0.0161)	(0.0163)	(0.0161)
Tribal Area	-0.0311**	-0.0304**	-0.0199
	(0.0147)	(0.0151)	(0.0150)
Rural Formal	0.0182	0.0156	0.0105
	(0.0497)	(0.0498)	(0.0150)
Fixed effects	Yes	Yes	Yes
Rho	0.1169	0.1172	0.1140
Wald Chi-Sq (df)	4512.76***(40)	4496.50***(40)	4483.70***(40)
Likelihood-ratio test (rho=0)	125.58***	123.28***	116.56***
Observations	31,989	31,989	31,989

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors (shown in parentheses) are adjusted for clustering at the PSU level. Dependent variable is *Satisfaction with Water Service Delivery*. *Urban Formal* and *Black* for *Geotype* and *Ethnicity*, respectively, are the reference categories and therefore omitted from the estimation. Fixed effects include *Year, Province* and *Drinking Water*.

Finally, results from the PSU level display a negative and highly significant estimate of *Relative Reliability*, suggesting that a one unit increase of the reference ratio is, on average, associated with a 9 percentage points decrease in the probability of being satisfied with water service delivery, controlling for households' own water service reliability. This hence confirms the hypothesized results of H2 that the PSU reference group ratio should have a negative and significant correlation with the probability of being satisfied with water services.

As expected, estimates of *Perceived Water Quality* and *Perceived Water Service Reliability* are positive and highly significant in the three specifications. While the magnitude of *Perceived Water Quality* remains constant, there is an inverse relationship between geographical level and the magnitude of *Perceived Water Service Reliability*. The implication is that a one unit increase in the quality score is associated with an average increase of 14 percentage points in the probability of being satisfied with water service delivery at al levels, whereas a one unit increase in the reliability score is associated with an average increase of 4, 12 and 14 percentage points in the probability of being satisfied for provincial, municipal and PSU reference group specifications respectively.

For individual and household characteristics, all three model specifications in Table 5.2 reveal estimates similar in magnitude, signs and significance levels. Since, intuitively, some of the individual and household characteristics should be correlated with each other, for example *Household Income*, *Owns Home*, and *Pays for Water*, we test for multicollinearity. This is done by computing the variance inflation factors (VIF) which indicate how much of the variance that is inflated by multicollinearity. A common rule of thumb is that a mean VIF value greater than 10 indicates presence of multicollinearity. All of our specifications generate mean VIF values below 10, averaging at 4.4, which suggests absence of a serious multicollinearity problem among the individual and household characteristics. Turning to the average marginal effects for these variables, we find no significant correlation of *Female*, *Years of Education Squared*, *Owns Home*, *Pays for Water* and *Lives in Metro* to *Satisfaction* respectively. Although small in magnitude (0.4 and 0.2 percentage points respectively), estimates of *Years of Education Household Head* and *Age of Household Head* are negative and significant at the five percent significance level. Regarding the non-linear variables, estimates of *Log of Household Income*, *Squared Age* and *Log of Household Size* are all positive and significant at the rather weak ten percent significance level, with the exception of *Log of Household Size* at the PSU level. However, estimates are again small in magnitude (0.5, 0.002, and 0.8 percentage points respectively, in absolute terms). Furthermore, the dummies for *Ethnicity* are highly significant in all three specifications, with the exception of *Colored* at the provincial level. Results suggest that being Asian or white, compared to being black, is on average positively and significantly associated with the probability of being satisfied with water service delivery. This

effect is largest in magnitude for the provincial specification. However, being colored is on average negatively and significantly correlated with the probability of being satisfied with water service delivery at the municipal and PSU level. Finally, it appears that, at a provincial and municipal level, living in a tribal area is associated with a decreased probability of being satisfied with water services compared to living in an urban formal area.

