Urban water pricing:

a critical-realist approach

Submitted by

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Abstract

Why water? And why pricing?

Many millions of poor people struggle to obtain ten litres of water per day yet much of the water currently supplied is used to support the meat-rich diets of the affluent, to fill their swimming pools and to irrigate golf courses for their leisure. These contrasts have never been more stark than they are today. Tensions and conflict over access to water, already prevalent in many regions, are certain to increase. In this context, what are the consequences of water pricing, what role should water pricing play and to what end?

Pricing policy advocacy based on neo-classical economic theory asserts that the objectives of Pareto-efficient and sustainable resource use can be attained through much greater reliance on markets, privatisation and pricing, and that issues related to the distribution of resources are a separate, essentially political, matter.

I contend that the theoretical basis of this policy advocacy is fundamentally flawed and that a more comprehensive theoretical framework is needed in order to understand pricing decisions, the affect of these decisions on different groups and the prognoses for change. In particular, these decisions and their influence need to be understood with reference to the specific political-economic context, both current and historic.

The objectives of the thesis are thus twofold: to point out the weaknesses and fallacies inherent in the neo-classical theoretical framework underpinning current policy advocacy in the urban water sector and to develop a comprehensive theoretical and methodological framework for the analysis of urban water pricing.

I make two original contributions to the literature on water pricing. I develop a methodological framework which is informed by critical-realism for understanding and analysing urban water pricing which is unique and specific to the urban water sector and I use primary and secondary data to demonstrate the implications of using this methodological framework.

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Preface

Outline of argument and sources

I review the contemporary water pricing policies of the OECD and World Bank, two influential multinational agencies, highlight the weaknesses of their policies and demonstrate the divergence between pricing policy advocacy and practice in Chapter 1.

Critical-realism stresses the need for methodological, epistemological and ontological self-awareness. It addresses the specificity of water as a particular commodity with social content and recognises that water pricing practice will be contingent on the particular geographic, socio-economic, political and historical context. I argue in Chapter 2 that this methodological framework is more satisfactory than the positivism which underpins neo-classical economic theory and the functionalism implicit within new institutional economics. The methodology shares common elements with that of political economy but they are not equivalent. Chapters 1 and 2, when read together, provide the motivation for the development of a critical-realist approach to urban water pricing.

The claims of neo-classical pricing theory are flawed and the theory is logically inconsistent. Nevertheless, most neo-classical economists apply the theory to urban water in an uncritical fashion. The problem of the second-best is generally ignored as a theoretical irrelevance. The necessarily subjective nature of marginal-cost price determination, particularly in the context of large capital indivisibilities, typically is unacknowledged. I examine these and other weaknesses of neo-classical economic theory in detail in Chapter 3.

The market structure has a fundamental influence on urban water pricing practice. The market structure, in turn, is a product the political-economic context. In Chapter 4 I illustrate how an analysis of the political economy of water pricing can shed light on pricing practice by looking at water pricing in Los Angeles. Based on this analysis, and drawing on primary and secondary material on the political economy of water pricing in other cities, I develop a set of 'stylised facts' pertaining to the political economy of water pricing. These facts can help to inform specific enquiries into context-specific water pricing practices.

The meaning and importance of equity are contested. Utilitarian moral philosophy asserts the primacy of "equality of marginal utility". Rawls' "justice as fairness" gives priority to liberty and the equal holding of primary goods. Sen prioritises "equality of capability". I examine the implications of these different philosophical approaches for water pricing in Chapter 5. The utilitarian philosophy supports the neo-classical focus on marginal utility or

preferences. Both Rawls' "justice as fairness" and Sen's "equality of capability" support at least a basic needs approach to pricing in which a specified minimum consumption of water is universally guaranteed. Both "justice as fairness" and "equality of capability" are open to more radical interpretations calling for a more fundamental redistribution of resources ("primary goods" and "capabilities"). The choice of ideology fundamentally influences the choice of water pricing system. The measurement of equality is also dependent on the choice of ideology and theoretical framework. I advocate the use of nonparametric density analysis to examine the social welfare effects of price reform, arguing that this tool is theoretically neutral and the methodology is transparent.

Water is inextricably linked to the environment. The early focus on technical solutions to environmental problems has given way to greater emphasis on economic and social factors. I argue in Chapter 6 that the prescriptions of environmental economics are too narrow and fail to take adequate account of the political economy of water-use and pricing practices. The valuation of environmental resources is subjective and fundamentally contingent on wealth distribution and the political-economic context. Neo-classical economists in general, and environmental economists in particular, place great stress on the role of pricing to promote Pareto-efficient water use. I examine the empirical literature on the relationship between water demand and price in detail and show that this literature is flawed. I propose two alternative operational definitions of water-use efficiency – X-efficiency and *optimal beneficial use* and argue that these definitions are more suitable for use in the evaluation of the efficacy of water pricing.

In contrast to the view presented by Schama (1995),[1] the contemporary provision of water needs to be examined within the hegemonic social, economic and political framework of capitalism. Neo-classical economics obscures this framework. In the concluding chapter I draw the above themes together and present the outlines of a methodology for analysing urban water pricing which illuminates this framework and hence provides a more accurate picture than is presently available to (or at least used by) the water economics profession. In this way I hope to have made an original contribution to the literature.

The thesis draws on three sources of material: primary and secondary texts on economic theory, sociology and philosophy; secondary sources containing relevant published data and analyses of the water sector; and primary data on the water sector in South Africa and Uganda.

[1] "Fountains of ancient Rome like standpipes ... in medieval cities of Europe have played roles in building civic culture as well as quenching thirst. They have become occasions for civic dialogue and meeting places central to creating a sense of civic belonging and responsibility" (Schama, 1995: 288).

The thesis emphasises the limitations of existing theoretical approaches to pricing with the view to developing a more satisfactory and comprehensive approach. The primary material covered has therefore been necessarily broad with a consequent loss in the depth of the analysis. The areas covered include neo-classical economics, institutional economics, political economy, environmental economics, political philosophy, economic methodology and econometrics. The choice of primary materials also has been influenced by the way in which theory is applied to water pricing. For this reason, the latest developments in neo-classical and new institutional economics have not been covered as these are not reflected in the literature on water pricing and in practical applications.

I have made extensive use of secondary sources covering a wide range of topics, periods, types of approach, geographic focus etc. I have used these sources to illustrate, substantiate and enrich my theoretical and methodological criticisms and the conclusions drawn from these.

The collection of primary data has not been a key focus of the research. Nevertheless, the primary data gathered does play an important role in substantiating my thesis. My data on the South African urban water sector comes from ten years of professional experience working in the sector, including a three-year project funded by the Water Research Commission specifically on urban water pricing. The project activities included interviews with key experts in the South African water sector involved at the national, regional and local levels. I also undertook two city case studies during this project: Durban and Grahamstown. During the last two years I have made more than ten trips to Uganda while working on an urban water sector reform project, staying in Kampala for more than five months altogether. The project enabled me to have access to a range of personnel involved in the urban water sector from the chief bureaucrats to drivers, consultants and community workers. The field information used in this thesis was obtained through a series of interviews and personal communications and a review of available reports and documents. As part of this project, I also undertook a study tour examining water pricing and institutional arrangements in Ghana, Côte d'Ivoire and Senegal, meeting with key sector experts in government, international development agencies and the private sector. Through these and other mechanisms, my professional experience in the sector has enabled me to obtain information through personal communications that otherwise would not have been readily available.

Chapter 1: Theory, policy and practice

The need for a new approach

Why should the choice between feasible options only take account of individual preferences if people tend to adjust their aspirations to their possibilities? (Elster, 1982: 219)

1. Introduction

The challenges

Three critical issues face the urban water sector: there is gross inequality, current practices are unsustainable and resource-use is inefficient.[2] The nature and scale of these challenges are illustrated briefly below.

The global urban population, which is almost 3 billion currently, comprises 47 per cent of the world population and is increasing by about 75 million per annum (World Bank, 1999). Most of this increase will be in developing countries where 75 percent of urban dwellers live (UNDIESA, 1998). Large cities with populations of more than 1 million account for 36 percent of the urban population (World Bank, 1999: 128). It is not untypical that informal settlements make up 30 to 60 percent of the population in large cities in developing countries and it is estimated that 100 million people have no permanent home (Biswas, 2000, World Bank, 1999: 48).

More than one billion people do not have adequate access to potable water services and nearly three billion people are without adequate access to basic sanitation services (Gleick, 2000: 1). Almost all of these people live in the developing countries. These numbers have been increasing with time (Biswas, 2000: 8). The consequences of inadequate services are stark: between 14 000 and 30 000 people die every day from water-related diseases; and, at any given moment, about half of the total developing world population suffer from disease caused by contaminated water or food (United Nations, 1997, in Gleick, 2000: 1).

[2] Biswas (2000) identified the following problems: rapid population growth, large proportions of urban populations living in informal settlements, increasing costs of water provision, poor economic performance in many development countries, poor management of systems leading to high operation inefficiencies, inappropriate investment choices leading to the wasteful use of scarce resources, and low levels of wastewater treatment leading to deteriorating water quality. These problems reduce to the three core issues identified.

Access to water services in urban areas in developing countries is highly skewed: some 80 percent of high-income households have access to a water supply connection compared to just 18 percent of low-income households (World Bank, 1999: 146). Households without adequate access to safe potable water supplies are often forced to buy water from vendors at many times the price of water from the network,[3] invest in their own (often costly) supply or storage systems,[4] or buy bottled water.[5]

Large and rapidly growing cities have not been able to cope well with wastewater. In South America, for example, it is estimated that only 2 to 6 percent of collected wastewater is treated adequately (Biswas, 2000: 7). This has exacerbated the adverse health conditions in many cities in developing countries.

Many large and rapidly growing cities are on the point of infrastructure collapse. The situation in Karachi, for example, has been described as follows: "Because Karachi is growing more than 5 percent per annum, many basic services are strained to the point of collapse. Moreover, much of Karachi's population increase is being accommodated in sprawling squatter settlements that have become grounds for social unrest" (United Nations, 1988, as quoted in Biswas, 2000: 9).

Costs of expanding water supplies are often more than twice as expensive as historic costs and current operations are often inefficient (World Bank, 1992). For example, unaccounted-for water is typically more than 30 percent and often more than 50 percent (Biswas, 2000: 21).[6]

High investment costs (exacerbated by inefficient investment) stretch country and household budgets. In Uganda, for example, the average investment cost per water connection is about $1200 whereas the country GNP is just $320 per capita and 69 percent of the population live off less than $1 per day.[7]

Very large disparities exist in patterns of water use. In Europe, average per capita consumption among urban domestic consumers typically is in the range of 100 to 200 litres

[3] In Uganda, for example, vended water typically costs in the range $1.50 to $3.50 per m^3 compared to $0.70 from the network (field visit, Uganda, 1999). Similar or higher multiples are widely reported (World Bank, 1992).

[4] Altaf (1994).

[5] The water available to households in cities in developing countries through both piped networks and alternative sources is often of dubious quality, giving rise to a rapidly growing bottled water market. In India, for example, bottled water sales increased by a factor of four in a period of five years in the early 1990s (Biswas, 2000: 18).

[6] In Kampala, for example, unaccounted-for water is about 50% (field visit, Uganda, 1999). Well-managed public utilities in both developed and developing countries typically have unaccounted-for water of less than 15%.

[7] Investment cost data are from field visits (Uganda, 1999); GNP and poverty data are from World Bank (1999). The $1 a day is at 1995 prices.

per capita per day (lcd). Consumption is much higher in the USA – 425 lcd.[8] It has been suggested that the minimum water requirement to sustain a healthy domestic environment is 50 lcd (World Bank, 1992; Gleick, 1997). Average domestic consumption for significant proportions of the population in many cities in developing countries is much less than that.[9] Households without access to onsite potable water frequently use less than 15 lcd (which typically is obtained from vendors, public standpipes or alternative informal water sources).[10]

Although urban water use is small compared to irrigation, water use is increasing rapidly in urban areas.[11] Total water use (domestic, industry and irrigation) is increasing by about 2 to 3.5 times the rate of population growth (Falkenmark and Lundqvist, 1995). By 2020 it is estimated that the share of water used by urban areas and industries in developing countries will increase from the current 13 percent to 27 percent.[12]

Competition for water between cities and agriculture already exists in many areas and is likely to intensify over time. The following two examples suffice to illustrate the point: local farmers have lost out in the face of increasing water needs in Beijing; and, there is intense and increasing competition for water rights between farmers and cities in California.[13] Postel (1999) argues that increasing urban and industrial demand, together with food substitutions arising from economic growth, will significantly affect the price of grains in the foreseeable future.[14]

Growing water use in urban areas (driven by population growth, industrial expansion and economic growth) is also placing a strain on the water environment more directly. In Bangkok, Jakarta and Manila, for example, water demands are being partially met by overuse of groundwater resources (Postel, 1999: 115).

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[8] See Sullivan (1996) and Postel (1985).

[9] Actual supply is typically higher than 50 lcd, but high losses result in low average consumption levels. See, for example, Uitto and Biswas (2000).

[10] For example, in urban areas in Uganda, including Kampala, typical consumption from public standpipes is about 10 lcd (field visit, 1999).

[11] Globally, urban and industrial use is about 800 cubic kilometres per annum at present compared to irrigation use of more than 3000 cubic kilometres per annum (Postel, 1992: 40). Water demands by households and industries in developing countries are expected to increase by 590 cubic kilometres between 1995 and 2020 (Postel, 1999: 112). The total "stable" fresh water resource availability is approximately 14 000 cubic kilometres, but much of this is needed to sustain ecosystems (Postel, 1992: 28). Of course, global figures hide wide disparities in the distribution of water resources and water use between regions.

[12] Rosegrant and Ringler (1998) in Postel (1999: 112).

[13] See Chapter 4 and also Postel (1999: 113) who provides further examples.

[14] Economic growth enables greater meat consumption which in turn requires disproportionately more water. Pork production, for example, requires twice as much grain (and hence water) compared to chicken, but much less than that required for beef production (Postel, 1999: 260).

Inadequate solutions

Many neo-classical economists argue that the problems outlined above can be overcome largely through a strategy of "getting the prices right". More particularly, these economists argue that prices should be set equal to the marginal resource costs in order to maximise welfare. I contend that this argument is essentially fallacious. In the following two sections, the nature and shortcomings of influential policies based on neo-classical economics are examined in more detail.

Urban water pricing policies advocated by the OECD are derived directly from neo-classical economics. However, actual pricing practices in OECD countries differ significantly from the OECD policy prescriptions. The reasons for this divergence are not explained by neo-classical economics.

Urban water policy issues faced by developing countries are different from those of developed countries: poverty and equity are usually more important concerns in developing countries where income distribution is typically more unequal and poverty much greater. The World Bank is the most influential multinational agency active in the water sector in developing countries. I show that its policies, which are strongly influenced by neo-classical economics, suffer from similar weaknesses to those of the OECD. I argue that the weaknesses of the policy prescriptions of both the OECD and the World Bank are directly linked to the ideological framework within which the policies were developed, namely neo-classical economics.

There is a need for a new methodological approach to urban water pricing theory and practice which is both more comprehensive and context-specific than that provided for by neo-classical economics. In this thesis I attempt to develop such an approach. In particular I seek to addresses the theoretical, empirical and practical issues related to urban water pricing theory, policy and practice in developing countries in a more satisfactory manner than the existing methodologies allow. I assert that this methodological approach should be unique to the urban water sector and should account for historical developments both in water pricing practices and pricing theory. Further, I argue that this approach also should take adequate account of the issues of justice, inequality and sustainability as an integral part of the methodology.

2. OECD: Policies and practice

Pricing objectives

The first OECD reports considering water management in any focused way were published in the 1970s (OECD, 1972, 1976, 1977). These reports were commissioned by the OECD to obtain a better understanding of water in relation to economic development in member countries. They are largely descriptive and contain little by way of policy recommendations. In the latter part of the 1980s, the OECD published a further set of reports on water management, and more specifically, on water pricing (1987ab, 1989). The motivation for these reports appears to have stemmed from the increased attention given to environmental issues within OECD countries. The primary concerns dominating these reports are the need for environmental improvements, water demand management and greater integration in water management. Further reports focusing on environmental issues were published in the 1990s (1991a-c, 1993, 1994a-e, 1995). Recently, progress with respect to water pricing policies and practice in OECD countries during the past ten years was reviewed (OECD, 1999a-d).

The report entitled "Pricing of water services" (hereafter referred to as the 1987 report) remains the most comprehensive report on water pricing published by the OECD (OECD, 1987a). This report is used together with the recent review (OECD, 1999a-d) as the primary source material for the discussion that follows.

The earliest OECD report on water management identified six objectives of water management: equity, economic efficiency, regional development, environmental improvement, co-operation with local administration, and international co-operation (OECD, 1972). The concept of equity was very loosely defined. The report noted that different countries had different equity objectives: for example, some were more concerned with vertical equity, that is, income distribution considerations, while others concentrated on horizontal equity or fairness. The report noted one example of a formulation of an equity principle: "Hardship and basic needs of particular groups within the general public shall be of concern, but care shall be taken to avoid resource use and development for the benefit of a few or the disadvantage of many" (OECD, 1972: 8). On the question of efficiency, the report noted that most countries understood efficiency in the context of water resource management to mean using the least amount of resources to achieve a desired outcome, that is, a least-cost conception of efficiency. The impossibility of practically implementing the neo-classical economics definition of Pareto-efficiency was stressed: "No country, however desirous of greater economic efficiency, has yet developed the analytical tools necessary for knowing what steps will unambiguously move the economy towards efficiency or recognising when it

has been achieved" (1972:9). Regional development was seen as a further extension of the equity objective, noting that almost all examples of regional development had the practical effect of favouring resource allocation to a particular region.

By 1987, the interpretation of principles had changed significantly. In addition, some of the objectives had been dropped and replaced by others.[15] Primary emphasis was now placed on the economic purposes of water rather than on the dual economic and social purposes of water given prominence in the earlier reports.[16] The definition of efficiency was changed from "least-cost" to the more theoretical (and difficult to implement) concept of "allocative-efficiency".[17] This objective is also given priority: "an economic approach to water conservation suggests that *efficient allocation of resources should be the prime objective of a charging system.* The other criteria to be listed act largely as constraints which generate pressures on tariff designers" (OECD, 1987a: 23, own emphasis). Equity had been presented as the first (and implicitly most important) objective in the 1972 report.