Results in Table 5.1 and 5.2 indicate that social comparisons of water service reliability seem to matter. However, prior tables do not allow the effect of social comparisons to be different for different households. Testing for the hypothesized asymmetry in social comparisons at the provincial, municipal and PSU level (hypotheses H3 and H4), Table 5.3 therefore reveals further interesting results. These will be interpreted in the following. At the provincial level, we find a positive and significant effect of downward comparisons and an insignificant effect of upward comparisons, controlling for households' own water service reliability. Hence, in line with the predicted outcome in hypothesis H3, more reliable water service than the reference group is, on average, associated with an increase in the probability of being satisfied with water service delivery. However, since there is no evidence for the upward comparison effect expected in hypothesis H3, we cannot establish that households with less reliable water services are less likely to be satisfied. Further, results report negative and highly significant effects of downward comparisons at both the municipal and PSU level, controlling for households' own water service reliability. Hence, at the municipal and PSU level, more reliable water service than the reference group is, on average, associated with a decrease in the probability of being satisfied with water service delivery. Moreover, the effect of upward comparisons is highly significant and positive, implying that receiving less reliable water services than one's reference group is, on average, correlated with an increase in the probability of being satisfied. As can be seen, the magnitude of upward comparison effects at the municipal and PSU level is approximately twice as large as the downward comparison effects (5 and 8 percentage points compared to 2 and 3 percentage points for municipal and PSU groups, respectively). These results are partly in line with hypothesized results for PSU reference groups in hypothesis H4, but contradicts hypothesis H3 regarding municipal reference groups. While we expected in hypothesis H4 to find insignificant downward comparison effects at PSU level, results indicate significant comparison effects of both upward and downward comparisons. Regarding the municipal level, results were expected in hypothesis H3 to be significant and have the opposite signs to what results indicate. Contrary to what was hypothesized, the asymmetric comparison effects at the municipal level are hence similar to the results at PSU level, rather than the provincial level. However, the magnitude of both negative downward comparisons and

Table 5.3: Asymmetric Comparison Effects (RE model, Average Marginal Effects)

Variables	(1) Provincial Level	(3) Municipal Level	(2) PSU Level
More Reliable Water Service than Reference Group	0.0517**	-0.0208**	-0.0315***
	(0.0263)	(0.00855)	(0.00758)
Less Reliable Water Service than Reference Group	-0.0316	0.0527***	0.0835***
	(0.0268)	(0.00884)	(0.00779)
Perceived Water Quality	0.139***	0.139***	0.139***
	(0.00448)	(0.00448)	(0.00446)
Perceived Water Service Reliability	0.0718***	0.145***	0.155***
	(0.0260)	(0.00657)	(0.00476)
Female	9.75e-05	0.000907	0.00196
	(0.00565)	(0.00564)	(0.00561)
Log of Household Size	-0.00842*	-0.00862*	-0.00813*
	(0.00485)	(0.00485)	(0.00482)
Log of Household Income	0.00558*	0.00599**	0.00576*
	(0.00301)	(0.00301)	(0.00299)
Age Household Head	-0.00235**	-0.00240**	-0.00234**
	(0.00106)	(0.00106)	(0.00106)
Squared Age	1.65e-05*	1.71e-05*	1.65e-05*
	(9.86e-06)	(9.85e-06)	(9.79e-06)
Years of Education Household Head	-0.00390*	-0.00443**	-0.00442**
	(0.00213)	(0.00213)	(0.00212)
Squared Years of Education	0.000151	0.000190	0.000180
	(0.000152)	(0.000151)	(0.000150)
Owns Home	-0.00387	-0.00334	-0.00304
	(0.00717)	(0.00716)	(0.00712)
Pays for Water	0.0139**	0.0117*	0.00845
	(0.00707)	(0.00708)	(0.00705)
Lives in Metro	0.00583	-0.00404	-0.00434
	(0.00901)	(0.00910)	(0.00895)
Colored	-0.0173	-0.0403***	-0.0396***
	(0.0151)	(0.0114)	(0.0112)
Asian	0.0906***	0.0617***	0.0639***
	(0.0244)	(0.0204)	(0.0202)
White	0.0921***	0.0605***	0.0616***
	(0.0202)	(0.0152)	(0.0150)
Urban Informal	-0.00646	-0.0120	-0.0139
	(0.0111)	(0.0111)	(0.0110)
Tribal Area	-0.0354***	-0.0196**	-0.0113
	(0.00959)	(0.00999)	(0.00978)
Rural Formal	0.0170	0.0141	0.00822
	(0.0347)	(0.0346)	(0.0343)
Fixed effects	Yes	Yes	Yes
Rho	0.1177	0.1174	0.1137
Wald Chi-Sq (df)	4504.43***(41)	4482.51***(41)	4463.42***(41)
Likelihood-ratio test (rho=0)	124.06***	123.48***	115.57***
Observations	31,989	31,989	31,989

Notes: *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors (shown in parentheses) are adjusted for clustering at the PSU level. Dependent variable is *Satisfaction with Water Service Delivery*. *Urban Formal* and *Black* for *Geotype* and *Ethnicity*, respectively, are the reference categories and therefore omitted from the estimation. Fixed effects include *Year*, *Province* and *Drinking Water*.

positive upward comparisons is larger at the PSU level compared to the municipal level. The implications of these results will be discussed further in Section 6.