The other principles of water pricing included were financial requirements, public health, consumer acceptability and administrative costs. The objectives of regional development and inter-agency and international co-operation were omitted. In relation to financial requirements the report states that water service providers are "usually required" to raise sufficient revenue to cover all their operating costs and "all or some" of the debt associated with capital expenditures (1987a: 28). This is not stated as an explicit principle or objective. The principle related to public health is phrased as follows: "charging systems should not be designed or operated such as to put public health in any *significant* danger" (30, own emphasis).[18] The interpretation of this is left open. The consumer acceptability principle states that "the

[15] Some variation in emphasis and interpretation of the objectives and principles between reports written by different authors and in different decades is inevitable. Some of the differences may simply reflect personal emphases (for example, ordering and prioritising of objectives). Notwithstanding this caution, the differences do indeed appear to be of some significance. Official OECD committees had editorial control.

[16] The title of the 1972 report is "Economic and *social* purposes related to water management" (OECD, 1972, own emphasis). The 1987 report states: "water is thus granted the status of an economic good" (1987a: 18). This principle was re-affirmed in the so-called "Dublin Statement" at the "International Conference on Water and the Environment: Development Issues for the 21st Century" held in Dublin in January 1992. The emphasis on "water as an economic good" was somewhat countered at the United Nations Conference on Environment and Development held in Rio de Janeiro in June 1992. Here it was argued that water should be recognised as a natural resource (part of the ecosystem), as well as a social and economic good, and that water should be allocated between uses through a combination of demand management, pricing and regulatory tools or mechanisms (UNCED, 1992).

[17] Allocative-efficiency was defined to mean: "Water services should be provided such that the community's net benefits are maximised. ... Where the water service is priced, it implies that the price should reflect the incremental costs to the community of satisfying marginal demands. Such a charging system is usually known as marginal-cost pricing" (OECD, 1987a: 23).

[18] It is curious that the word "significant" has been inserted. A more appropriate phrasing might have been: "charging systems should not be designed so as to endanger public health".

charging system should be comprehensible to consumers and command broad acceptance among them" (31). This principle is based on the argument that price signals that are not understood are unlikely to induce appropriate responses. Lastly, the report states that administrative costs should be efficient in the least-cost sense.

Another consideration related to pricing is highlighted in the report: the influence that pricing has on employment. The report notes that employment objectives may be a high priority and that it is important to understand the links between pricing and employment. However, there is no detailed discussion of this.

The recent review states:

> *More than ten years after the OECD last formally stated the criteria which should inform the design of sensible water service charging systems (OECD, 1987a), the list today would probably look not very different. Few would quarrel with the inclusion of the following: allocative (economic) efficiency; equity; financial requirements; public health; environmental efficiency; consumer acceptability and understanding; and administrative costs. On the other hand, two criteria on the 1987 list (energy and employment) would probably be omitted in the late 1990s, not because of any re-evaluation of priorities, but rather because it is generally now believed that there are better ways of addressing these two issues than by reflecting them in the water pricing system. (OECD, 1999a: 17)*

The primary goal of allocative-efficiency is maintained whilst acknowledging that pricing is used in practice to attain multiple objectives. No guidance is given on how these (often conflicting) multiple objectives are to be reconciled.

Allocative-efficiency as a primary policy goal

The 1987 report asserts that, if the water sector were either perfectly isolated from other sectors of the economy or all sectors of the economy were perfectly competitive, then setting prices to equal marginal costs (where marginal costs are understood as marginal opportunity costs) would maximise allocative-efficiency. Where this is not the case, the report acknowledges that achieving maximum efficiency by equating price and marginal cost is *not* justified by theory. Nevertheless, the report goes on to state that "optimal departures from price/marginal cost equality may be calculated only when precise information is available concerning the nature of the interdependence" (OECD, 1987a: 24). This statement is not theoretically correct given the problem of the second-best.[19]

The report continues: "Shortage of information will *usually* mean that the relationship of price to marginal cost required to satisfy efficiency criteria in the water services is *assumed to be*

[19] See discussion of second-best in Chapter 3.

one of equality" (OECD, 1987a: 24, own emphasis). The report thus, in effect, glosses over the theoretical difficulties presented by imperfect markets and other externalities. In this context, it is not correct to assert that marginal-cost pricing will maximise efficiency.

The report notes that strict use of marginal-cost pricing is impractical given the multiple objectives faced by water service providers, and hence advocates a "*sensible use*" of this approach: "efficient pricing methods, based on the principles of marginal-cost pricing but *responsive to day to day realities* of water resources management, [are] an important policy instrument that could improve the economic and environmental efficiency of water resource use" (1987a:13, 16, own emphasis). These statements are further qualified: "[It] is not straightforward to determine in practice what marginal system costs actually are in a given situation and whether the introduction of marginal-cost pricing would be practical" (1987a: 25, own emphasis). Nevertheless, the report still advocates marginal-cost pricing as the benchmark and asserts the need for some kind of "approximate" marginal-cost pricing methodology.

The report also goes on to claim that "it is *clear* that [the] other objectives [equity, finance, consumer acceptability, administrative costs, environmental considerations] confronting water managers could be accommodated within the pursuit of the economic efficiency objective and that these other objectives need not necessarily be reasons for the adoption of pricing principles in contravention of economic efficiency principles" (16, own emphasis). This assertion is not justified in the report. The notion of Pareto-efficiency is not treated correctly in terms of neo-classical theory. Although the problems associated with marginal-cost pricing are dealt with in a relatively frank and open manner, the report's conclusions and recommendations fudge the problems raised.

Household water tariffs

Water pricing practices in OECD countries are reviewed below in order to show the divergence between the prescribed policies and the water tariffs found in practice.

The dominant tariff structures found in OECD countries are summarised in Table 1, ranked in terms of the "conservation signal" provided by the tariff structure (OECD, 1999a).[20] The data presented are largely illustrative and statistical analysis has not been undertaken. Data availability is limited with the result that data sets are often incomplete and sample sizes small,

[20] The "conservation signal" refers to the degree to which the tariff structure discourages the wasteful use of water. Different tariff structures imply different marginal prices of water and different incentives for the amount of water consumed. An overview of the relationship between tariff structure and the marginal price of water, together with examples of cities using different tariff structures, is given Appendix 1.

the data are often not strictly comparable, much of the data are highly approximate, and the data exhibit very wide ranges over a small sample size. Under these conditions, tests for the statistical significance of relationships between variables may be misleading.

Table 1: Household Tariff Structures in OECD Countries

Category [1]	Countries Included	Number	%
Conservation and social pricing [2]	Belgium, Greece, Italy, Japan, Korea, Mexico, Portugal, Spain, Turkey	9	31
Volumetric tariff only	Czech Republic, Hungary, Poland	3	10
Two part tariff: fixed fee with a volumetric tariff	Austria, Australia, Denmark, Finland, France, Germany, Luxembourg, Netherlands, Sweden, Switzerland, USA	11	38
Fixed fee	Canada, Iceland, Ireland[3], New Zealand, Norway, UK	6	21
All		**29**	**100**

Source: Adapted from OECD (1999a). Notes: [1] Dominant category in country. See source for more detailed information by country. [2] Typically an inclining block structure with a low marginal price for low consumption and a high marginal price for high consumption. [3] Revenue for water services is derived from general taxes.

Available, though rather incomplete, evidence suggests a shift in tariff structures within OECD countries over time away from fixed fees and declining block structures towards constant volumetric and inclining block ("conservation") pricing, a move which is presumably a response to the increasing pressures on the water environment and intended to increase the "conservation signal" (Gleick, 1993, Raftelis, 1998, and OECD, 1999a).

The degree to which a water tariff is effective in affecting water consumption is not only dependent on the structure of the tariff, but is also affected by the proportion of total revenue derived from a volumetric-based charge, the absolute price level of the volumetric charge and the magnitude of the water bill as a proportion of household income.[21] Information on these factors for selected countries, based on data availability, is summarised below.

[21] Of course, supply considerations could have a significant effect consumption. In the discussion that follows it is assumed that, for all practical purposes, supply is unconstrained. This is a plausible assumption for the OECD countries under discussion, but certainly would not be a reasonable assumption for most households in developing countries.

Table 2: Proportion of tariff income from volumetric tariff in some OECD countries

Country	Income from volumetric tariff (% of tariff income)
England and Wales [1]	0 to 10
Netherlands	15
Switzerland	50
Sweden	70
France	75
Denmark	85

Source: Sullivan (1996). Note: [1] ± 87% of households are not metered.

Tariffs in Denmark, France and Sweden are likely to be much more effective in encouraging water conservation compared to tariffs in England, Wales and the Netherlands, other things being equal.

The ability to levy tariffs that are based on consumption is dependent on metering. The extent of metering in OECD countries is generally quite high. Meter penetration in single-family houses exceeds 90 percent in 20 OECD countries (OECD, 1999a). In a few countries, meter penetration is very low: Ireland (0%), Iceland (0%), Scotland (0%), England and Wales (12%), Norway ("low"), New Zealand (25%), Canada (55%), and Denmark (64%) (1999a: 46). Water supplied to multi-family apartment buildings is almost universally metered within OECD countries, however, metering of individual apartments is not prevalent. The countries with high penetration of individual apartment meters are Greece, Japan, Korea, Spain and Turkey (1999a). It is notable that Greece, Spain and Turkey are (water) resource-constrained compared to most other OECD countries.

Price comparisons between countries are fraught with difficulties and comparative price data should be viewed with caution. Nevertheless, it is possible to show rough approximations of the difference in the price levels for water supplied to households in different OECD countries. Data from a recent comparison are presented in Table 4, showing significant variability in price levels between countries (OECD, 1999a).

The significance of the absolute price level for a household is dependent on the income level of the household. Estimates of aggregate affordability of household water bills are presented in Table 3.

Table 3: Indicators of aggregate affordability, selected OECD countries

	Affordability index [1]	Water Bill as % of Income [2]	Water Cost as % of Income [3]
	1996	1997/8	1997/8
Hungary	3.62	3.0%	
Germany	1.32	1.0%	1.2%
Netherlands	1.13		
France	1.12	1.1%	1.5%
England	1.05	1.3%	1.3%
Switzerland	0.94		
Denmark	0.68	0.8%	0.9%
Sweden	0.59		
USA	0.46	0.8%	

Source: OECD (1999a). Notes: [1] The ratio of the typical household monthly water bill for a family of four to country GDP per capita multiplied by 100. A lower index number indicates greater affordability. [2] Water bill for typical water consumption for a family of four as percentage of average household income for the country. [3] Actual cost of supply substituted for water bill.

The data indicate that there is a significant range in aggregate affordability levels across OECD countries. The difference in affordability between Germany and the USA can be explained primarily in terms of differences in the absolute price level of water, whereas the difference in affordability between Hungary and the USA is largely the result of the difference in average household income (see Table 4).

Table 4: Water prices, domestic consumption and affordability

	Water Price [1]	Price increase [2]		Consumption [3]	Affordability [4]	Cost Recovery [5]
	US$/kl	% pa	years	lcd [6]	index	% full cost
Germany	1.69	3.8	92 to 97	116	1.32	83%
Belgium	1.68	2.7	88 to 98	122	1.09	
England	1.60	2.0	94 to 98	153	1.05	100%
France	1.58	7.0	91 to 96	137	1.12	73%
Netherlands	1.41	4.6	90 to 98	130	1.13	
Denmark	1.34	6.3	84 to 95	139	0.68	89%
Japan	1.20	0.3	95 to 98	278	0.60	
Sweden	1.04	1.9	91 to 98	190	0.59	
USA	0.58	2.4	92 to 98	350	0.46	
Italy	0.51	2.0	92 to 98	213	0.43	
Hungary	0.48	18.7	86 to 96	102	3.62	

Source: Adapted from OECD (1999a). Notes: [1] Average water price for typical household consumption at market exchange rates. [2] Real price increase. [3] Average household consumption. [4] See Table 3 for definition. [5] Water bill for typical household as percentage of full cost of supply. [6] lcd = litres per capita per day.

There is a much stronger relationship between the affordability index and consumption compared to the absolute price level and consumption. The former relationship is shown in Figure 1. Higher average domestic consumption levels are associated with greater levels of affordability (that is, a low value for the affordability index).

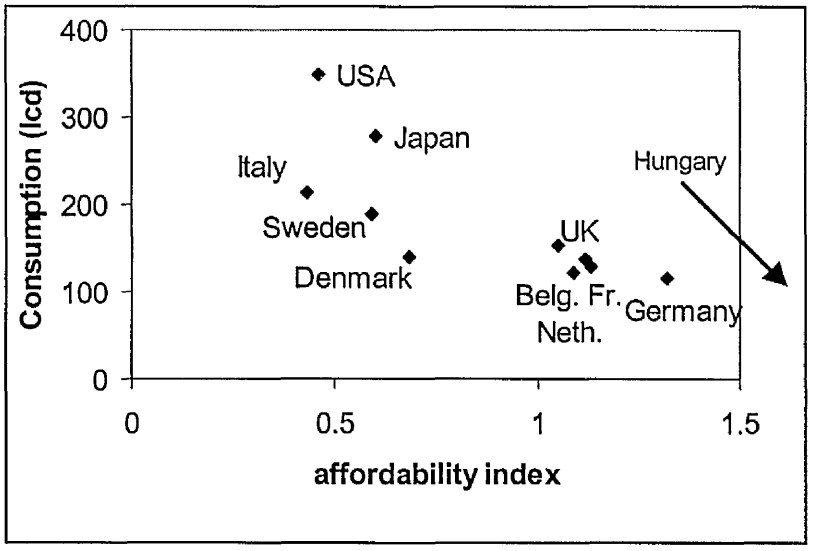

Figure 1: Household consumption (litres per capita per day) and affordability

Affordability appears to be a strong factor in the relatively low recent consumption levels in Hungary which have dropped significantly in recent years in response to significant price increases (see below).

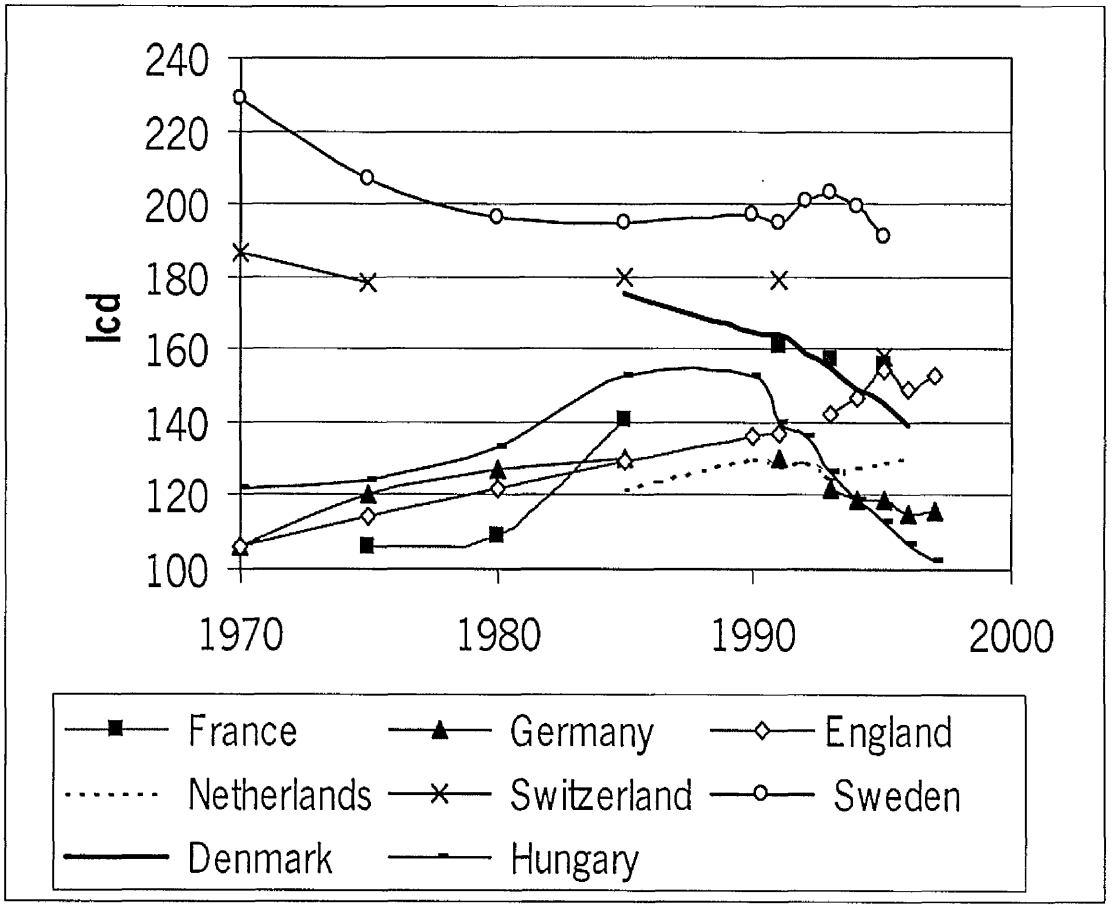

Figure 2: Household water consumption (litres per capita per day) in OECD countries

Trends in household consumption over time are shown in Figure 2 (OECD, 1999a). The significant decreases in average domestic water consumption in Hungary, Denmark and Germany are associated with sustained real increases in the price of water of 18.7, 6.3 and 3.8 percent per annum respectively in the recent past (see Table 4). On the other hand, household consumption has continued to increase in the UK (England and Wales only) and the Netherlands despite significant increases in the price of water of 2 and 4.6 per cent per annum respectively over the last number of years. In the UK, only 10 percent of households are metered and in the Netherlands, only 15 percent of tariff income for households is derived from a volumetric tariff. Hence households in these countries have little incentive to conserve water even though water prices have increased significantly.