6 Discussion of Results

In the following, we discuss the results obtained in Section 5. First, the main variable of interest, *Relative Reliability*, which is a proxy for social comparisons, is discussed. Second, the geographical aspects of provinces and locality types, as well as the social aspects of ethnicity, are analyzed. In the third and fourth subsections, issues of internal and external validity are elaborated on. The fifth subsection discusses potential policy implications and the final subsection suggests topics for further research.

6.1 Social Comparisons

Starting our analysis with the object under scrutiny, the social comparison effect, we find that its relation to satisfaction partly follows the hypothesized pattern of negative comparison effects for larger reference groups and positive for smaller, that was based on results found in Kingdon and Knight (2007). This indicates that the definition of the reference group matters greatly and that households evaluate their relativity differently depending on whether comparison is made to close neighbors or to more distant others[14]. The social comparison pattern found is interesting for several reasons. First, as seen in Table 5.2, at the provincial level we find signs of rivalry; an increase in the water service reliability relative to the reliability of the reference group correlates with an increased average probability of water service delivery satisfaction and vice versa, controlling for households' own reliability of water services. As outlined in the literature review, this effect could be explained in various ways. It could mean that a household receiving a higher frequency and longer duration of interruptions in water supply, compared to what is common among others of the same ethnicity living in the same province, feels envy and hence is less satisfied. Another explanation is that those receiving less interruptions and/or interruptions with shorter duration would feel prestige and gratefulness of finding themselves in a better position than "similar others" in their province. The asymmetry test, reported in Table 5.3, indicates the latter, since the variable for having more reliable water services than the provincial reference group has a positive and significant correlation with satisfaction. Regarding the variable for having less reliable water services than the provincial reference group we find no significant correlation with satisfaction and we can therefore not find any signs of envy in our sample. Second, when the reference group is instead defined at the lowest geographical level (PSU), we observe the opposite effect of relative water service reliability on satisfaction, such that an increase in frequency or duration of interruptions relative to the PSU reference group correlates with a higher average probability of

[14] Note has to be made that when geographical distance increases, we also assume that social distance increases, so that the meaning of "neighbors" and "distant others" could have both a physical and social meaning. Hence, even though PSU groups are only defined geographically, we assume that also social proximity is the closest at this level due to neighborhood interaction and the fact that households living in a PSU often have the same ethnicity.

satisfaction, controlling for households' own reliability of water service (see Table 5.2). Hence, at this level we find signs of altruism or risk-sharing within the reference groups. As outlined in the literature review, a possible explanation to this result is that households receiving more reliable water service than their PSU reference group experience feelings of regret. On the other hand, it could also be the case that households receiving less reliable water service than the reference group benefit from an information signal of how their future water service delivery will be. Conducting the asymmetric comparison effects regressions, reported in Table 5.3, we find signs of both regret (downward comparisons) and information signaling (upward comparisons), with the latter being the strongest effect. Given that both effects exist and differ in magnitude, we conclude that comparison effects do seem to affect households differently at PSU level. However, what is commonly interpreted as an altruistic effect could in fact also be a sign of households with below-mean services benefitting from using water from neighbors with more reliable water, alternatively households with above-mean services suffering from neighbors expecting to share it, which would reflect both positive and negative externalities from risk-sharing. This could also result in the households receiving above-mean services having to pay not only for its own water consumption, but also for that of its less well-off neighbors. Finally, as was seen in Table 5.2, defining reference groups at the municipal level produces an insignificant estimate of *Relative Reliability* in contrast to the hypothesized negative and significant correlation between social comparisons and satisfaction. Since the probability of households knowing each other decreases with the inclusion of a bigger geographical area in the reference group, we expected to find increasingly more negative effects of reliability comparison the more distant respondents that were included in the reference group. In this line of thought, the municipal level results could indicate that the municipal level is a "medium" level in the sense that the reference group is not close enough for altruism and risk-sharing to exist, but also not distant enough for there to be rivalry effects. However, looking at the asymmetry regressions at the municipal level in Table 5.3, we find signs of both regret and information signaling, with the latter being the strongest effect, as was also the case at the PSU level. This again supports the notion that comparison effects affect households differently, and that upward comparisons are the strongest.

In the discussion on social comparisons it is also important to remember that the performance variable *Perceived Water Service Reliability* is affecting results through both a direct effect and an indirect effect via *Relative Reliability*. An improvement in actual reliability would hence be correlated with satisfaction in two ways, and differently at province and PSU level. At the provincial level, both *Perceived Water Service Reliability* and *Relative Reliability* would increase its positive effect on satisfaction by this improvement. At the PSU level, however, an improvement of actual reliability

would affect *Perceived Water Service Reliability* and *Relative Reliability* positively, but due to the negative estimate of *Relative Reliability*, the implied correlation with satisfaction would be more ambiguous. Since results for this variable at municipal level are insignificant, we cannot make the same analysis at this level.

Concluding this subsection, social comparisons seem to correlate strongly with households' satisfaction with municipal water service delivery and this effect varies between different definitions of reference groups.

6.2 Geographical and Social Differences

Another aspect worth noting in the results is that of geographical and social differences. Starting with geographical disparities, living in Western Cape is most notably associated with an increase in the average probability of satisfaction compared to the other provinces. This is the case for all model specifications in Table 5.1 and 5.2. A potential reason for this could be that its development started earlier, as mentioned in Section 2. Hence, Western Cape might have had a head start when it comes to, for example, building water service infrastructure. The reason that Western Cape distinguishes itself could, however, also be explained in political terms. Cape Town has had frequent shifts in power between the African National Congress (ANC) and the Democratic Alliance (DA), whereas in the other metros ANC has held a more permanent power position (Smith, 2011). These frequent political turnovers might hence have forced the party in power to perform better than expected, since they have had much to prove. As a result, there might have been a positive pressure causing political leaders to, for example, improve water service delivery systems. Explaining the success of Western Cape in political terms is not without ambiguity, however, since high political turnover could also cause planning and policy implementation to be shortsighted in which case budget allocations for upgrading or maintaining sustainable water service delivery systems might be of lower priority than more populist projects. Another geographical difference indicated by the results is the effect of locality type (*Geotype*) on satisfaction with water service delivery. In the model specifications for province and municipality in Table 5.1 and 5.2, the only significant locality type effect is that of tribal areas. Hence, at the provincial and municipal levels living in a tribal area is significantly correlated with lower average satisfaction compared to living in an urban formal area, whereas all other locality types have insignificant correlations with satisfaction. Neither does the variable controlling for if the household is located in a metro correlate significantly with satisfaction. Living in a tribal area thus seems to be associated with a particular disadvantage when it comes to water service delivery. There could be several explanations to this. One is that households living in tribal areas tend to move around, aggravating the possibilities of providing reliable water service delivery. However, since this thesis only focuses

on respondents staying in the same dwelling for three consecutive years, this reason, although valid, could not be applied in our case. Instead, there might be other reasons such as greater distrust in government explaining the dissatisfaction of this group.

As for social differences, all specifications in Table 5.1 and 5.2 show strong significance of the dummies for *Ethnicity*, where being black or colored correlates with lower average satisfaction than being white or Asian. The strong significance of these variables might be seen as a reflection of the South African society, where segregation during apartheid created socioeconomic divides defined by ethnicity (Kingdon and Knight, 2007). Even though twenty years has passed since this era, black and colored South Africans still earn less than whites and Asians (Statistics South Africa, 2012). These ethnic groups are also overrepresented in poverty and unemployment statistics (Ayo-Yusuf and Olutola, 2013; Statistics South Africa, 2012). All of these factors might contribute to a general dissatisfaction with public services, and hence explain part of the obtained results.

In conclusion, besides the effect of social comparisons, households' satisfaction with municipal water service delivery in 2009-2011 also correlated with factors such as perceived water service performance, and household and individual characteristics capturing regional and social differences.