It may be concluded that domestic water pricing practices in OECD countries do not follow neo-classical policy prescriptions closely. A similar conclusion can be reached based on a review of industrial water pricing practices in OECD countries.[22]

The divergence between theory and practice

Four key points arise from the review of urban water pricing policies and practice in OECD countries. First, the only theoretical touchstone used to inform pricing policies is neo-classical theory. Second, it is recognised that Pareto-efficiency is only one objective of pricing whereas the pricing process is typically constrained by multiple objectives. OECD policies are unable to address the problem of how to reconcile these multiple objectives other than to prioritise the Pareto-efficiency objective and to have the other objectives constrained by this prior objective. Third, the choice of efficiency as the primary objective appears to have more to do with the orientation of neo-classical theory (which only addresses allocative-efficiency) than with the needs of water managers and others involved in the tariff design and implementation. Actual tariff structures appear to be contingent on factors other than the policy prescriptions of the OECD.[23] Fourth, the discussion of equity and other policy and pricing objectives is remarkable vague: no appeal to theory is made. Equity considerations appear to play a part in pricing practice, but not in any systematic, theory-based way.

3. World Bank: policies and practice

Pricing objectives and policies

In the World Bank's Policy Paper on Water Resources Management (hereafter referred to as "The Policy Paper"), the organisation's primary objective and its relationship to water resources management are described thus: "The Bank's overarching objective is to reduce poverty by supporting the efforts of countries to promote equitable, efficient and sustainable development [which entails, *inter alia*] support for the provision of potable water and sanitation facilities, flood control, and water for productive activities in an economically viable, environmentally sustainable, and socially equitable manner" (World Bank, 1993b: 13). In order to achieve these objectives, the World Bank advocates expanded markets, greater competition, increased private sector participation (with a concomitant reduction in the

[22] See OECD (1999b) and Eberhard (1999a).

[23] Mann, for example, notes that in the United States, "the neglect of pricing and costing matters has produced general underpricing of urban water services in the United States ... [which] is a function of historical accounting [and] consumer pressure combined with the political orientation of water rate determination" (1989: 164).

involvement of the public sector), "economic pricing" (opportunity cost or marginal-cost pricing), reduced subsidies, decentralisation ("managing at the lowest appropriate level") and active user participation (World Bank, 1992, 1993b, 1994). I argue below that, at least in the context of urban water pricing, these policies are selectively interpreted and applied with adverse consequences, particularly for poor people.

The principle policy statements of the World Bank concerning water resources management are to be found in their policy paper "Water Resources Management" (World Bank, 1993b). This and the annual World Development Reports (particularly 1992, 1993a and 1994) are the primary sources for the review given below.

The key objectives of pricing for the Bank are improved efficiency and sustainability. Equitable development is also a goal for the Bank; however, it typically does not recommend adapting pricing mechanisms for the purposes of promoting equity. In general, the Bank regards prices as the best means to create the "right" allocative-efficiency incentives and argues that equity can be addressed via (usually non-water sector based) transfers. There is an inherent inconsistency in this position because all transfers involve price distortions of some kind. If price "distortions" are ruled out on the grounds of inefficiency, and if transfers are ruled out on the grounds of price distortions, then a circuitous argument is generated which justifies the status quo with respect to equity considerations.

World Bank policies with respect to the objectives of efficiency, equity, cost recovery, subsidies, institutional arrangements and the sustainability are described below.

Efficiency. The World Bank Policy Paper advocates *opportunity cost pricing* as the key means for promoting greater efficiency in water use:

> *If economic criteria alone are employed, water should be allocated to a given use when the opportunity cost is lower than the selected use. ... Economic efficiency would be obtained by setting water charges equal to the opportunity cost of water. (World Bank, 1993b: 42, 49)*

The report goes on to note, however, that the immediate adoption of such prices "often proves to be politically difficult" and that cost recovery would be a good starting point (1993b: 49).

The initial goal of cost-recovery refers to recovering the financial costs of providing water to end-users (the capital and operating costs of the infrastructure and necessary related services). This is quite clear and easily understood. However, notwithstanding the text's contention that pricing urban water is "generally straightforward", the policy statement "economic efficiency

would be obtained by setting water charges equal to the opportunity cost of water" is not discussed in any detail and is, in fact, remarkably undefined and ambiguous.

The concept "opportunity cost" is difficult to define as an operational term for at least two reasons. First, there is an almost infinite array of possible alternatives in the economy and it is very difficult (if not impossible) to choose the optimum output from this array. Second, having chosen an alternative, it is not possible to place an objective social value on the output foregone. This is partly because the social valuation of a set of outputs is dependent on the existing income distribution which will change as a result of the project/pricing intervention.

In other World Bank documents, and in their operations, the World Bank is more explicit about advocating a marginal-costing approach. For example, in an important World Bank sponsored text on urban finance, Bahl and Linn state that "the basic rule of efficient pricing states that the price of a public service should be set equal to the marginal cost of producing the service" (1992: 241).[24] The World Bank Mission to South Africa on water pricing strongly advocated marginal-cost pricing (Roome, 1995: personal communication).

Equity. The World Bank recognises that "the potential health benefits from improved water and sanitation services are huge" and that in order to secure these benefits water supply must be uncontaminated and water use greater rather than less (World Bank, 1992: 101).[25] Thus, the World Bank contends that extending adequate access to safe water supplies is the most important contribution to equity that a government can make in contexts where these minimum conditions are not universally met. Where access is not universal and resources are scarce, the World Bank argues that it is equitable for those that have access to pay the costs of that service for two reasons: it reduces the inequity between those that do have access and those that do not, and the additional resources thus made available may be channelled to extending access. (Of course, the second reason is only compelling if service coverage is indeed improved.) An example of their line of argument is given below:

> *Many governments fear that fully recovering costs will hurt the poor, yet increasing prices to enable cost recovery may actually help the poor. They often pay much higher prices per unit for privately provided water because they are not connected to the public service networks that have lower unit costs, and because they do not benefit from the subsidies to users of the public system. Expansion of access benefits the poor by allowing them to rely on much less costly sources of water. (World Bank, 1994: 49)*

[24] They then go on to give a thorough exposition of marginal-cost pricing. See Chapter 3.

[25] The World Bank notes that a supply of 50 lcd is much more likely to secure health benefits than 30 lcd or less and that this higher consumption is only likely if water is supplied directly to the house or yard. Collection of water from communal street taps typically results in water usage that is much less that 30 lcd (World Bank, 1992).

To ensure that "appropriate" services are provided, the World Bank advocates a demand responsive approach with willingness-to-pay a key determinant. The World Bank *reluctantly* admits that subsidies may be appropriate and uses strong language to caution against the dangers associated with subsidies:

> *In urban areas there is abundant evidence that most people want on-plot water supplies and are willing to pay the full cost of these services. In some areas this standard solution will have to be adjusted and special efforts made to accommodate poor people. In Latin America and, more recently, in Morocco utilities have helped poor families to install a connection and in-house plumbing by giving them the option of paying over several years. Another option is a "social tariff" whereby the better-off cross-subsidise the poor. Properly executed, such policies are both sensible (since the poor use relatively little water) and compassionate.* But there are dangers. *Social tariffs can lead to a general spread of subsidies. And the assignment of non-commercial objectives to a public enterprise generally has an* insidious effect *on the achievement of all its objectives, commercial and non-commercial alike. (World Bank, 1992: 104, own emphasis)*

For piped water supply, the Bank recognises that increasing block rates may be appropriate to achieve equity, efficiency and cost-recovery objectives. However, at least some policy analysts in the Bank remain sceptical of the efficacy of these tariffs in practice.[26]

Financial cost recovery and autonomy. A key justification given by the Bank for advocating financial cost recovery is management autonomy:

> *A pricing strategy [should be] designed to ensure cost recovery, which creates a desirable form of financial independence for public utilities. ... With fewer budgetary transfers, the government has less occasion to interfere, a key to managerial autonomy. (World Bank, 1994: 37; 47)*

This sentiment is also set out in the Policy Paper, with the additional motivation of sustainability:

> *Given the low level of cost-recovery at present and the extent of under-pricing, fees that establish the water entity's financial autonomy would be a good starting point to ensure the entity's independence and the sustainability of operation. (World Bank, 1993b: 49)*

Possible mechanisms to achieve cost-recovery are explained in the 1994 Development Report:

> *The general principle for pricing public utilities to recover costs without distorting the allocation of resources is to set the price equal to all the short-run costs in efficiently producing an additional unit of output while keeping productive capacity constant – that is price equals the short-run marginal costs. However, water systems periodically require large investments and*

[26] See, for example, work commissioned by the Bank and reported by Whittington (1992). A World Bank mission to South Africa specifically focusing on water tariffs strongly recommended against rising block tariffs (Roome, 1995, personal communication). More recently, the World Bank advocated the removal of block rates in Uganda (field visit, Uganda, 1999).

> *average costs fall as production is increased, and the efficient price is below the average cost. Charging that price would result in a deficit and hence a loss of financial autonomy. Adjustments in the general pricing formula can be used to avoid an operational deficit and minimise the trade-offs imposed by the need to jointly address equity, efficiency and financial goals. In general, if financial autonomy is a requirement, the public price has to be revised to cover the cost of providing the service plus a mark-up, often resulting in multi-part tariffs and possible cross-subsidies. Two common options to minimise the distortions (to efficiency and equity) of achieving financial autonomy are increasing block tariffs and time-of-use tariffs. Under increasing block tariffs, consumption of services is priced at a low initial rate up to a specified volume of use and at a higher rate per block thereafter. The number of blocks varies from 3 to as many as 10. The most effective structure is the simplest, particularly when monitoring and administrative capacity are constraining. (World Bank, 1994: 48)*

Here the potential role of increasing block and seasonal tariffs is acknowledged.

Subsidies. Despite a general resistance to subsidies (for example, "the demand-driven approach remains appropriate in most places, even in low-income settings, ... and should be compromised only in rare circumstances"), the World Bank does recognise that public investment in infrastructure which benefits the whole community , which is important for environmental quality and health, and for which there is a low willingness to pay among households, could be undertaken using public funds (World Bank, 1993a: 94).

The case for subsidies for water supply, in particular, is reluctantly conceded:

> *Even though willingness to pay for improved water and sanitation services may be high, affordability may still not be enough to cover the costs. Subsidies may be justified in such situations. But the rationale should primarily be one of redistribution: a society may choose to provide cheap water or other services to the poor as one of many alternative means of improving their welfare. Health benefits alone do not generally provide a rationale for public subsidy of water and sanitation. (World Bank, 1993a: 93)*

> *When willingness to pay is much less than costs, it is usually a mistake to justify subsidies on the basis of health benefits alone. First, such subsidies compromise the demand driven approach to service provision (that is, services that people want and are willing to pay for); lack of accountability and efficiency are the* inevitable *consequences. And second, if public financed investments in these services are being considered for health reasons, it should be noted that such investments cost more per DALY gained than other [directly health related] interventions.*[27] *(World Bank, 1993a, 106, own emphasis)*

The Bank uses strong language against the *potential* pitfalls of subsidies by alleging that they lead to the "general spread of subsidies" and that they are "insidious".

[27] DALY stands for disability-adjusted life year. For a definition and discussion of this measurement, see World Bank (1993a: 26). The World Bank contends that a comprehensive (primary) health package could cost about $4 to $7 per capita per annum whereas the infrastructure costs for water supply and sanitation could cost between $30 and $200 per capita per annum (1993a: 106).

Institutional arrangements. The World Bank is pessimistic about the public provision of services:

> *Supply-side failures are largely caused by inefficient and unresponsive public sector monopolies which, in the water sector, typically provide subsidised services at between one-third and two-thirds the full economic cost. Massive public investments, often supported by the donor community and the World Bank, have been made in public or quasi-public agencies responsible for the delivery and maintenance of household services. The net result has often been bloated public agencies with low accountability to their customers and few incentives for improving efficiency; a middle class that is increasingly well served with subsidised services; a poorer class that receives little or no service; and a ripe environment for patronage. (World Bank, 1993a: 93)*

As a minimum, the World Bank recommends the commercialisation of service provision, although it does recognise that regulation, or "public oversight", is necessary:

> *Urban piped water and sewerage at the municipal or metropolitan level should be provided by enterprises run on commercial principles. Professional management accountable to users and having clear incentives for providing high-quality, reliable services and efficient asset management is also desirable. The responsibility of government in such situations is, at a minimum, to ensure commercial operation, which can be achieved through delegation to a private company via a management, lease, or concession contract.* Public oversight is necessary *to ensure access for low-income users and to protect public health and environmental quality. In countries with modest technical capacity, concessions can successfully draw on international expertise. Pricing water to reflect the full financial, environmental and economic costs of supply is essential for generating funds to expand service and for promoting efficient use. (World Bank, 1994: 117, own emphasis)*

Typically, the World Bank views political intervention as necessarily malevolent and wishes to isolate management from this:

> *Infrastructure must be conceived of as a "service industry" providing goods that meet customer demands. Such a commercial orientation contrasts sharply with the situation in most government departments and state-owned public utilities, which suffer from multiple and conflicting objectives and inadequate accounting for costs or financial risks, and which put little emphasis on revenue collected and the quality of service delivered. Managers have little motivation in such circumstances to satisfy customers or to achieve a reasonable return on assets through efficient operation and adequate maintenance.* Typically providers of infrastructure are subject to pervasive interference by political authorities, which adversely affects *operational decisions on investment, pricing, labour, and technological choices. (World Bank, 1994: 33, own emphasis)*

The World Bank promotes privatisation, ostensibly as a means of improving efficiency:

> *More private involvement in the operation of water companies is warranted. Many industrial countries have found it difficult to reform public enterprises, except as part of a move to privatise them. Indeed, privatisation is increasingly seen as a way not only to effect performance improvements but also to lock in the gains. (World Bank, 1992: 110)*

This strongly expressed view is qualified to some extent: "private sector involvement in the sector is not a panacea and is never simple", noting that the privatisation of the water sector in the United Kingdom (England and Wales) was the most complex of all of the privatisations undertaken in the country, and that, in developing countries, "there are formidable problems" (World Bank, 1992: 111). Yet despite these important qualifications, privatisation continues to be strongly advocated. Moreover, the equity implications of the concentrated private ownership of public infrastructure are rarely discussed.[28]

Where public agencies are not privatised, the World Bank envisages three core instruments to commercialise and increase the efficiency of operations: corporatisation – creating quasi-independent public enterprises insulated from non-commercial pressures and constraints; management contracts – holding managers (both private and public) to performance contracts; and "a pricing strategy designed to recover costs which creates a desirable form of financial independence for public utilities" (World Bank, 1994: 37).

Other institutional and/or management themes prevalent in World Bank advocacy are decentralisation and user participation. The World Bank supports the decentralisation of service delivery functions to local government particularly where local capabilities are adequate but, even where not, will support the development of local capacity (World Bank, 1993b: 72). The Bank "will encourage the participation of beneficiaries and affected parties in the design and implementation of projects it supports. ... Particular attention will be given to the participation of women since they are essentially the managers of domestic water" (World Bank, 1993b: 73).

Although these policies may be appropriate in certain contexts, it is not necessarily true that decentralised management is more effective and efficient than centralised management. Centralisation may, in fact, be more effective than decentralisation in resource-scarce contexts. The World Bank policy on decentralisation is in danger of prescribing a solution that may not always be appropriate.[29] The World Bank appears to have qualified its support for

[28] Cairncross has criticised the World Bank for the lack of attention given to the long-term equity implications of privatisation. Subsequent to this criticism he has not been re-invited to consult to the World Bank (Cairncross, 1997, personal communication).

[29] This is evident in Uganda where there are clear advantages to the centralised management of urban water services. This is admitted by the Principle Water and Sanitation Specialist for East Africa at the World Bank (Locussol, 1999, personal communication). However, because of the World Bank policy of decentralisation, the official World Bank advice to the Government of Uganda is to decentralise the

decentralisation further more recently, acknowledging that where capacity is weak, decentralisation can increase corruption and reduce access to basic social services (World Bank, 2001: 107).

Sustainability. On the water supply side, the Bank advocates that new projects should "give consideration to protecting the natural ecosystems and to directing development to less sensitive or already altered watersheds" and should look carefully at investing in existing systems first (rehabilitation, investment in water saving technologies etc.) to improve water-use efficiency rather than increasing supply (World Bank, 1993b: 61).

The Bank recommends that water quality be protected through a multi-pronged strategy which includes the following: effluent charges, pollution permits, public investment in wastewater treatment, incentives for water reclamation and reuse, public disclosure of effluent discharge data, citizen mobilisation and regional environmental assessments (World Bank, 1993b: 74).

Pricing practices in South Africa and Uganda

Water pricing practices in two developing countries, South Africa and Uganda, are briefly reviewed here in the light of World Bank policies in general and their specific advocacy in these two countries.

South Africa. The responsibility for water services is the constitutional responsibility of local government in South Africa. Local government can provide the service itself or contract with another party (public of private) to provide the service. In either case, the local government retains responsibility for setting the water tariff subject to national government guidelines. The guidelines specify cost recovery tariffs for non-domestic consumers and inclined block tariffs for domestic consumers with the first block provided at a concessionary rate, the second at the cost recovery rate and the third at a higher "conservation-orientated" rate linked to the marginal cost of system expansion. Local governments are left to specify the structure and level of the industrial tariff and the block sizes and tariff levels for domestic consumers. Consequently, a wide variety of tariffs exist in urban areas in South Africa, but all have two common characteristics: they generally cover the costs of supply (overall) and equity considerations are built in with a "life-line" tariff for low levels of consumption.

responsibility for the management of urban water services to local government, a policy which is almost certainly doomed to failure.

The World Bank advocated the implementation of long-run marginal cost based tariffs in the Gauteng area and urged the scrapping of the inclined block tariff for domestic supplies in favour of a constant volume based tariff. The government rejected both of these arguments.[30]

Uganda. Although local government is constitutionally responsible for water services provision, a single public utility owns the assets and provides the services in twelve large towns in which about 66 percent of the urban population live. A uniform tariff structure is applied to all twelve towns. An inclined block tariff is applied to non-domestic consumers (differentiated between institutional, commercial and industrial), a flat rate is applied to domestic consumers and a concession rate is offered to licensed standpipe holders. Service provision in the other towns is decentralised at present (though options for reform are being considered) and tariffs vary widely.