6.3 Internal Validity

While this thesis has accounted for several of the biases discussed in Section 4.2, some concerns still remain. The following is a discussion on how results might have been affected, should our data be subject to any of these biases. First, recall bias would have an ambiguous effect on results since the direction of this measurement error bias is not obvious. Second, the presence of obsequiousness bias in data would imply that respondents answered in accordance with what they anticipated that the interviewer expected to hear. Should this bias be present in our data, we believe it would cause an upward bias, so that for example reported satisfaction would be exaggerated and frequency and duration of interruptions understated. Third, subjectively reported measures might not reflect actual values. If so, we believe it would cause a downward bias since one of the reasons for low cost recovery in the South African water sector is distrust in government, which might be reflected in satisfaction surveys. Hence, when asked about satisfaction for a specific public service, respondents might instead evaluate the service provider and express dissatisfaction with the same. Fourth, our chosen dependent variable, *Satisfaction with Water Service Delivery*, might capture the same household perception as the two control variables of water service performance (*Perceived Water Quality* and *Perceived Service Reliability*). However, since we receive different effects of *Relative Reliability* on *Satisfaction with Water Service Delivery* at different geographical levels, we conclude that

the separation of the dependent variable from the independent ones does not seem to be a problem in our case. Finally, when it comes to omitted variable bias, it is possible that we do not account for factors correlated to both water service performance and satisfaction, indicating an upward bias. One example is quality of sanitation, which could influence both perceived water service performance and satisfaction with water service delivery and the importance of water service performance might therefore be exaggerated in the regressions. Other omitted variables could be municipal or PSU specific effects such as common municipal governance or neighborhood spirit. However, since results do not change much when running the regressions with municipal fixed effects, this concern is minimized[15]. In conclusion, possible biases beyond our control could be both downward and upward.

6.4 External Validity

Extrapolating the results of this thesis geographically is not without concerns. On the one hand, social comparisons can be argued to be part of human nature and thus something that takes place everywhere, so that external validity of these results would be extensive. What mainly differs might then be how the reference group is defined in different societies. However, South Africa is in many aspects a unique country and several aspects must be considered before transferring lessons learned and policy formulations to other countries. Adaption to local settings must always be incorporated into the analysis and recommendations. First, social comparisons in water service delivery presuppose that there are differences in the same. It might thus be hard to extend the results of this thesis to developed countries, since differences in interruption frequency and duration are not as commonly seen as in the South African sample. Further, in developed countries, the occurrence of private taps located in the yard rather than inside the house and/or community taps is not very common. This results in less visibility of potential differences in water services and hence decreases the opportunity for comparisons. Second, results should not be extrapolated too far in the other direction either. Developing countries are diverse and, as discussed in Section 2, South Africa distinguishes itself as far more developed than most other African countries. It is therefore not obvious that results of social comparisons of water service delivery in a diverse and increasingly urban society such as South Africa can be taken as valid for rural and less developed countries. Third, the most similar countries to South Africa would perhaps be other emerging markets, not the least the rest of the BRICS countries. In certain aspects, some of these countries are indeed similar. For example, Brazil compares to South Africa in its colonial history and in inheriting both infrastructure and an ethnically divided society. However, in terms

[15] Due to practical reasons of the software (Stata 12) not handling regressions of that size, PSU fixed effects could not be added in our regressions.

of growth rate and size, South Africa is not comparable to other BRICS countries. One should therefore be careful in applying the results of this thesis to the rest of the BRICS. In this regard, smaller emerging markets, such as Nigeria, might be more comparable to South Africa. Finally, regarding the representativeness of results for South Africa, consideration must be taken to the fact that our results cohere only to a sample of citizens with municipal water and a permanent address. Moreover, visibility of water reliability is likely to decrease with increased income, since wealthier citizens are more likely to have in-house taps. Results might hence be more valid for households in the lower income ranges. Given these two caveats, even extrapolation of results to the whole South African population should be done with caution.

6.5 Policy Implications

Since the data used in this thesis is from 2009-2011, one should be careful in suggesting policy implications on basis of its results, considering the fast pace with which urbanization and informal settlement enlargement is taking place in South Africa. Also, it is important to note that the results in this thesis cannot be interpreted as causal effects but rather as correlations, and that results only apply with certainty to citizens with municipal water supply and a permanent address, since this is the specific sample studied. Even so, our results do indicate aspects of comparison effects in relation to satisfaction surveys that might be useful to consider in future policy-making in South Africa.

The main point to be made in relation to our results is that, as indicated by the significant effects of comparisons on satisfaction with water service delivery, satisfaction surveys might have limited validity as a basis for policy making in the water sector. The reason for this is that households' satisfaction with water service delivery appears to be significantly influenced by psychological and behavioral factors such as social and geographical comparisons. Even in the case of non-significant comparison effects at the municipal level, we find evidence of significant asymmetric effects – again indicating that subjective behavioral factors are important for the probability of being satisfied. Attempting to use this in policy-making is difficult, since it is neither clear *how* to formulate policies targeted at decreasing/increasing comparison effects, nor *what effects* these policies would have. Designing policies aimed at reducing inequalities would have ambiguous results since we find evidence of both upward and downward comparison effects at PSU and municipal level. Further, the significant downward effect found at provincial level is opposite to the downward effect found at PSU and municipal level. The complexity of sometimes opposing effects suggests that whatever group water reliability polices are targeted towards, some households' satisfaction will increase and others' will decrease. Moreover, since household's satisfaction is both directly affected by own water service reliability and indirectly affected by

relative reliability, the effect of any changes in water service reliability will depend on which effect is stronger and the final effect on satisfaction is hence ambiguous. In the light of this, the use of satisfaction surveys as a basis for policy formulation is limited. Nevertheless, satisfaction surveys might serve other purposes and should hence not be ruled out. For example, the World Development Report from 2004 as well as prior research has emphasized the importance of providing citizens with the opportunity to voice their concerns and give feedback to public service providers since, in contrast to private services, citizens often lack the option of turning to alternative service providers should they not be satisfied with the public service delivery (Deichmann and Lall, 2003; Roch and Poister, 2006; Bratton, 2007; World Bank, 2004). In this respect, satisfaction surveys can play an important role for democracy in that it enables citizens to monitor service providers. Also, if used frequently, these feedback opportunities might even cause protests to be considered a less necessary action. Finally, satisfaction surveys could also serve as a complement to more objective measures, so that implemented public policies are designed with the service user in mind.

6.6 Further Research

Research regarding social comparisons of public services in developing countries is still scarce and further research is needed in several areas. First, previous research on health and education services in developing countries has shown that responsiveness is one of the most important determinants of satisfaction with these public services (Bratton, 2007). This aspect would be an interesting extension to the research questions in this thesis. In other words, to what extent is satisfaction with water service delivery determined by the public service provider rather than the actual public service? A general (dis)satisfaction with responsible authorities' availability and responsiveness might potentially affect how households evaluate the services that these authorities provide. While the water service provider is not as visible to the service user as providers of health or education services, a more transparent and accountable policy towards citizens would promote satisfaction and establish a sense of influence among the citizens. Second, since comparisons are highly subjective, future studies in this area should collect endogenous data both on to whom households compare themselves as well as on how households perceive the reliability of other households' public services. It would allow for more variation in size and design of reference groups as well as give more accurate measures of the perceived relative service received. This would also solve the problem of having less visibility of public services among certain groups in society, as discussed in Section 6.2. Finally, to investigate whether the results obtained in this thesis can be generalized to other public services of interest, research on social comparison effects and satisfaction should be extended to other public services such as sanitation and electricity.

7 Conclusion

This thesis has sought to answer the following two research questions for South African households with municipal water supply and a permanent address 2009-2011: *1) Which factors affected satisfaction with water service delivery? 2) To what extent did social comparisons affect satisfaction and how did this effect vary between different definitions of reference groups?*