The World Bank has advocated that prices be set at the long-run marginal cost of supply that was calculated to include the costs of wastewater collection and treatment (available only to a minority of consumers although the tariff would be applied to all consumers). The World Bank has also advocated the elimination of subsidies from government and cross-subsidies between larger and smaller towns.[31] The government has rejected this reasoning. However, the World Bank is an important financier of water infrastructure in Uganda (which is not the case in South Africa) and has considerable influence over government policies. It is possible (and even likely) that the World Bank's proposed policies and reform recommendations for Uganda, including a private concession for the three largest urban centres, could be imposed on the government in the near future.[32]

The divergence between theory and practice

Neo-classical economic thinking has come to dominate the policy advocacy of the World Bank which has a very significant influence on water pricing policies in developing countries because of its role as financier.

A careful reading of World Bank publications appears to suggest the possibility of using their policies to advance a nuanced approach to the complex problems facing urban water managers in establishing water tariff policy and setting tariffs. The publications do recognise, at least to some extent, the "political realities" and inequalities inherent in the real world of water

[30] Roome (1995, personal communication).

[31] No discussion of the potential health benefits arising from safe water was given, and certainly no justification for public subsidies was provided (field visit, Uganda, 1999). This seems to be typical of the divergence between the policy (to recognise health benefits) and practice (to ignore these benefits).

[32] Locussol (1999, personal communication). Further discussion of the political-economic context is provided in Chapter 4.

supply and that the role of subsidies will continue to be important. Nevertheless, the themes that tend to dominate the policy advocacy arena are those derived from neo-classical economic theory, namely, marginal-cost pricing, eradication of subsidies, managerial autonomy from government influence and privatisation. Furthermore, World Bank practice appears to ignore the nuanced arguments presented in the World Bank's published policies.

For example, while the motivation for privatisation is ostensibly pragmatic (improving both efficiency and equity), the single-minded implementation of privatisation across a large variety of contexts and with limited consideration of either the equity implications or the regulatory requirements leaves the Bank open to allegations of ideological bias.[33] The potential disadvantages of privatisation, including the longer-term effect on inequality through the concentration of resources, are either not mentioned at all or are under-emphasised.[34] Numerous examples of positive outcomes from privatisation are cited whereas privatisation failures are rarely mentioned, or if they are, are blamed on the public sector.

The almost universal non-application of marginal-cost pricing in the water sector does not appear to limit the World Bank's advocacy of this pricing practice.[35]

Policies that seek to increase efficiency invariably have equity implications. It may be considered irresponsible to advocate efficiency-enhancing policies without adequate analysis of the equity implications, a practice the World Bank has frequently followed.[36]

Perhaps the key failing of the World Bank policy advocacy on water pricing is that the policies are not grounded in specific contexts. Each urban water supply situation calls for a particular approach. Some of the policies advocated will be applicable in some contexts, but clearly not all policies will be applicable in all contexts.[37] Constructing the right policy mix

[33] See footnotes 34 and 36. See also Cramer (1998).

[34] In the case of Uganda, for example, World Bank advocacy of a concession for three large towns has adverse equity implications. It is a classic case of "cherry picking" with the low cost, high affordability area being given to a private operator and the government being left with a high cost, low affordability area which is very difficult to manage without the economies of scale available when all of the towns are managed together. The potential risks attached to privatisation are also not mentioned at all in World Bank communications with the government (field visit, Uganda, 2000).

[35] The potential lack of congruence between the advocacy of marginal-cost pricing for public enterprises and franchise bidding for long-term lease contracts (the adjudication of which often hinge on the water tariff as one of the key determinants, with the lowest price bid being deemed the most efficient) is not discussed at all.

[36] For example, in World Bank policy advocacy related to water pricing in South Africa, the Bank was very explicit that its brief was to improve efficiency and that the equity implications were something for South Africans to look after (Roome, personal communication, 1995). Similarly, the equity implications of privatisation in Uganda have also not been adequately considered by the World Bank.

[37] The importance of context is demonstrated in more detail in Chapter 4. For now, it suffices to note that conditions is Uganda and South Africa are completely different, yet the World Bank is advocating essentially the same policies (no subsidies, marginal-cost pricing, constant volumetric rates and

requires a thorough understanding of the particular context. The key point being made here is that policy advocacy cannot be undertaken in a contextual vacuum and the "universal" policy truths advanced by the World Bank and other multinational agencies are in danger of doing just this.[38]

4. Towards a new approach

The review of pricing practice, undertaken as part of the research for this thesis, found no instances of "pure" marginal-cost pricing in which the marginal-cost price was applied to *all* units of water sold (although some instances of selective marginal-cost pricing were found).[39] The disjuncture between neo-classical pricing advocacy and the practice of water pricing is stark. Most theorists pose the question: why is there a general failure to implement marginal-cost pricing? While this question is certainly valid, an alternative and equally valid question is seldom asked: why do (neo-classical) economic theorists continue to advocate marginal-cost pricing in the face of overwhelming evidence that such pricing appears to be an anathema to citizens, government and water managers alike and that political-economic realities universally and persistently render the implementation of "pure" marginal-cost pricing unfeasible? The answers to both of these questions lie in a more serious analysis of the political economy of pricing (the topic of Chapter 4).

Neo-classical theory is one-dimensional with its exclusive focus on Pareto-efficiency, refusing to answer the question posed by Elster and quoted at the start of the chapter. The theory steers away from equity issues because of the inherent subjectivity that is a necessary and inescapable part of such analysis. Proponents of the theory are unwilling to recognise the subjectivity of the neo-classical paradigm itself. Furthermore the theory is ahistorical. The theory asserts that there are sets of universal normative policy prescriptions that may be applied everywhere to improve the efficiency of resource allocation and, therefore, the overall

privatisation). These policies do not take adequate account of the local political-economic context and it is not surprising that the policy advocacy has met with resistance.

[38] A more charitable reading of World Bank policy advocacy would emphasise their frequent use of contextualised examples. However, this method is also subject to the criticisms of selective sampling and reductive reasoning. For example, the "success" of water markets are repeatedly cited by the World Bank and Chile is praised for following a neo-liberal economic agenda. Yet a World Bank report specifically examining water markets in Chile failed to mention equity issues once, whilst an external evaluation of the water markets in Chile raised important concerns in relation to the negative equity effects (Briscoe, 1996; Bauer, 1998). In another example, SODECI, a private company providing services in Côte d'Ivoire is praised as a positive role model yet the company does not provide connections to the large informal settlements in Abidjan (World Bank, 1999: 148; field visit, Côte d'Ivoire, 1999).

[39] The review comprised both a literature review of secondary sources as well as primary data gathering for a number of cities in South Africa, Uganda and the United States. Current and historical pricing practices were reviewed for a selection of cities in both developed and developing countries on all five continents. The review is reported in Eberhard (1999b).

wealth of society. The theory concentrates on static equilibrium analysis with little understanding of dynamic processes and how current economic conditions have arisen, and how and why these change over time. The theory is also universalistic. It does not recognise the specificity of the object of its analysis, applying a universal method to all commodities. Water is a very specific "commodity" which is profoundly linked to cultural, social, religious, political and economic processes. To treat water as any other commodity represents a particular ideological position.

The extent of the protection of the environment and the degree of equity desired are essentially political decisions that will be influenced by the political-economic balance of power. Any policy advocacy that is to stand a chance of successful implementation must be firmly rooted within such a contextualised political economy analysis. The implications of this are that a positivistic approach to policy advocacy is flawed, and that policies must be developed on a case-by-case basis and with a proper understanding of the political economy at both the country and city level. Notwithstanding this, within a country-specific context, it may be possible to develop a generalisable methodology that is applicable to a number of cities and towns.

The intention of this thesis is to develop a pricing theory and methodology that is not exclusively focused on Pareto-efficiency but is able to account for multiple objectives, is context-specific, is able to account for and explain dynamic historical changes in pricing practices and institutional arrangements over time, and is specific to the unique physical, social, cultural and economic properties of water.

This task is taken up from Chapter 4 onwards. First, the methodology employed in this thesis is justified (Chapter 2) and neo-classical pricing theory, which is so pervasive in policy advocacy in the water sector, is examined in further detail (Chapter 3).

Chapter 2: Reflection on methodology

The argument for a critical-realist methodological approach

> *Starting from the point which helped inspire epistemology, namely that there are tools used in knowledge, and that these deserve and require examination, there is an attempt [within postmodernism] to link this to the indisputable fact that in this world there is a great deal of inequality of power. Could there be a link between the way the tools of knowledge* make *the worlds which they claim to* find, *and those inequalities? (Gellner, 1992: 42)*

1. Introduction

There is remarkably little discussion of economic methodology within the "mainstream" economics literature (Dow, 1997).[40] This is rather surprising given the important influence that methodology has on the process of economic theorising and policy-making.[41] Mainstream economics has traditionally based the justification of its methodology on logical positivism. I will argue that mainstream economic methodology has not responded to the substantive criticisms of this schema, in particular, the postmodernist challenge to universal truth claims. I argue that critical-realism avoids the methodological pitfalls of positivism and allows for the development of a more satisfactory *range* of understandings pertaining to the necessarily open system of water pricing.

Methodology is fundamentally influenced by the choice of subject matter, that is, the epistemological base. Mainstream economics is predominantly concerned with the problem of maximising Pareto-efficiency. This preoccupation means that questions related to the underlying market structure and how this came about tend not to be addressed. This is a particularly significant shortcoming when neo-classical economics is applied to water pricing where equity issues are prominent. The epistemological basis for the critical-realist methodological approach adopted in this thesis is set out at the end of Section 3.

Methodology is contingent on the choice of ontological system which, in turn, is influenced by ideology ("a shared system of meaning and comprehension").[42] I argue that neo-classical

[40] In her critical review of mainstream economic methodology, Sheila Dow (1997) does not define "mainstream". It may be assumed to refer primarily to the current hegemony of neo-classical economics and also to the new institutional economics and the new political economy (to the extent that these branches replicate the methodology implicit within neo-classical economics).

[41] "The way an issue is formulated, and the perspective that is adopted, often crucially shapes the policy conclusions that follow" (McNeill, 1998: 261). This is a rare admission in the literature on water economics.

[42] The definition comes from Bromley (1990: 86).

economics is dominated by the "ideology of efficiency" and I subject this ideology to detailed criticism. The ideologies informing new institutional economics and classical political economy also are briefly presented and criticised.

Critical-realism stresses the need for methodological, epistemological and ontological self-awareness. I argue that a critical-realist approach to urban water pricing presents an improvement over existing approaches to the extent that it is able to achieve self-awareness and reduce ideological bias by critically evaluating water pricing theory and practice with reference to the epistemological, ontological and ideological "prisms" implicit in three important economic schools of thought: neo-classical economics, new institutional economics and political economy.

2. Methodology as scientific method

The methodological foundation of mainstream economics is logical empiricism, an outgrowth of logical positivism. This requires that theories be both logically coherent and consistent, and predictive. Milton Friedman (1953) asserted that predictive success (and not the truth content of assumptions), should be the primary criterion for the appraisal of a theory. This methodological approach, which is termed instrumentalism, encouraged economists to develop theories in terms of an internal agenda that was free of constraints, subject only to empirical testing of outcomes (Dow, 1997). This lack of grounding in external methodological principles has been criticised by Lawrence Boland (1982) and Hausman (1994). Hausman argues that "even if all one cares about is predictive success in some limited domain, one should still be concerned about the realism of the assumptions of an hypothesis and the truth of its irrelevant and unimportant predictions" (1994: 220). This is a direct and valid methodological challenge to Friedman's narrow conception of instrumentalism.[43]

Instrumentalism is distinctly limited because no amount of empirical confirmation of a theory can prove it to be true. Karl Popper (1957) sought to overcome the problem of induction by proposing falsification as the appropriate testing procedure. If conjectures from a theory could be expressed in such a way as to be falsifiable, then a theory could be assumed to be true unless it was falsified. Even though this approach allowed for the existence of axioms that were not falsifiable (such as the rationality axiom in neo-classical economics), it proved to be impossible to put the approach into practice (Dow, 1997). The criticism of falsification is reinforced by Bayesian theory which asserts that evidence is likely to fall within a Bayesian

[43] Friedman's methodology is not a true instrumentalist methodology because it is not concerned with *all* the observable consequences of a theory. Hausman (1994: 217) argues that the logic implicit in this narrow version of instrumentalism is flawed.

distribution and has the implication that a contrary observation is not sufficient to refute a theory. Dow comments: "The notion of confronting a range of theories with a set of independent facts is misconceived" (1997: 76).

Donald McCloskey (1983) has analysed the rhetoric of mainstream economics and concluded that, in contrast to the rhetorical claim that logical empiricism was the methodological foundation for theorising, persuasiveness was the criterion actually employed by economists for appraising economic theories. This conclusion accords with postmodern thinking which claims that there is not one universal knowable truth, but only multiple, subjective and partial truths.[44] Hence the hegemony of one truth can only be obtained at the expense of other truths and must be achieved through the powers of persuasion.[45]

It is important to point out that distinct methodological pitfalls lurk within the pluralist and postmodern schools of thought. For example, McCloskey's attempt at offering a pluralist pragmatic criterion of appraisal ("A theory is to be preferred which is accepted by an academic community, i.e. which has proved to be most persuasive") is itself a prescriptive methodological claim (McCloskey, 1994 in Dow, 1997: 79).[46] Similarly, the statement "there is not one universal knowable truth" is itself a universal truth claim. Nevertheless, it is useful to think of the process as dialectic: the modernist claim to absolute truth, the postmodern rejection of this claim and the synthesis of these two claims. Dow describes this synthesis as follows: "We are now in transition to a synthesis consisting of new ways of generating knowledge which aim to identify a version of the truth, while admitting the impossibility of identifying absolute truth, on the one hand, but asserting the feasibility of different versions of the truth, on the other" (1997: 86).

[44] Dow claims that postmodernism "denies the possibility of identifying truth of any kind" and "also involves a denial of the basis for humanism, or government intervention" (1997: 79, 86). Ernst Gellner, while noting that it is almost impossible to give a coherent definition or account of postmodernism, interprets its practical outcome in the following terms: "In the end, the operational meaning of postmodernism in anthropology seems to be something like this: a refusal (in practice rather selective) to countenance any objective facts, any independent social structures, and their replacement by a pursuit of 'meanings', both those of the objects of inquiry and of the inquirer. There is thus a double stress on subjectivity: the world creation by the person studied, and the text creation by the investigator" (1992: 31).

[45] This is, of course, an assertion. Nevertheless it begs a more fundamental question highlighted by Gellner: "And yet there is a hint of an underlying more or less coherent idea in [postmodernism]: starting from the point which helped inspire epistemology, namely that there are tools used in knowledge, and that these deserve and require examination, there is an attempt to link this to the indisputable fact that in this world there is a great deal of inequality of power. Could there be a link between the way the tools of knowledge *make* the worlds which they claim to *find*, and those inequalities?" (1992: 42). Posing this question is, perhaps, the most important contribution that postmodernism has made to social theory.

[46] Dow comments that the "purist (non-critical) pluralist position leads to the type of untenable position occupied by McCloskey when she denies the role of prescriptive methodology in prescriptive methodological terms" (1997: 80).

Within mainstream economics there is an ongoing tension between deductive and inductive logic. The theorists emphasise deductive logic whereas the empiricists concentrate on inductive logic. Both methodologies are inherently flawed: it has proved difficult, if not impossible, to test the deductions derived from pure theory, and inductive logic is subject to the impracticalities of falsification.[47] It seems as if the methodological debate within mainstream economics has not progressed much beyond this dualistic preoccupation. Boland (1991) argues that mainstream economics still operates within the methodological framework of positivism whereas the philosophy of science has moved beyond this.

There is, however, a third strand. The advocates of this third way, called the "Minnesota Agnostics" by Johnston (1991), use inductive logic (like the empiricists) but not for the purposes of testing or proving theories. Rather, they employ econometric techniques deliberately designed to be atheoretical (Dow, 1997). This approach, also termed "letting the data speak for themselves", argues against the process of mainstream theory construction which consists of developing axiom-based closed systems yielding equilibrium solutions (1997: 82). This approach is compatible with the critical-realism that is described below.

Traditional mainstream economics methodology is based predominantly on a closed systems approach. However, social systems are inherently open. Both logical and empirical certainties are severely constrained because the full range of variables is not known and dynamic processes limit the scope for replicable events. These limitations have long been recognised by major non-mainstream economists such as Hayek, Keynes, Robinson and Kaldor (Dow, 1997).

A promising open systems methodological approach is critical-realism. Dow describes this approach as follows:

> [Critical-realism] stresses the requirement to ground all epistemology, methodology and theory in an ontology. Specifically, it is argued that observed reality is generated by underlying structures and processes, and that it should be the purpose of science to identify these structures and processes. But because these structures and processes are organic, our knowledge of them is inevitably incomplete; reality can only be understood as an open system, so there is scope for a range of understandings. But each understanding can be discussed rationally in relation to perceptions of the underlying structures and processes. The logic is thus fundamentally different from that of mainstream economics which is geared to identifying empirically, or formalising mathematically, event regularities along logical, positivist lines. ... Methodological awareness is crucial, but does not go far enough – even more crucial is ontological and epistemological awareness. (1997: 88)

[47] Dow notes that there has been a "shift in relative power exercised in the profession by pure theorists relative to empiricists, with a growing gulf between the two groups" (1997: 82).

Critical-realism acknowledges the primacy of subjectivity in an open systems context (a concern highlighted by postmodernism) and seeks to mitigate this through self-awareness in the method of enquiry as well as in the systems of belief and knowledge informing the enquiry.

In addition to its commitment to open systems, Fine (2000a) identifies three other key characteristics of critical-realism: it is systematic and requires an understanding of social and historical content; it recognises that there is no direct relationship between theory and empirical observation; and, it renders much of neo-classical economic theory redundant because of its philosophical base (methodological individualism) and its preoccupation with equilibrium as an organising concept.

Fine (2000a) criticises critical-realism for not being critical enough; for not engaging with the content of neo-classical theory; for failing to address the system within which economic theory is practised, that is, capitalism; for its naivety with respect to the methodologies and content of other social science disciplines, in particular, classical political economy; and, for a limited incorporation of history. These criticisms seem to carry more validity with respect to the actual *practice* of critical-realism rather than the methodological approach itself.