We find significant effects of water-related factors and household and individual characteristics on households' satisfaction with water service delivery. In addition, social comparisons significantly influence households' satisfaction with municipal water service delivery in two of the three reference group definitions. Interestingly, the sign of the effect varies depending on the reference group definition. When the reference group is defined by the largest geographical unit (province) as well as by ethnicity, we find a positive relationship between households' probability of being satisfied with water service delivery and its relative water service reliability, controlling for households' own water service reliability. When the reference group instead is defined by the smallest geographical unit (PSU group), results suggest a negative relationship between households' satisfaction and their water service reliability relative to the reference group. The main implication is therefore that households' evaluation of their relative water service reliability depends on whether comparisons are made to close neighbors or to more distant others. Further, when investigating the asymmetry of comparison effects, we find evidence of both *upward* and *downward* comparisons at PSU and municipal levels and *downward* comparisons at the provincial level, suggesting that comparison effects impact households differently. In summary, this thesis has, in the context of South Africa, offered a perspective on the relationship between citizens' satisfaction and social comparisons with regard to water service delivery. We conclude that satisfaction surveys serve a limited purpose as a basis for public service assessment since psychological and behavioral factors such as comparison effects are found to be significant for the probability of being satisfied. While these factors, non-related to experience by the actual service user, are difficult for policymakers to influence, citizen feedback through satisfaction studies could still have an intrinsic value in a society with an escalating trend of public protests and governmental distrust.

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9 Appendix

Table 9.1: Comparison of Mean Values between Municipal Water Sample and Our Sample

Variable	Original Sample	Our Sample	t/z-Statistic	Pr(|T| > |t|)/ Pr(|Z| < |z|)
Individual and household characteristics				
Age of household head	49.31	50.55	-11.15	0.000
Household size	3.86	4.15	-17.18	0.000
Probability female household head	44.53%	46.34%	-5.00	0.000
Years of education household head	8.18	7.90	8.74	0.000
Total household income (SA rand)	4884.75	4789.13	2.39	0.017
Probability paying for water	52.12%	52.44%	-0.89	0.372
Probability owning house	76.00%	80.64%	-15.45	0.000
Probability household head is:				
Black	77.62%	78.99%	-4.59	0.000
Colored	12.53%	12.77%	-1.00	0.316
Asian	3.21%	2.70%	4.17	0.000
White	6.65%	5.54%	6.31	0.000
Geographical characteristics				
Probability of living in:				
Western Cape	12.40%	12.38%	0.09	0.927
Eastern Cape	9.93%	10.11%	-0.84	0.401
Northern Cape	7.41%	7.59%	-0.96	0.337
Free State	11.78%	11.76%	0.08	0.933
KwaZulu-Natal	15.03%	13.98%	4.11	0.000
North West	8.23%	8.67%	-2.16	0.031
Gauteng	15.61%	14.58%	3.95	0.000
Mpumalanga	11.38%	11.70%	-1.35	0.178
Limpopo	8.23%	9.24%	-4.93	0.000
Water related variables				
Probability satisfied	59.32%	58.33%	2.76	0.006
Quality score	4.83	4.83	0.37	0.714
Reliability score	3.05	2.99	6.72	0.000