Given its current hegemony, neo-classical economists tend to set up neo-classical economics as *the* appropriate methodology, asserting an exclusive truth claim to the analysis and understanding of economic processes. This claim has certainly been adopted within the water economics literature, as shown in Chapter 1. From a critical-realist perspective, such a claim is flawed. Neo-classical economics may reveal "truths", but these are partial truths generated within a particular ontological system. Other truths, generated from different ontological systems, can co-exist together with the (partial) truth claims of neo-classical economics. An examination of the question of water pricing using the methodology of mainstream neo-classical economics is inevitably partial and incomplete. A more complete understanding of water pricing can be achieved by using the critical-realist approach, the approach adopted in this thesis.

Although it would be possible to address the topic of urban water pricing purely from a classical political economy perspective, it will be argued that such an approach would not be helpful for the development of urban water pricing theory and praxis if it were to be undertaken on its own. Similarly, an institutional approach to urban water pricing has distinct limitations.[48] A critical-realist approach creates the "methodological space" for the examination of water pricing using different approaches. Three approaches are examined in

[48] The specific limitations of institutional economics are demonstrated in Chapter 4.

this chapter: neo-classical economics, institutional economics and political economy. I argue that although each approach adds insights into urban water pricing, none of the methodologies on their own provides a satisfactory explanation of the theory and practice of water pricing, and therefore, a more satisfactory explanation can be obtained by selecting and combining the insights in a critical way, using the methodology of critical-realism. The implications of this approach are shown in the chapters that follow. The success of the approach is evaluated in the concluding chapter.

3. Methodology as epistemology

A second dimension of methodology has to do with the choice of subject, that is, the epistemological base. There are marked differences between the subjects studied and the kinds of questions asked in the three main branches of economics: neo-classical economics, classical political economy and (new) institutional economics. At the risk of over simplification, the core subject matter and key questions asked within these three branches of economics are briefly encapsulated below.

Mainstream neo-classical economics is almost exclusively concerned with the problem of the Pareto-efficient allocation of resources in the context of scarcity. The primary question asked is: how can resources be allocated more efficiently so as to maximise social welfare (usually equated with aggregate wealth)? The basic unit of analysis is the rational calculating individual (methodological individualism). Aggregates (for example, a firm) are treated as if a single rational individual could represent their actions. The dynamics of capital accumulation and the distribution of power that influences how the surplus is allocated are largely ignored in the analysis. Methodological individualism refers to the dominance of the individual unit (household in the case of the consumer and firm in the case of the producer) as the basic unit of analysis (Hodgson, 1986). In classical economics, also called classical political economy, the focus of analysis was on economic interest groups and their interaction (at the risk of over simplifying, mercantilists and monopolist traders versus others in the case of Adam Smith, landlord versus the landless in the case of David Ricardo, and the owners of capital versus labour in the case of Karl Marx).

The ahistorical approach of neo-classical economics differs markedly from classical political economy. Geoffrey Ingham (1996) asserts that the latter sought to answer three questions: first, an explanation for wealth creation, second, what determines the distribution of this wealth, and third, why this occurs in a "reasonably ordered manner" when the potential for violence arising out of self-interest is great. The dynamic of accumulation and the power relationships related to this were thus explicitly part of the subject matter.

The key features of neo-classical economics which stand out in contrast to classical economics have been succinctly summarised by Krishna Bharadwaj (1986) as follows: "(a) The [neo-classical] theories introduced through their characterisation of the productive process and their concept of 'costs' a symmetry among all the revenue categories and offered a uniform explanation of 'factor rewards'. (b) The theory of price subsumes the theory of distribution in the sense that both product and factor prices are explained by the same processes, equilibrating demand and supply. (c) The 'individual' making optimising decisions in response to prices is the basic unit of analysis. (d) A formal and apparent symmetry was introduced in the roles that production and consumption play in determining prices. This introduced, prominently, considerations of individual subjectivity; for ultimately consumption provided not only the *raison d'être* for production but also the basis for determining factor rewards; while consumption was itself explained on the basis of utility maximisation by individuals, guided essentially by relative prices, the system of preferences of the individual was taken as foreknown. (e) Analysis shifted prominently to the sphere of circulation, or exchange; both, the determination of all the quantities and of distribution, being subsumed under the general theory of relative prices, the latter came to acquire analytically the key role as the driving force behind change" (1986:31f).

Much of the new institutional economics (epitomised by the contribution of Oliver Williamson, 1985) is functionalist in its methodology. New institutional economics seeks to explain the existence and/or persistence of economic and social institutional arrangements in terms of their efficiency (*vis-à-vis* other alternatives). This approach is subject to at least three serious logical and substantive difficulties: first, effects are treated as the cause or origin, thus reversing the time sequence of conventional causal analysis; second, it is not possible to measure any particular item's net contribution to efficiency; and third, other functional alternatives may exist and functionalism gives no explanation as to why this particular system emerged (Ingham, 1996: 251). New institutional economics, like neo-classical economics, expressly excludes the analysis of power relations.[49]

An analysis of water pricing solely in terms of neo-classical economics is severely limited by its preoccupation with Pareto-efficiency concerns. Institutional economics adds value through its concern with the institutional structures underpinning economic relations. Classical political economy, through its exploration of historical processes and the dynamic of accumulation over time, asks a different set of questions which may be used to complement and criticise the above analyses.

[49] In a survey article on institutional economics by Geoffrey Hodgson, a key proponent of this approach, power relationships are not mentioned once (Hodgson, 1998).

Using critical-realism as the methodological approach, this thesis seeks to understand water-pricing using all three "epistemological sets" defined by the three main branches of economics. The questions posed in this thesis require an understanding of static allocation issues, dynamic allocation and accumulation, institutional structures (and the changes to these over time), and historical economic processes encompassing an analysis of power and conflict over resource allocations and outcomes.

In the above light, the data required to examine urban water pricing would include (but not be limited to) the following: costs and cost structures related to the supply and distribution of water; demand and demand structures related to the consumption and use of water; the distributions of both supply and demand in relation to consumer classes and income distribution; environmental, health and social benefits and costs related to the supply, distribution and consumption of water and distributions of these benefits and costs; the institutional structure and characteristics of the specific "market" for water, in particular, the governance and regulation of water provision, the extent of monopoly, the ownership and management of assets, the effectiveness of service provision and the distribution of rents; and, the historical processes that have resulted in the present institutional structures and the distribution of costs and benefits and, specifically, the role of capital accumulation in this process and the distribution of the surplus.

It is obvious that much of this data will be specific to a particular urban water context. Hence, the analysis in the following chapters is presented with reference to context-specific data, with a particular focus on urban water pricing practices in South Africa, Uganda and the United States of America. Secondary data have been supplemented with primary data where necessary. Primary data have been collected through field visits in South Africa and Uganda and through personal communications with influential policy makers in the water sector in these countries, the World Bank and the United States.

4. Methodology as ideology

Methodology is contingent on the prior choice of ontological system. In turn, the choice of ontological system is influenced by ideology. Hence methodology is contingent on ideology and the choice of methodology involves a choice of a belief system and set of norms.

A cornerstone of the ideology of efficiency is the subjective preference theory of value that simply stated, means that commodities have value because they are wanted, and wanted

because they (presumably) have some use or utility for the individual.[50] This has two crucial consequences: first, it treats individuals and their structure of wants (preferences) as the ultimate and independent data of the economic problem; and second, the theory of distribution becomes incidental to the pricing process. To link allocation decisions so directly and unambiguously to consumer preferences, as neo-classical economics does, is clearly problematic. Sagoff (1994) points outs that the implications of this for welfare economics in particular are catastrophic because preferences have no demonstrable relation with well-being.[51]

In neo-classical theory, the subjective value of individual preferences becomes objectified in the measure of marginal utility. This marks a distinct departure from classical economics that sought an objective base for the measure of value. The subjective preference theory of value has been criticised by Maurice Dobb (1973) and others for failing to concern itself with the social conditioning of the individual's desires or behavioural reactions: "The concept of the individual making free choices on the basis of an autonomously given scale of preferences conflict[s] directly with reality, when consumers' preferences [are] directly moulded by the availability of consumables and by the individual's environment and class position" (Bharadwaj, 1989: 188).

A key assertion of neo-classical theory is that the overall welfare of society is maximised when free agent producers and consumers interact through voluntary exchange (free competitive market), with individual consumers seeking to maximise their utility and producers seeking to maximise their profits. Such a state of maximum welfare is said to be *Pareto-efficient* if it is not possible to increase overall welfare without causing some individuals in society to become poorer. The theory claims that Pareto-efficiency is attained when individual producers produce up to a point where the marginal cost of production equals the marginal revenue received (that is, the sale price in a competitive market) and individual consumers consume up to the point where the marginal utility of consumption equals the marginal loss of utility (or opportunity cost) of foregoing consumption of other goods (that is, the purchase price in a competitive market).[52] These claims rely on the validity of the two

[50] "The methodology ushered in by the 'Jevonian revolution' and given more systematic formulation by Menger and the 'Austrian school' sought to derive an explanation for exchange-value from the attitudes of individual consumers towards commodities as use values catering for satisfaction of individual wants" (Dobb, 1973: 33). See also Cole *et al* (1991).

[51] In terms of modern neo-classical economic theory, utility reduces to subjective consumer preferences. Sen notes that there is some ambiguity in this "preference" view of utility (1992: 6): preferences can be defined purely in terms of individual choice, in which case there is no content to interpersonal comparisons, or at least not in any straight forward way; alternatively, preferences can be defined in terms of desires or satisfactions. See Chapter 5.

[52] In this way, neo-classical economics sets up symmetry between producer and consumer. Again, this is markedly different from the views of classical economists, particularly those of Marx, who recognised the

fundamental theorems of welfare economics: competitive equilibrium allocations are Pareto-efficient; and, any Pareto-efficient allocation can be achieved as a competitive equilibrium if appropriate lump-sum transfers are made.[53] For the purposes of application, these theorems require that economies are in competitive equilibrium and that lump-sum transfers can be made without cost or the creation of market distortions. Neither of these conditions pertain in real economies.

It is also necessary to address the problem of welfare changes that result in some individuals being made better off and others worse off (which is the norm rather than the exception). Neo-classical economists defend the primary goal of improving Pareto-efficiency in this context by appeal to the Kaldor-Hicks compensation principle. This states that if an economic policy has the consequence of making one set of people better off and another worse off, then a potential Pareto-improvement can be said to have occurred if the gainers could compensate the losers and still benefit from the change. Dinwiddy and Teal (1996) criticise this principle on three counts: the notion of "potential" is problematic: payment does not have to occur, in which case the notion of Pareto-improvement as an ideological justification for neo-classical welfare economics is misleading to the point of being completely undermined; costless lump-sum transfers are not possible; and, the Scitovsky paradox shows that even if costless lump-sum transfers do occur, the direction of social welfare change may be ambiguous (Scitovsky, 1971).

In practice, neo-classical economic policy-making relies heavily on the Kaldor-Hicks compensation principle. The emphasis of most neo-classical analyses in support of particular policies is on "potential Pareto-efficiency improvement"; the question of the distribution of losses and gains inherent in almost any economic intervention is typically left to a political process (that is, it is ignored in the analysis). Neo-classical economics consciously chooses this route in an attempt to avoid the inevitable subjectivity of welfare economics and in this way sets itself up as an "objective" science. However, this objectivity is a thin and misleading veneer for a number of reasons. First, as already noted, almost all economic policies have very real consequences for income distribution whether these are acknowledged and factored into the analyses or not. Second, the process of establishing policies which seek to maximise potential Pareto-efficiency improvements is hardly objective, requiring numerous subjective judgements. Third, the many accommodations required to account for imperfect or incomplete

asymmetries between the owners of the means of production on the one hand and consumers on the other.

[53] Formal proofs of these theorems are provided by Mas-Colell *et al* (1995).

markets, externalities, imperfect or asymmetrical information, capital indivisibility, and transaction costs render the potential Pareto-efficiency claims implausible.

One of the most important failings of neo-classical economics is that it does not treat income distribution logically and coherently. Neo-classical economics asserts that Pareto-efficiency is independent of income distribution, that is, any distribution of income can be Pareto-efficient.[54] However, this is inconsistent within the theory's own logical framework. Clearly, the prevailing structure of market demands is dependent on the income distribution. Therefore, the whole pricing process implicitly assumes a postulated initial income distribution, which contradicts the second fundamental theorem of welfare economics.

Thus the theory of price actually subsumes the theory of distribution (Bharadwaj, 1986). In fact, in some development of neo-classical theory, the claim to explain distribution has been given up, with "the theory being avowedly designed only to explain price formation" (Bharadwaj, 1986:31). Dobb expands on this point:

> *A theory of distribution, in other words, if it is conceived as a theory of derived prices of productive services or factors, cannot be independent of initial income-distribution as essential premise. ... [In the classical approach,] income distribution is treated as being a result of social institutions and social relations, whereas in [the neo-classical approach] it is determined by the conditions of exchange. [For classical economists,] social conditions and class forces are more fundamental than relations of exchange. [For neo-classical economists,] income distribution (at least between factors) is supra-institutional and supra-historical. (Dobb, 1973: 35)*

The theory of welfare economics thus ends in a logical quagmire and the assertion that perfect competition maximises welfare and is in the best interests of all is untenable. The existence of imperfect markets, market power, income inequality, imperfect information, transaction costs and uncertainty poses insuperable problems for welfare economics.

The key danger of neo-classical economics is that the pure theory (which describes, and is only applicable to, an artificially constructed abstract world) is translated into a dogma that asserts that free competition and self-interest (utility maximisation and profit maximisation) are good for every one.

An important and direct consequence of the philosophical basis of the neo-classical theory is the tacit support it gives to the view that the existing distribution of wealth is a result of ability, hard work and efficiency and thus the wealthy have "earned" their wealth in a fair

[54] This is the second fundamental theorem of welfare economics.

and just way.[55] Although most self-respecting neo-classical economists would dissent from such a view, there is an important sense in which the philosophy underpinning neo-classical economics, with its obeisance to the market and its support of the notion that the pursuit of "utility maximisation" results in the "overall good" for society as a whole, supports a form of social Darwinism. Indeed, the moral justification of wealth (in the presence of poverty) in many modern European and North American countries is achieved by appealing to neo-classical economic theory.[56]

The policy conclusions arising from the neo-classical economic analysis of Pareto-efficiency therefore must be viewed critically in the light of the inherently ideological content of the philosophical underpinnings of the theory.

New institutional economics operates within a similar ideological framework to that of neo-classical economics with respect to the ideology of efficiency. Efficiency is regarded as the "objective yardstick" which can be used to explain institutional forms. Efficiency is implicitly understood to be Pareto-efficiency and is reliant on the subjective preference theory of value. Hence, new institutional economics is subject to the same methodological criticisms as neo-classical economics, with the exception that new institutional economics does not require the strong rationality assumption used within mainstream neo-classical economics. Williamson, a key proponent of the new institutional economics, assumes that human agents are opportunistic ("self-interest seeking with guile") but exhibit bounded rationality ("intendedly rational but only limitedly so") as a result of incomplete information and uncertainty about the future.[57] He asserts that this is "human nature as we know it" and admits that "the resulting conception of nature is stark and rather jaundiced" (Williamson, 1985: xiii). These are slightly milder assumptions than those used for standard neo-classical economics. The assumption of imperfect information is an implicit acknowledgement of the fact that social systems are inherently open. This allows institutional economics to move away from the static equilibrium analysis inherent in standard neo-classical economics. For example, Douglas

[55] The pure form of this view is proclaimed by social Darwinists. For a vivid description of social Darwinism, see Galbraith (1984: 48). See also *The Economist* (August 21, 1999: 13) for a more contemporary view of the same phenomenon.

[56] See Galbraith (1984: xiv).

[57] Williamson states: "I do not insist that every individual is continuously or even largely given to opportunism. To the contrary, I merely assume that some individuals are opportunistic some of the time and that differential trustworthiness is rarely transparent *ex ante*. As a consequence, *ex ante* screening efforts are made and *ex post* safeguards are created. Otherwise those who are least principled (most opportunistic) will be able to exploit egregiously those who are more principled. ... One of the implications of opportunism is that 'ideal' co-operative modes of economic organisation, by which I mean those where trust and good intentions are generously imputed to the membership, are very fragile" (1985: 64). North (1990) asserts that one of the key roles of institutions is to reduce uncertainty.

North attempts to explain the persistence of inefficient institutions by appeal to the notion of "fuzzy feedback" which is a characteristic of imperfect information (North, 1990).

In contrast to new institutional economics, "old" institutional economics was not concerned with the primacy of individual behavioural assumptions. Both John Commons and Thorstein Veblen, the pioneers of the discipline, were interested in how institutions affected individual behaviour.[58] Like classical political economy, old institutional economics sought an explanation for why things were as they were. This is very different to neo-classical economics with its focus on the predictive success of theoretical models to explain prices and distribution.

The methodological challenge to the critical approach of classical political economy is to make the ontology explicit and to be self-aware about the limitations imposed by ideology. By way of example, Marx set out his premises with respect to the development of a materialist conception of history as follows:

> *The method of approach is not devoid of premises. ... Its premises are men, not in any fantastic isolation and rigidity, but in their actual, empirically perceptible process of development under definite conditions. ... Talk about consciousness ceases and real knowledge has to take its place. When reality is depicted, philosophy as an independent branch of knowledge loses its medium of existence. At most its place can be taken by a synthesis of the most general results that may be abstracted from observation of the historical development of men. Separated from actual history, these abstractions have in themselves no value whatsoever. ... The difficulties only begin when we set about the observation and arrangement – the real depiction – of the materials, whether it be of a past epoch or the present.*[59]

Marx makes both the premises of the methodology and its limitations explicit. The methodology is premised on a study of human action under real and specific *social* conditions.[60] The method seeks to understand this action in relation to the historical development of humankind and requires abstractions and generalisations which nevertheless must be routed in actual and specific histories. The limitation of the methodology pertains to the fact that the abstractions from an open social system must necessarily involve subjective judgements and choice.[61] In this context, Friedrich Engels pointed out that "there are

[58] See Commons (1950) and Veblen (1909). For a discussion of the methodological differences between old institutional economics and neo-classical economics, see Dugger (1994).

[59] Karl Marx, *The German Ideology*. London. 1965. As quoted in Giddens (1994: 22).

[60] Marx makes the obvious point that "production by an isolated individual outside society ... is as much an absurdity as is the development of language without individuals living *together* and talking to each other (Marx, 1994: 120). In an important sense the methodological individualism of neo-classical economics ignores this very point.

[61] Of course, this limitation applies to all theoretical abstractions.

innumerable intersecting forces .. which give rise to one result – the historical event".[62] The task of attributing causation to a historical event therefore is fraught with difficulty. If history is understood to be an attempt to understand the present in terms of the past, then it is not correct to speak of *the* history of an event *y* (say), but only of *a* history of *y*. This does not deny the existence of objective facts, but rather seeks to make explicit the inherent subjectivity involved in the selection and interpretation of a *necessarily finite* set of facts from an essentially *infinite* open system.

The methodology of classical political economy in a specific instance is compelling to the extent that it is able to provide a more comprehensive and satisfactory explanation of the observed phenomena compared to rival explanations.

5. Critical-realism and water pricing

The critical-realist approach adopted in this thesis seeks to be self-aware of the ideologies employed in the analysis of water pricing by neo-classical economics, institutional economics and classical political economy. By looking at water pricing through different "ideological prisms", an economic analysis will be developed which provides multiple, partial-truth views of the complex open system of water pricing. It is contended that this approach, which has not been attempted before, provides a superior understanding of water pricing compared to approaches that rely exclusively on one ideological framework. This represents an original contribution to the economic analysis of water pricing.

[62] Engels to J. Bloch, in Konigsberg, 21 September 1890.

Chapter 3: Widgets and water

Neo-classical economic theory and urban water pricing

> *The task of translating [the principles of marginal-cost pricing] into actual price schedules is so extraordinarily difficult that it is entirely possible to accept their validity while at the same time concluding that the task of following them is an impossible one [and that even] the most sophisticated and conscientious effort to apply these principles inevitably involves large doses of subjective judgement. The uncertainty of the estimates [counsels] a tempering of the principles themselves. (Kahn, 1988: I:182)*
>
> *We find ourselves forced to hunt for a solution in the dark jungles of the second best. (Baumol, 1978: 802)*

1. Introduction

Much of the literature on urban water pricing is premised on the basic pricing schema advocated by neo-classical economics – marginal-cost pricing. The theoretical basis for this approach is usually taken as given in the water pricing literature and the underlying assumptions necessary for the theory to hold are seldom critically examined. For these reasons, it is useful to take a step back and re-examine the essentials of the general positivistic and axiomatic neo-classical approach to pricing. A critical evaluation of neo-classical pricing theory reveals that the Pareto-efficiency claim is not robust. The theory is forced into a seemingly endless retreat from the original Pareto-efficiency and welfare maximisation claim as a result of pervasive externalities, informational asymmetries and imperfect competition. The measurement of marginal costs also is uncertain, requiring subjective judgements. Moreover, the practical outcome of marginal-cost pricing may be highly inequitable and socially undesirable.

The application of neo-classical economics to water pricing typically is undertaken in an uncritical fashion. The key debates in the literature have to do with superficial aspects of the theory, for example, the definition of marginal costs and the techniques for incorporating "externalities" within the pricing-framework. Although some of the characteristics of water supply, such as capital indivisibility, are taken into account, water is commodified and could, for all intents and purposes of the theory, just as well be a widget. That is, the theory does not address all of the specific characteristics of water nor does it take into account adequately the political-economic context.

Neo-classical pricing theory can assist with the definition and estimation of costs and benefits. However, the distributions of these costs and benefits can only be understood within a dynamic political-economic framework. A critical-realist pricing methodology is able to overcome the limitations of neo-classical theory by addressing urban water pricing theory and practice in a more comprehensive way.

2. The pricing of widgets

The claim

The primary claim of neo-classical theory in relation to pricing is that Pareto-efficiency is maximised when the (selling) prices of commodities are equal to the marginal cost of supply. This claim is universal in that it applies to all commodities in all contexts. It is contingent on the axiomatic treatment of demand (in terms of rational consumer choice) and supply (in terms of profit maximising production) and a competitive equilibrium between demand and supply in the whole economy (that is, perfect information, zero transaction costs and no externalities).

The basic theory of consumer demand relies on six axioms:[63] (1) reflexivity – each bundle of "consumer goods" is considered to be as good as itself; (2) completeness – the consumer must always be able to state a preference between two possible alternatives;[64] (3) consistency – choices are not allowed to cycle;[65] (4) continuity – the consumer's preferences cannot exhibit "jumps;[66] (5) non-satiation – the consumer always prefers more to less;[67] and (6) convexity – indifference curves are convex to the origin.[68]

The key difficulties with the set of consumer choice axioms used in neo-classical theory, are that the role of socialisation, the effect of income distribution and the influence that producers have on consumer choice, are largely ignored. The notion that consumer choices are pre-

[63] See, for example, Mas-Colell *et al* (1995).

[64] This requires that consumers are able to evaluate alternatives that may be far from their realm of experience and that this evaluation has already taken place.

[65] Failure to satisfy this axiom will result in the invalidation of much of consumer choice theory. Axioms 2 and 3 together assure that consumers' choices are rational.

[66] That is, a consumer preferring each element in a sequence $\{x^n\}$ to the corresponding element in a sequence $\{y^n\}$ cannot suddenly reverse his/her preference at the limiting points of these sequences x and y. This rules out lexicographic ordering for the sake of mathematical convenience even though such orderings represent a perfectly reasonable system of choice

[67] The consumer choice problem can thus be reduced to one of maximising utility subject to a budget constraint.

[68] This may be interpreted as diminishing marginal rates of substitution, that is, for any two commodities. It can also be regarded as a formal expression of a basic inclination of economic agents to diversify. Of course, there are choice situations in which this is violated and not all of the theory relies on this assumption, however, it is of critical importance for welfare analysis.

determined, fully known and absolute, and, indeed, that there is such a thing as a representative consumer, is fanciful. Knowledge of the full range of choice is almost always incomplete. Choices may also be inconsistent and not all choices have to do with scarcity of resources (Green, 1996, Sen, 1977).

Using all of the above axioms, and assuming a linear budget constraint, consumer choice (and hence demand) reduces to the standard problem of utility maximisation.[69] The solution shows that an increase in the relative price of x must lead to a fall in its purchases provided utility is held constant. However, this simple algebraic solution has defects: it requires convexity of preferences; it relies on tangency arguments;[70] and, the functions need to be continuously differentiable twice. The solution therefore requires additional onerous restrictions not guaranteed by the axioms themselves.[71]

While the mathematics of the standard neo-classical theories of consumer choice and utility maximisation may be elegant, the validity of much of the practical application of these theories to the real world is, at best, misleading, and, at worst, simply wrong. For example, Deaton and Muellbauer argue that demand functions are primarily consequences of budget constraints rather than preferences and that non-linear budget constraints and corner solutions are common (1980: 24).

The utility maximisation problem can be restated as one of minimising costs to achieve a desired level of utility. The results of this approach give four basic properties of demand functions of the Marshallian[72] and Hicksian[73] form: they add up; the Marshallian demands are homogenous of degree zero in prices and total expenditure;[74] the compensated price responses of the Hicksian demands are symmetric;[75] and, these price responses form a negative semidefinite matrix.[76] Adding up and homogeneity are the consequences of specifying a linear

[69] See, for example, Deaton and Muellbauer (1980: 31).

[70] This hold under special circumstances only, for example, every consumer must buy every commodity.

[71] A variant of consumer choice theory using a less restrictive set of assumptions based on observable choice behaviour exists. Unfortunately, the stronger assumptions used in the preference-based approach are of critical importance for the analysis of welfare.

[72] The Marshallian demand function is in the form *demand* = $g(x, p)$ where x is the vector of outlays of goods x_i and p is the vector of prices p_i for each x_i.

[73] The Hicksian demand function is in the form *demand* = $h(u, p)$ where u is the utility of the consumer.

[74] That is, equal proportionate changes in prices and total expenditure will not alter demand.

[75] That is $\partial h_i(u, p) / \partial p_j = \partial h_j(u, p) / \partial p_i$.

[76] The N x N matrix M is negative semidefinite if $z \cdot Mz \leq 0$ for all $z \in \Re^N$.

budget constraint. Symmetry is a guarantee of the consumer's consistency of choice. Negativity comes from the concavity of the cost function, that is, that costs are minimised.[77]

There are three important implications: an equal percentage change in all prices and wealth leads to no change in demand; total expenditure cannot change in response to a change in prices; and, total expenditure must change by an amount equal to any wealth change.

The above theory deals with the demand of individual consumers only. Aggregate or market demand is usually of much greater importance in economics. Not all of the properties of individual demand hold for aggregate demand without additional restrictions. A necessary condition for exact aggregation is to be able to treat aggregate consumer behaviour as if it were the outcome of a single maximising consumer. This requires quasi-homothetic preferences.[78] This is a stringent condition unlikely to be satisfied in the case of narrowly defined commodities and where the focus is on demand response differences between high and low income households.[79] This is particular pertinent to water demand in developing countries where there are wide disparities in income, access and consumption patterns and where demand responsive varies greatly across consumers.[80]

There is no guarantee that consumer choice is "rational" in the sense defined. Although the weak revealed-preference approach represents consumer choice more closely, it does not have the mathematical convenience of the utility function derivable from preference theory, *nor can it be used to establish the fundamental axioms of welfare economics*. The alternative approach to consumer demand based on cost-minimisation (the duality approach) also suffers from distinct limitations. The requirement that an equal percentage change in all prices and wealth leads to no change in demand is only likely to be valid under restrictive conditions. The requirement that consumers spend all of their wealth is also restrictive, even if a life-cycle approach to consumer choice and spending is adopted.[81] Thus, total expenditure may change in response to a change in prices, and total expenditure may not change by an amount equal to

[77] This is less restrictive than the convexity of preferences required in conventional utility maximisation.

[78] Homothetic preferences imply that the a consumer's preference ordering is independent of wealth and hence all expenditure-elasticities are equal to one. For Quasi-homothetic preferences, preference orderings (or actual expenditure patterns) are a weighted average of value shares appropriate to very rich and very poor consumers, and expenditure-elasticities tend to unity as total expenditure increases.

[79] This is so because exact aggregation models a representative consumer, whereas additional demand for specific goods is likely to occur at both the extensive margin with new consumers entering the market and at the intensive margin with the same consumer buying more of a good (Deaton and Muellbauer, 1980: 151).

[80] Price-elasticities of demand are discussed in Chapter 6.

[81] The introduction of life-cycle analysis brings new restrictions: not only must consumers have perfect knowledge of current potential choices, they must also have perfect knowledge of all future opportunities and choices.

any wealth change. Additional demand for specific goods is likely to occur at both the extensive and intensive margins making aggregate and individual demand schedules different from each other. This latter point is highly relevant to urban water supplies in developing countries where much of the new demand arises from new connections to the system.[82]

The neo-classical theoretical approach to supply proceeds largely in an analogous fashion to that of consumer choice theory with suppliers or producers (firms) assumed to maximise profits (or minimise costs for a given output). Supply theory is based on the following general properties of production sets (Z), not all of which are assumed to hold under all circumstances:[83] (1) Z is non-empty – there is always something that a firm can plan to do; (2) Z is closed – there are technical limits to the extent of the production set; (3) there is no free lunch – it is not possible to produce something from nothing; (4) it is possible to do nothing; (5) there is "free disposal" – it is possible to absorb additional inputs without any reduction in outputs; (6) production is irreversible – output cannot be re-transformed into the original inputs at zero cost;[84] (7) there are constant returns to scale; (8) there is free entry into production; and, (9) the production set is convex.

If it is assumed, in addition to the above, that the firm is producing for a competitive market and is a price taker, then the theory asserts that a profit maximising firm will produce at the point where the marginal cost of output equals the marginal revenue from sales.

Property 5 (free disposal) denies the existence of externalities.[85] Property 7 (constant returns to scale) is often not true to real production processes, although it is a fundamental assumption for much of the theory (see Property 9). Property 8 (free entry) is certainly not true in all contexts. Thus competition is threatened and the problem of market power arises (see below). Property 9 (convexity) is one of the fundamental assumptions of microeconomics. Convexity encompasses non-increasing returns to scale and the notion of "balanced" inputs being more productive than "unbalanced" ones, neither of which is necessarily true. Non-convexities in production can arise from capital indivisibilities, fixed costs or increasing returns to scale, all of which are present in the urban water supply sector.

[82] In Uganda, for example, the number of active connections is anticipated to double in the next 10 years and total water consumption is likely to increase by about 50 percent.

[83] See, for example, Mas-Colell *et al* (1995: 130) and Debreu (1959).

[84] Properties 1, 2, 3, 4 and 6 are trivial and impose no significant restrictions on supply theory.

[85] The treatment of externalities in neo-classical economics is discussed in a separate section below.

The possibility of increasing returns to scale raises at least two logical problems for equilibrium analysis: the assumption of competition is threatened;[86] and, the notion of technological change is externalised as an exogenous variable that cannot be explained within the analytical framework.[87]

The assumption that firms maximise profits has been criticised from an empirical point of view as an inadequate description of the motivation underlying decisions taken by firms. Simon (1959) argues that firms aim for a minimum satisfactory profit because they operate in a world on uncertainty.

If firms maximise profits taking prices as given, then the production side of the economy aggregates perfectly. Efficient production may be defined as a production vector y for which there is no other feasible production vector y' that generates as much output as y using no additional inputs. If y is profit maximising for a given vector of prices, then y is efficient. This applies even if y is not convex. If y is convex, then every efficient production y is a profit-maximising production for a given p.

The existence of a firm implies the suspension of markets within a firm.[88] Increasing returns to scale, both within individual firms as well as across a group of inter-related industries threatens the assumption of competition and invalidates the Pareto-efficiency claim of marginal-cost pricing. Although game theory attempts to model firm behaviour under these conditions, its practical relevance has yet to be proved.

Whilst the theory distinguishes between private and public goods on the demand side, it largely fails to make an equivalent distinction on the supply side between those goods that can be supplied by individuals and/or firms, and those requiring the collective action of groups or society.[89] In the case of water supply, for example, the social consequences of private water production (in the absence of adequate public regulation) have been dire.[90]

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[86] The theories of monopolistic and oligopolistic competition cater, to an extent, for this threat to competition, although the outcomes are shown to be necessarily sub-optimal under most realistic conditions. See "Market power" below.

[87] Recently, attempts have been made by theorists in the neo-classical tradition to incorporate technological change as an endogenous variable. See Fine (2000b) for a critical assessment of this literature. Classical economists sought to explain technological advance within their theories of value and distribution.

[88] This contradiction within neo-classical theory has given rise to the literature on transaction costs and institutional economics (see Chapter 4).

[89] Ostrom (1990) has developed a theory of collection action which is discussed in Chapter 4.

[90] A classic example is provided by the history of water supply to New York where the private water company was a key obstacle to improving health conditions through improved access to safe water (Koeppel, 2000).

The claim for Pareto-efficiency requires the existence of a competitive equilibrium between supply and demand, that is, markets must clear with the implication that the desired consumption and production levels for *all* commodities are mutually compatible. Market clearing also requires that there is no "false" trading, that is, trading at prices other than those at the general equilibrium. The notion of a competitive general equilibrium is a hypothetical theoretical construct requiring extremely restrictive assumptions. It is, in fact, impossible to conceive of any real market that could achieve such equilibrium. Howard points out the theory's high degree of abstraction renders its distributional content inconsequential (1988: 195).

Neo-classical theory seeks to explain changes in output, consumption and distribution all within the domain of price theory. This restricts the analysis to a static equilibrium framework that imposes distinct limitations on the theory's ability to explain dynamic changes over time.[91] The symmetrical treatment of consumption and production, while being mathematically elegant, belies the fundamental asymmetries in power and wealth that exist between the majority of producers and consumers and the consequences of these asymmetries on outcomes.

Adjustments for a non-ideal world

Four important categories of departure from the theoretical ideal world of perfect competition are incomplete markets (externalities and transaction costs); incomplete information (uncertainty); market power; and, capital indivisibility.

In the neo-classical view, externalities arise where markets are missing, and missing markets result from the incomplete allocation of property rights.[92]

Although the concept of externality is straight forward, it does not lend itself readily to theoretical analysis. Mas-Colell *et al* propose the following definition as a point of departure: "A [non-pecuniary] externality is present whenever the well-being of a consumer or the production possibilities of a firm are directly affected by the actions of another agent in the economy [without compensation]" (1995: 352).

According to the Coase Theorem, "if trade of the externality can occur, then bargaining will lead to an efficient outcome no matter how property rights are allocated", *provided that* property rights are both well-defined and enforceable (Mas-Colell *et al*: 1995: 357). The

[91] See footnote 87.

[92] This view is directly related to the philosophy underlying neo-classical economics which asserts the primacy of the individual and individual property rights.

actual allocation of the property rights does not affect the efficiency of the outcome, though it does affect distribution. The validity of Coase's Theorem requires the externality itself to be traded competitively and with zero transaction costs. Alternatively, provided adequate information is available (without cost), an outside agency can impose a quota or tax/subsidy such that the optimal allocation of resources is achieved. Although these approaches are equivalent in theory, asymmetries in information and the costs of obtaining information will mean that the outcomes of the different approaches will be both different from each in practice.

The presence of externalities poses serious problems for the notions of economy-wide Pareto-efficiency and welfare maximisation. Once an externality exists, any "solution" will be sub-optimal, by definition. Thus externalities give rise to the problem of the second-best. Lipsey and Lancaster have shown that if only *one* of the many conditions necessary to achieve Pareto-efficiency is not met, then other Paretian conditions are not, in general, achievable (1956:16). The response of economists to the implications of this problem varies widely, but many ignore it.[93] *Lipsey and Lancaster's proof essentially destroys the general theoretical claim that, in an imperfectly competitive economy, setting the price of any one particular commodity equal to marginal cost will be Pareto-superior to setting the commodity price to any other level.*

Externalities are pervasive in market economies and hence pose a serious challenge to the Pareto-efficiency claims of marginal-cost pricing in general and its application to the water sector in particular.