Figure 9.1: Construction of Reliability Score

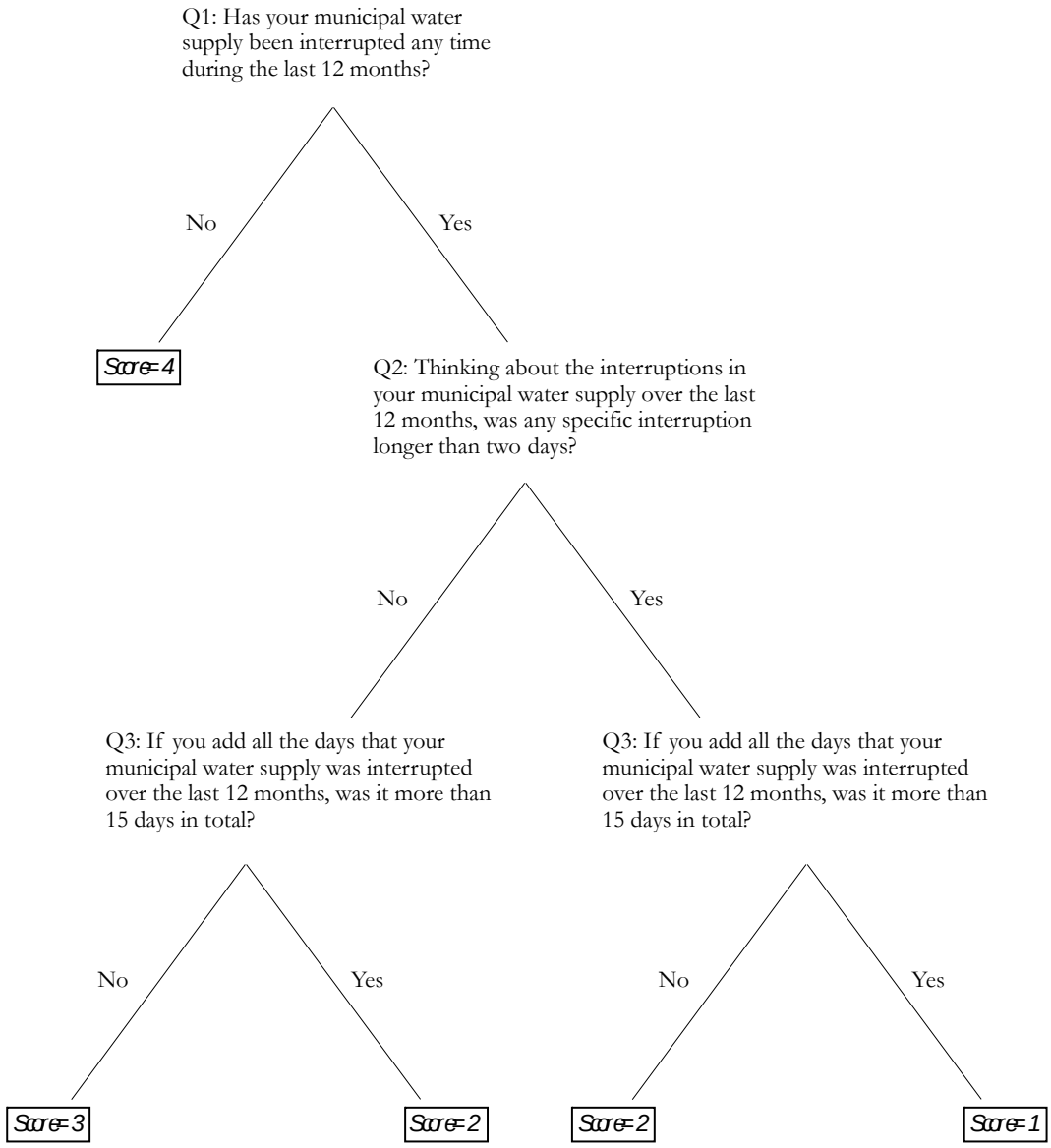

Figure 9.2: Construction of Quality Score

Q1: Is the water from the main source of drinking water before any treatment...		
...safe to drink?	Yes	No
...clear (has no color/free from mud)?	Yes	No
...good in taste?	Yes	No
...free from bad smells?	Yes	No

→ Four "Yes" = Score5

→ Three "Yes" and one "No" = Score4

→ Two "Yes" and two "No" = Score3

→ One "Yes" and three "No" = Score2

→ Four "No" = Score1

Table 9.2: Meetings in South Africa

Gauteng

Name	*Title*	*Organization*	*Date*
Mr Niël Roux	Manager - Service Delivery and Education Statistics	Statistics South Africa	2014-02-19 and 2014-04-08
Dr Johane Dikgang	Senior Lecturer at the Department of Economics and Econometric	University of Johannesburg	2014-02-19 and 2014-02-24
Mr Abri Vermeulen	Market Sector Head Community Infrastructure – Water	AECOM	2014-02-20
Mr Willem Wegelin	Director	WRP Consulting Engineers (Pty) Ltd	2014-02-27
Dr Mthokozisi Ncube	Manager – Innovation and Technology	Johannesburg Water	2014-02-25
Mr Jay Bhagwan	Executive Manager – Water Use and Waste Management	South African Water Research Commission	2014-02-25
Mr Paul Herbst	Directorate Waste Discharge and Disposal	Department of Water Affairs	2014-02-27

Western Cape

Name	*Title*	*Organization*	*Date*
Dr Barbara Nompumelelo Tapela	Senior Researcher at the Institute for Poverty, Land and Agrarian Studies	University of the Western Cape	2014-03-24
Dr Jo Barnes	Senior Lecturer at the Division of Community Health	Stellenbosch University	2014-03-26
Dr Willem J de Lange	Senior Economist	The Council for Scientific and Industrial Research	2014-03-17
Mr Michael Moss	Researcher	Social Justice Coalition	2014-04-07