Another important source of incomplete markets is transaction costs, that is, the cost of undertaking economic exchange or making contracts. Most importantly, transaction costs typically lead to information asymmetries that in turn lead to Pareto-inefficient resource allocations and distributional inequalities.

Incomplete information may arise for a number of reasons. Information may be costly to obtain, or it may be asymmetrically distributed. Another important source of incomplete information is uncertainty. Uncertainty has particular relevance for the efficiency of investment decisions and efficacy of cost-benefit analysis.[94]

The most significant threat to the neo-classical claims of Pareto-efficiency is market power.[95] Of particular interest here is "natural monopoly" which arises as a result of economies of

[93] This is particularly common in the theoretical literature on water pricing. See page 68.

[94] See Baumol (1977), Baumol and Oates (1975) and Dixit and Pindyck (1994).

[95] An extensive literature exists on this subject; see Robinson (1933), Chamberlain (1933) and Hall and Hitch (1939) for landmark early discussions of monopolistic competition; Mas-Colell *et al* (1995: 383f) provides a more recent theoretical overview.

scale and is particularly applicable to the urban water sector.[96] Market power enables a monopoly to restrict output and raise prices away from the optimal level (from society's point of view) thereby reducing consumer surplus and resulting in the Pareto-inefficient allocation of resources. Monopoly regulation is discussed in Chapter 4.

Capital indivisibility makes the definition of marginal cost ambiguous because there is a difference between short-run marginal costs where the level of capital investment is held constant and long-run marginal costs with variable capital investment. Capital indivisibility typically is an important characteristic of the urban water supply industry because significant economies of scale may be derived through investments in large increments in water supply, for example, new dams. Although the definition of short-run marginal cost is fairly clear and straightforward to measure, this is not the case for the long-run marginal cost. Different measures exist in the literature. None of these measures provides for the precise and objective determination of the long-run marginal cost. All are subject to future uncertainty (future demand, supply and costs) and involve subjective choices with respect to the time-frame of the analysis and choice of discount rate.

There is no consensus in the literature on whether the price should be related to the short-run or long-run marginal cost of supply. One school of thought advocates commodity pricing with respect to the short-run marginal cost, with the fixed costs (sunk investments) being regarded as irrelevant to the determination of price once the investment has already occurred. According to this school of thought, the investment decision should be determined separately from (though not wholly independently of) the commodity-pricing decision. The investment decision could be decided through undertaking a social cost-benefit analysis and the costs of the investment may be recovered in a number of ways, for example, through tax revenues[97] or fixed charges.[98] In general, the theoretical case for Pareto-optimality of short-run marginal-cost pricing in the presence of non-convexities and within a general equilibrium framework is weak.[99]

[96] A French water manager recently described (with satisfaction) the urban water supply business as "the ultimate natural monopoly" (*The Economist*, 24 February 1996).

[97] Hotelling (1938) was the first to argue that short-run marginal-cost pricing together with income taxes was Pareto-superior to average-cost pricing. Ruggles (1949-50ab) surveyed the controversy sparked by Hotelling (1938) and concluded that the marginal-cost pricing rule did not, in fact, meet the conditions for maximising welfare if the means of raising the subsidies were taken into account (Ruggles, 1949-50ab).

[98] Coase (1946) proposes discriminating two-part tariffs as a means of recovering overhead costs specific to individuals. Brown and Sibley (1986) argue within a partial equilibrium framework that such a discriminating two-part tariff is Pareto-optimal. However, Vohra (1988) refutes this within a general equilibrium framework.

[99] See, for example, Brown and Sibley (1986) and Cornet (1988).

Another school of thought advocates setting commodity prices equal to long-run marginal costs thereby including the cost of future capacity expansion in the commodity price. The advocacy of this method is particularly prevalent in the water pricing literature (cf. Bahl and Linn, 1992 and Hanemann, 1997). The theoretical claim of Pareto-optimality using the long-run marginal cost commodity pricing approach also is weak. (See Section 3 below.)

Taxes and subsidies impose further, unavoidable, distortions on the economy. All countries impose taxes on firms, citizens and economic transactions that distort markets and hence result in the Pareto-inefficient allocations of resources.[100]

In addition to the problem of distortions discussed above, there are also problems related to measurement of capital and the choice of discount rate.

It may be argued that the value of capital is not independent of prices and the rate of profit, and that this poses problems for the consistency of general equilibrium theory and hence the Pareto-efficiency claim of marginal-cost pricing.[101] Although this viewpoint is contested, there is a significant question mark attached to the logically coherent valuation of capital and this casts a shadow over the validity of marginal-cost pricing theory.[102]

Discount rates are important for water pricing for two interrelated reasons: discount rates affect cost-benefit analysis which in turn affect project decisions, project prioritisation and project timing; and, discount rates affect long-run marginal-cost pricing both because of its effect on projects and because of its direct influence on the calculation of long-run marginal cost. In a context where a project has high initial investments and is expected to produce benefits for many years to come (which is the case for water supply), the choice of discount

[100] There is an extensive literature on the theory of taxation in the context of externalities commencing with Pigou (1920). More recently, the taxation of negative environmental externalities has achieved prominence. See, for example, Baumol and Oates (1975).

[101] Bharadwaj describes the problem as follows: "In the case of capital, in particular, the construction of a 'demand function for capital', consistent with the theory, has met with severe difficulties. In the economy-wide models, the usual data of the system are taken to be the available quantities of primary resources (usually land, labour and capital), a given preference system defined over the final goods and the technology in the form of production possibilities relating to inputs and outputs. A quantitative notion of capital enters both at the stage of defining availability of capital and in defining production possibilities. In the aggregate versions of the model, capital in its aggregate form is denoted as a value-sum. However, capital goods are themselves produced goods and as such it is not possible to talk about 'quantity' of capital independently of prices. To generate the demand function for capital with 'well behaved' properties, it is essential that the various methods of production (depicted by their capital intensity, capital however measured) that would emerge as optimum at respective rates of profit maintain a monotonic inverse ordering with the variations in the rate of profit. By now, theoretical discussions have established that such a proposition cannot be maintained except under extremely restrictive conditions without violating the internal consistency of the theory" (1986: 54).

[102] There is an extensive literature on the subject. See, for example, Harcourt (1972). The fate of Sraffa's criticism of the neo-classical aggregate production function provides the lesson that the acceptance of theories is not just a function of logic but also a function of the cultural and institutional context within which the theories have been produced. (See Hodgson, 1997.)

rate is important: for example, a discount rate of 10 percent compared to 2 percent will decrease the present value of a benefit 50 years in the future by a factor of more than 40.

At the conceptual level there is disagreement over whether the discount rate should be based on the of the social rate of time preference or on the marginal rate of return on investment in the private sector.[103] This dilemma aside, the empirical measurement for each approach is not straightforward. For example, both the marginal rate of return on capital and the consumption rate of interest need to be estimated in order to derive the social rate of time preference and the shadow price of capital (Lind, 1982: 24). But public investment decisions result in an almost "infinite stream" of consequences for both consumption and private investment which "greatly complicate" the problem of evaluation because most publicly produced goods are not sold in the market and it is not possible to observe all the benefits and costs in each year (1982: 26, 71).

There is also disagreement on the appropriate way to account for risk and uncertainty in the choice and use of discount rates.[104] Furthermore, at a practical level, it is common for a wide range of discount rates to be used, reflecting the disagreements both at the philosophical level and in measurement methodology.[105] At a theoretical level, a strong case can be made for the argument that a different "correct" discount rate exists for every project, and possibly even for every time period.[106] This adds considerable complexity and uncertainty to the choice of discount rate. Furthermore, Lind (1982) shows that *the choice of discount rate is inherently subjective* and hence it is appropriate that the choice of discount rates is subject to the political process.[107]

It can be readily appreciated that the adjustments required to cater for the non-ideal real world of pricing introduces uncertainly, measurement problems and subjectivity. Under these

[103] A survey of the theoretical, measurement and practical issues related to discount rates is presented in Lind (1982). More recent discussions on discount rates may be found in Lind (1990) and Lind (1997).

[104] One point of view is that the discount rate should not be adjusted for risk (Lind, 1982: 22). On the other hand, practitioners commonly adjust discount rates for risk.

[105] Lind notes that prior to the political standardisation of discount rates, different US government agencies used discount rates ranging from 3 to 12 percent (1982: 5).

[106] "If one were to establish the social discount rate so that it properly reflected the differences in opportunity costs and riskiness of different projects and so that it properly reflected the social rate of time preferences as well, one would have to set a different rate for almost every project, and the choice of the social discount rate for each project would depend on many things" (Lind, 1982: 22).

[107] The choice of the social discount rate for evaluating public policy choices is itself a public policy decision that in most cases will be politically determined. The choice is likely to depend not only on the merits of the supporting economic arguments but also on the policy implications of one choice versus another and on the political strength of forces in support of those implications (Lind, 1982). The key issues here are the intra- and inter-generation distribution of benefits and costs. "If one adopts the position that the appropriate rate of discount for evaluating benefits and costs over time from a public perspective is unrelated to private rates for whatever reasons, then the discount rate must be chosen on the basis of a political process based on political goals" (1982: 59).

circumstances, the objective Pareto-efficiency claim of neo-classical economic theory does not stand-up to scrutiny. This point which is taken up in more detail in the following section.

Does the claim stand up?

Two basic questions may be asked with respect to the validity of the primary Pareto-efficiency claim. Is the theory coherent and internally consistent? Is the theory predictive? I contend that the theory is logically flawed and that its predictions do not concord with the real world economy.

The theory is logically flawed on two primary counts. First, neo-classical economics asserts that Pareto-efficiency is independent of income distribution, that is, any distribution of income can be Pareto-efficient, but this is inconsistent within the theory's own logical framework because the prevailing structure of market demands is dependent on the income distribution which contradicts the second fundamental theorem of welfare economics. Second, because of the problem of the second-best and the pervasiveness of externalities, the Pareto-efficient claim of marginal-cost pricing is fallacious. The presence of externalities, transaction costs, uncertainty, information asymmetry, market power, capital indivisibilities, taxes and subsidies, together with theoretical and empirical measurement problems related to the valuation of capital and the choice of discount rate, forces neo-classical economics into a seemingly *endless retreat* from its original Pareto-efficiency and overall welfare maximisation claims. Further, the justification of sub-optimal states as optimal (in the sense of the best that can be achieved) through theoretical quests of increasing mathematical sophistication and yet apparently of decreasing practical relevance to policy-making means that there is a very real danger of neo-classical theory falling prey to the circuitous and meaningless argument: whatever exists (at least in the private sector) is optimal, an argument of infinite regress.

At the practical level, the determination of marginal costs is prone to measurement problems arising from future uncertainty and subjectivity in the choice of the time- frame of analysis and discount rate.

Even if the theoretical Pareto-efficiency claim of marginal-cost pricing is accepted, the practical outcome of marginal-cost pricing may be highly inequitable and thus socially undesirable (see Chapter 5).

Despite these strong criticisms of the marginal-cost pricing rule, this rule is still widely advocated by neo-classical economists. For example, Kahn, while admitting the seriousness of the problem of second-best pricing, and noting that the marginal-cost pricing rule does not

necessarily produce optimum results if applied partially and where there are market distortions in an economy, comes to the following remarkable and illogical conclusion:

> *In the author's view, in principle it does not make solution impossible in specific situations, nor does it make it practically impossible in such circumstances to make the type of informed piece-meal decisions policy makers must inevitably make about how far and in what directions to qualify the basic rule of marginal-cost pricing. (Kahn, 1988: I:70)*

In the water sector, the marginal-cost pricing rule remains the "holy grail" whose pursuit is strongly urged (almost universally) by water economists notwithstanding its inherent logical flaws and practical limitations. The specific application of the marginal-cost pricing rule to the urban water sector is discussed below.

3. Urban water pricing

Partial versus general equilibrium analysis

Much of the theoretical literature on urban water pricing implicitly assumes the validity of a partial equilibrium framework without discussion or justification. General equilibrium analysis of water pricing issues in general, and urban water pricing in particular, is rare.[108] Although it is not surprising that most studies have opted for partial equilibrium analysis, there is remarkably little discussion on this issue.[109]

Welfare analysis in the partial equilibrium context starts from the premise that demand curves reflect willingness to pay for a commodity: "Given the assumption that consumers equate relative marginal utilities with relative prices, changes in individual welfare or 'utility' can be translated into monetary measures and a measure of individual welfare change can be based on the analysis of changes in price and income levels" (Dinwiddy and Teal, 1996: 264).[110] When moving from one consumer to many consumers, two problems arise. First, if marginal utilities of income are not constant, then the analysis is strictly not valid, although Dinwiddy and Teal (1996: 264) assert that for small changes in welfare the approximation should

[108] Hanemann (1997) presents the theory of intermediate (industrial) water demand within a more general equilibrium framework, however, his review of urban water demand studies in the United States does not include one general equilibrium study out of more than 50 studies cited.

[109] In a rare remark on the topic in the literature on urban water pricing, Hanke and Davis note that a general equilibrium analysis is necessary in order to deal with the problem of the second-best but admit that "this type of analysis is a manifestly impossible task" (1973: 811).

[110] Marshall (1920) defined consumer surplus as the excess of price which [the consumer] would be willing to pay rather than go without the thing, over that which he does actually pay . In its most basic conception, consumer surplus is measured by the "area under the demand curve". Whilst absolute consumer surplus is difficult (if not impossible) to measure, relative changes in consumer surplus are less so. Welfare economics is usually concerned with welfare *effects*, that is changes in welfare, rather than absolute welfare.

hold.[111] Second, "aggregating price and income changes over different households implies a comparison of interpersonal utilities and requires a value judgement about social value of income accruing to individuals in different circumstances" (1996: 265). This latter problem is more fundamental because no ready solution exists.

Mas-Colell *et al* summarise the conditions under which partial equilibrium analysis is (approximately) justified as follows: prices of all commodities other than the one under consideration remain fixed and there are no wealth effects in the market under study (1995: 341). Within the residential water demand sector in developed countries, wealth effects are likely to be small in view of the fact that monthly bills for water services are typically less than one percent of income. If the arguments presented by Dinwiddy and Teal (1996) are accepted, then the partial equilibrium analysis of residential water demand in this context is likely to be valid at a general level. In other words, it is likely that changes in the prices of non-water commodities, in general, will not have a profound effect on water demand. However, this conclusion is not likely to be universally valid, even within a developed country context. Where marginal prices for water consumption are perceived to be significant, then the price of both water itself *and* water using appliances are likely to affect water demand.[112]

Amongst poor households in developing countries, wealth effects may be significant. Cairncross and Kinnear (1978) show that poor households in Khartoum spend up to 20 percent of their income on water. Expenditures on water in excess of 10 percent of household income are not uncommon in Uganda.[113] In such cases, marginal-cost pricing may have unpalatable welfare consequences.[114] This is because in these circumstances, water has become an essential subsistence good necessary for survival, and the near zero price-elasticity is not an indication that a given price rise will exact a smaller social cost in consumer surplus reduction (relative to the increase in producer surplus), but rather that the household is *forced* to make other substitution choices (for example, reduction in food expenditure). That is, the consumer surplus reduction may be reflected in the reduction of demand for *other* basic commodities. In this context, welfare effects are profound and certainly cannot be ignored. On the other hand,

[111] "From an applied point of view, the pertinent question is the size of the real income effect. In partial equilibrium analysis it can be assumed that most goods will play a relatively minor role in the overall household budget and the assumption of zero real income effect may be a good approximation" (Dinwiddy and Teal, 1986: 31).

[112] The degree to which the price of water is perceived to be significant is an empirical matter. See Chapter 6.

[113] Field visits, Uganda (1999, 2000).

[114] The welfare effect will be exacerbated where price-elasticities are very low and marginal pricing is implemented along the lines advocated by Baumol and Bradford (1970), that is, deviation from marginal-cost pricing in inverse proportion to price-elasticity. Cairncross and Kinnear (1978) have shown that poor households may have very low price-elasticities of demand.

amongst wealthy households in developed countries, wealth effects arising from water price increases are likely to be negligible.[115]

The marginal-cost pricing rule in the urban water sector

Many neo-classical economic texts on urban water pricing begin with the twin premises that water is a public service and that prices should be administratively set equal to marginal costs in order to maximise allocative-efficiency.[116] For example, Hanke and Davis state that "of the many pricing policies available, marginal-cost pricing is most conducive to the efficient allocation of resources" (1973: 808), and Hanemann states that "economic theory supports some version of marginal-cost pricing on the principle that *all* users draw on the system at the margin and should be signalled the scarcity value of water" (1997: 147, original emphasis).[117] The literature generally ignores the problem of the second-best when asserting that marginal-cost pricing promotes allocative-efficiency.

The definition of marginal cost in the urban water services industry is not straight-forward for at least two broad categories of reasons: the service is multi-dimensional (there are many different marginal costs to consider) and there exist important capital indivisibilities.

There are three different types of marginal *access* costs: local distribution infrastructure costs – the incremental capital costs of building, expanding, replacing and maintaining the local distribution infrastructure neighbourhood infrastructure; connection to the network- the incremental capital cost of installing a new connection including the related marginal capital replacement and maintenance costs; and the readiness of the agency to provide the service – the incremental cost of the administrative and management capacity necessary in order to serve an additional customer, for example, the institutional capacity required to undertake an additional meter reading, send out another bill, and undertake related financial accounting activities for an additional customer.

In addition to these, there are two types of marginal *consumption* costs: capacity costs – the marginal capital cost of building or extending capacity, including the marginal capital replacement and maintenance costs; and operating costs – the marginal operating costs required to deliver an additional unit of water to a consumer.

[115] Obviously these judgements must be contextualised and subjected to empirical verification. See Chapter 6.

[116] This discussion focuses on the public administration of pricing rules.

[117] See also Bahl and Linn (1992: 21) and Meier (1983: 170).

Marginal access and consumption costs are likely to vary *spatially*. These differences arise from physical factors such as length of pipeline and height to be pumped which are in turn related to settlement patterns and the nature of terrain. Marginal consumption costs may *vary temporally*, particularly seasonally and diurnally. Marginal costs of water supply typically differ between the dry and wet seasons. Marginal costs will also typically *vary by consumer*: local access costs will depend on the consumer's physical location and demand, marginal capacity and operating costs will depend on individual consumer demand. Marginal costs will also typically *differ between existing and new consumers*. Existing consumers whose demand is not growing over time arguably do not contribute to marginal capacity expansion costs, although opinions differ on this.[118]

The multi-dimensionality of marginal costs has at least three implications. There is not one marginal cost, but an array of marginal costs relating to different aspects of the service. The calculation of marginal costs may be quite complicated and resource intensive. Important dimensions of the marginal costs relate to the future and hence are uncertain.

The provision of urban water supply is characterised by significant capital indivisibility. Short-run marginal costs may diverge substantially from long-run marginal costs and expenditure on short-run costs may be a small fraction of total expenditure.[119] Much of the literature on marginal-cost pricing addresses this problem.

Mann *et al* describe their view of a "theoretically correct" approach to marginal-cost pricing in the presence of capital indivisibilities:[120]

> *The marginalistic (sic) approach requires that price equal short-run marginal cost when capacity is less than fully utilised; but, if existing capacity becomes fully utilised, price should be raised to ration existing capacity. This procedure should continue to where consumers pay a price for additional output equal to short-run marginal cost plus the [periodic] equivalent of marginal capacity cost. Where existing capacity is fully utilised and price equals long-run marginal cost, investment in additional capacity is justified. Once the investment has been carried out, however, price should fall again to short-run marginal cost. Price thus plays the dual roles of (1) obtaining efficient utilisation of resources when operating at less than full capacity and (2) providing a signal to invest in additional capacity. (Mann* et al, *1980: 603)*

[118] See Hanke and Wenders (1982) and Hanemann (1997: 147). It should be noted that the impact of pricing schemes that differentiates between old and new consumers may be quite regressive.

[119] Hanemann notes that the difference between SRMC and LRMC is particularly "huge" in the water industry because of its unusually high capital intensity. In the United States, the asset requirement per dollar of revenue is $10 to $12, which is three to four times the capital intensity of the telephone and electricity industries (1997: 152).

[120] See also Saunders and Warford (1976).

They readily recognise that such a pricing system is not operational for a number of reasons: it will result is excessive price fluctuations, it will give rise to considerable uncertainty about future prices leading to sub-optimal investment in water-using appliances and additional water capacity (Mann *et al*, 1980).[121] Thus this "theoretically correct" pricing structure is not Pareto-optimal even on its own terms.

In the light of this, "almost all advocates of marginal-cost pricing have recognised that some method must be employed to average out cost and thus price fluctuations over time" (Bahl and Linn, 1992: 265). The problem is that there are several different, but equally "valid", ways of doing this (Hanemann, 1997: 147). For example, Mann *et al* (1980) present four definitions of marginal cost, each differing in how they treat capital expenditures and Beecher *et al* (1991) add a further definition.

Mann *et al* note that the choice of definition depends on the demand or supply increment, the time horizon of the analysis, the desired emphasis on short-term versus longer-term allocative-efficiency, how rapidly economies of scale are expected to affect costs, the extent to which price stability is desirable, and revenue implications and requirements (1980: 604). On the same topic, Bahl and Linn comment as follows:

> *The criterion for the selection of the optimal smoothing device should be that the costs (losses from mistaken investment decisions and additional administrative costs) saved by averaging should just equal the losses (consumer surplus forgone or non-price-rationing costs) which arise if the short-run marginal cost principle is not applied. (1992: 265)*

Hidden in an endnote is the following comment:

> *Other considerations, such as higher, more stable revenue generated by alternative pricing systems and political advantages of more stable prices, will also enter the selection.* In fact, they may be more important than efficiency. *(1992: 504, own emphasis)*

It is remarkable that this comment is not given more prominence. Notwithstanding this important qualification, Bahl and Linn recognise that the information requirements for such a calculation are onerous and that it is not surprising that "shortcuts or rules of thumb" are applied (1992: 265). Some theorists even doubt the possibility of measuring marginal costs. For example, Turvey, a theorist advocating marginal-cost pricing, concluded that marginal costs could not be measured for practical reasons and therefore some sort of "average-marginal cost price" should be used instead (Turvey, 1967).

[121] Investments in additional water capacity will be sub-optimal because these investments need to be planned and built a number of years prior to the point when price equals the marginal capital cost of capacity expansion. As this point is unknown, the investment will only be optimally timed as a matter of luck rather than planning.

There are three key points to be noted. First, there is no one "correct" definition of marginal cost where capital indivisibilities and economies of scale are present. For example, Mann *et al* (1980: 604) conclude that, "where capital indivisibility is present, it is impossible to construct a precise set of rules that can be mechanistically followed in applying the marginal cost principle". Second, different choices of the definition of marginal cost (and its translation to water pricing) will typically result in quite different outcomes (in terms of water price, water demand and distributional consequences). Third, the actual measurement of marginal cost may be either impossible or subject to large uncertainties.

Balancing short and long-run considerations

The prevailing view of public utility pricing earlier this century and up to the 1960s was that the commodity price (the marginal price of the sale of an additional unit) should be set equal to the short-run marginal cost of production and that the fixed investment cost should be funded separately, either through taxes or through a two-part tariff.[122] Typically, project evaluation was separated from the question of who pays for the project output on the basis that the project decision was undertaken on the grounds of a combined efficiency and welfare analysis. The decision of who pays for the project was made on cost sharing or equity grounds.[123]

Dasgupta describes this approach as follows: "The rule that [a] State enterprise would ideally follow would be for it to determine the optimal level of output, set price equal to the marginal cost of production, and ensure that its losses are covered by a lump-sum subsidy" (1993: 148). However, Dasgupta does caution that such an approach "is unlikely to work in poor countries where governments are strapped for cash", and further notes that efficient (optimal) lump-sum taxes are not feasible, even in developed countries, hence he recommends that the rule be amended: "so the correct thing to do is to set price equal marginal cost plus a tax" where "the magnitude of the user tax depends on the necessary revenue to be collected, the pattern of consumption by income classes, and so forth" (1993: 148). He goes on to further qualify the rule to take into account poverty: "For the very poor regions the infrastructure has to be provided free of charge, the expenditure being financed by general taxation" (147).[124]

[122] See footnotes 97 and 98.

[123] See, for example, Eckstein (1958).

[124] This is justified on the basis of the positive externalities that basic infrastructure provides in terms of health benefits and promotion of economic growth. For example, Dasgupta notes that the World Bank relates low returns on investment in sub-Saharan Africa to the lack of infrastructure (1993: 147). See also World Bank (1994).

However, he is reluctant to theorise about this, noting, "these are matters of institutional detail over which it is difficult to theorise" (148)

This approach has lost ground, particularly in the United States, although it is still practised in some countries.[125]

Hanke criticises this approach saying "although there are differences in emphasis between project evaluation and pricing policy, they cannot be separated in proper economic analysis. The amount and method by which beneficiaries pay for the output of a project does influence efficiency; the assessment of charges has been shown to affect the rate at which a project is used" (1978a: 809).[126] Similarly, Hanemann criticises an approach where consumers are not forced to face the long-run marginal costs when asked to make decisions concerning investment in additional capacity (1997: 153).[127]

Urban water price policy advocacy undertaken within a neo-classical economic framework (and particularly in the United States) since the early 1970s overwhelmingly endorses a long-run marginal-cost pricing approach in general, and the use of the average incremental cost (AIC) pricing method in particular.[128] For example, this approach is favoured and recommended by the World Bank; Bahl, Linn, Mann, Saunders, Warford, Hanemann, Hanke, Saleth, Dinar and Winpenny, to name a few.[129] It is also an approach favoured by some (but not all) neo-classical public utility theorists. For example, Kahn asserts the following:

> *The practical achievable benchmark for efficient pricing is more likely to be a type of average long-run incremental cost computed for a large expected incremental block of sales, instead of short-run marginal cost estimated for a single additional sale. This long-run incremental cost would be based on (1) the average incremental variable costs of those added sales and (2) estimated additional capital costs per unit for the additional capacity that will have to be constructed if sales at that price are expected to continue over time or to grow. Both of these components would be estimated as averages over the same period of years into the future. (Kahn, 1988: 85)*

[125] The electricity industry in France is an example of this model. Investment costs and operating losses of the government owned electricity utility arising from short-run marginal-cost pricing are funded through lump-sum state subsidies (Dasgupta, 1993).

[126] The impact on water use through implementing metering and a positive marginal price is clearly demonstrated in the study by the same author (Hanke, 1970).

[127] Hanemann cites the example of the Washington Public Power Supply System, an investment that was made on the basis on consumers' estimated willingness to pay the short-run marginal cost rather than the long-run marginal cost, which resulted in the largest municipal bond default in U.S. history and which still has "serious financial repercussions for the Pacific Northwest" (1997: 153).

[128] Long-run marginal costing is also gaining currency in the United Kingdom within the framework of regulated private water companies. See, for example, London Economics (1997) who incidentally give rather curious definitions of long-run marginal costs.

[129] See Bahl and Linn (1992: 299, footnote 8; 208), Mann *et al* (1980: 604), Hanemann (1997: 154), Hanke (1978b), Saleth and Dinar (1997) and Winpenny (1993: 105).

Bahl and Linn describe this method in the context of water supply as follows: "average incremental costs can be calculated by dividing the discounted value of future supply costs by the (similarly discounted) amount of additional water to be produced" (Bahl and Linn, 1992). They present the following justification:

> *In practice, any version of discounted marginal-cost pricing has to be approximate, and ultimately some averaging of costs over a range of output is always required. Average incremental costs will therefore be theoretically less desirable the greater the degree of capital indivisibility, for while capital remains idle, price will be in excess of the currently relevant marginal cost. However, in view of the difficulties inherent in any system requiring fluctuating prices, this method appears to be the best practical approximation to optimal pricing that can be achieved in the water supply field, and is one that, in general, we recommend. (Bahl and Linn, 1992: 208)*

In a similar vein, Mann *et al* comment on the AIC pricing method:

> *AIC avoids severe price fluctuations, although it does not adhere closely to [the short-run marginal cost] either at capacity points or during periods of excess capacity. It is a compromise solution, neither adequately signalling justification for any specific investment, nor corresponding to the short-run marginal cost. That is, with the introduction of capital indivisibility, AIC becomes more appropriate, compromising between avoiding price fluctuations, signalling justification in investment, and making the best use of existing capacity. (1980: 604)*

The two approaches described above reflect different philosophical assumptions and ideologies. The advocates of short-run marginal-cost pricing believe in the efficacy and efficiency of the state, that is, the ability of the state to compensate adequately for market failure. They assert that it is efficient for the state to undertake the cost-benefit analyses and to make the appropriate choices with respect to investment in urban water capacity, and further, that the state is efficient in raising taxes to make the required capital investments and to subsidise the losses arising from pricing at the short-run marginal cost. On the other hand, the advocates of long-run marginal-cost pricing are more sanguine about the ability of the market to generate the "correct" signals for investment in additional capacity and implicitly have less confidence in the ability of the government to make efficient investment and taxing decisions. Each approach is likely to have very different distributional consequences.

The currently prevailing neo-classical view favours using the market to allocate resources, leaving distributional issues to the political process (appealing to the Kaldor-Hicks compensation principle). The alternative view is that the initial distribution fundamentally affects the systems of demand that in turn affects income distribution. Thus an examination of the current system of demands in isolation from income distribution considerations is both myopic and politically naïve.

Critical-realism highlights the inherent subjectivity of each framework of analysis, seeks to make this transparent and emphasises the need to contextualise the problem of pricing.

Adjustments to account for externalities

There are two basic types of externality: missing markets and distorted markets. (Both are strongly inter-related.) The former can be classified into positive externalities (typically public health benefits) and negative externalities (typically environmental costs). Distorted markets arise from imperfect competition, and asymmetrical information and uncertainty.

The basic neo-classical treatment of externalities is, in principle, straightforward: prices are adjusted to eliminate distortions and to reflect prices under perfectly competitive conditions.

Water economists generally ignore the problem of the second-best implicit within externality adjustments.[130] Some dismiss it as a theoretical irrelevance – this is typical of World Bank marginal-cost pricing advocacy (Garn, personal communication, 1996). Others misinterpret it, for example, Lal (1983) gives a rather curious and essentially meaningless interpretation of the second-best. A few take it seriously; for example, Hanke and Davis (1973: 811) note that "unless one performs a general equilibrium analysis of the situation, deviations from optimal pricing anywhere in the economy make it impossible to conclude that the application of marginal-cost pricing in any one sector will be desirable". They go on to state that "since this type of analysis is manifestly an impossible task, the theory of the second best appears to be a counsel of despair" (811). Nevertheless, they claim that a "rough and ready 'third best' approximation will at least be better than 'standing by and sadly sucking our thumbs under the sign of second best' " (811). They go on to recommend the "third best" guidelines proposed by Turvey (1968, 1971), and interpret them as follows: "One can justify pricing water services *above* marginal cost if (1) close substitutes sell significantly above marginal cost or generate external economies, (2) products using water as a major input sell significantly below marginal cost or generate large external diseconomies, (3) close complements sell significantly below marginal cost or generate large external diseconomies, and (4) major inputs of the water undertaking are purchased at significantly below marginal cost or involve large external diseconomies. In short, there is no substitute for judgement when it comes to the job of applying marginal-cost pricing principles" (Hanke and Davis, 1973: 811). Interestingly, in an exposition of the practical application of marginal-cost pricing given by the same author (Hanke, 1978b), these principles are not applied and the problem of the second-best is presumed not to exist. This is not surprising. The complexity of the suggested guidelines

[130] See, for example, Hanemann (1997) and Hanke (1978b).

become readily apparent when capital indivisibilities are present not only for water but also for its substitutes and complements. In this context, the appropriate marginal cost for water, its complements, substitutes and inputs, and the extent to which these cost/prices deviate from marginal costs, are imponderables. For those unwilling to give up the exercise altogether, Baumol (1978: 802) provides an apt conclusion: "we find ourselves forced to hunt for a solution in the dark jungles of the second best".

The practical application of externality adjustments is not only patchy but also tends to be asymmetrical. There appears to be a general presumption in much of the literature in favour of including negative environmental externalities and yet ignoring positive health related externalities.

The discussion on positive externalities given by Bahl and Linn (1992: 253f) is typical of the neo-classical economic treatment and proceeds as follows. Externalities related to access to, and consumption of, the service are differentiated from one another. If positive externalities are related to access to the service (rather than consumption), then it is the connection costs which should be subsidised, and if they are related to consumption of the service, then the consumption costs of the service should be subsidised. Where the positive externalities exist only for relatively small quantities of consumption, as is the case for water supply, then access to the service should be subsidised rather than consumption if the level of consumption at marginal cost prices exceeds the quantity exhibiting positive externalities. Where capacity constraints limit consumption or connection to a level below that determined by setting prices to marginal costs, then consumption or connection should not be subsidised because this would lead to a more inefficient allocation of resources. Their conclusion is sceptical of subsidies:

> *In summary, it is not sufficient merely to cite the likelihood of external benefits in arguing for subsidised provision of services. One also needs to know which dimension of service provision is conveying the externalities; the extent of externalities; and whether there are capacity constraints which require price rationing. Because of these practical difficulties and because of the natural tendency of actual and potential users to clamour for service charges below marginal costs, one should be very cautious in accepting arguments for a digression from marginal-cost pricing of urban services on account of external benefits. (Bahl and Linn, 1992: 253f)*

Contrary to the cautionary conclusion given by Bahl and Linn above, there is actually a very strong case to be made for positive externalities for at least a "basic" water supply. Investment in urban water supply has been historically justified on the basis of community health benefits based on the conventional wisdom that "20 - 40 litres per capita per day of readily available water, if accompanied by adequate waste disposal facilities and sound

hygienic practices, are *sufficient* to attain the main benefits of water use" (World Bank, 1980a). In fact, more recent literature has shown that water use of 50 lcd has more beneficial health effects compared to a lesser volume, and that this is a necessary condition for improved health (World Bank, 1993a). The importance of these positive externalities is readily apparent when typical consumption levels in many cities in developing countries are much less than the "basic" requirements specified above (see Chapter 1).

Negative externalities related to the consumption of water exist on the water production side (the environmental costs associated with water withdrawals) and on the return of wastewater to the environment. Neo-classical economists generally strongly urge that these costs are estimated and included in the cost of water provision notwithstanding the fact that estimation procedures are often highly subjective, uncertain and dependent on prevailing income distributions. For example there may be significant asymmetries between the value that rich households place on the loss of a pristine river environment (which, say, is used for recreation and valued on this basis) compared to the value that a poor household places on an incremental quantity of water supply. These asymmetries arise not so much because of differences in preferences but rather because the ability to pay between the households is so different (see Sagoff, 1994).

Neo-classical economists are quick to point out the uncertainties involved in the estimation of positive externalities arising from investment in urban water supplies and use these uncertainties to caution against using them to justify a deviation from marginal-cost pricing. Yet these same economists are not self-critical concerning the uncertainties and subjectivity inherent in the estimation of negative externalities and the choice and calculation of the "appropriate" marginal cost on which to base the price. This inconsistent approach is particularly serious when the distributional effect of the pricing policy is regressive.

For example, in Kampala, the World Bank has urged the application of a water tariff that is equal to the long-run marginal cost of water supply *as well as wastewater collection and treatment*. Only a small minority of households are connected to the sewerage system, hence a tariff that includes the wastewater costs and is applied to everybody (as advocated by the World Bank) is grossly inequitable because large water consumers contribute disproportionately to the environmental costs.

Distortions in the input and output prices arising from imperfect markets tend to be ignored.[131] For example, Bahl and Linn state that: "[a] widely accepted view is that distortions in the

[131] For example, the World Bank's calculation of the long-run marginal cost of water supply in Kampala (cited above) included no estimations of shadow prices (field visits, Uganda, 1999).

factor and product markets do need to be accounted for [through shadow pricing] but often do not matter much" (1992: 259). Nevertheless, an extensive literature detailing methodologies for calculating shadow prices exists.[132] Although details differ, the general approach in these methodologies is similar: marginal cost is interpreted as the marginal opportunity cost to society, that is, the cost of output forgone in providing an additional unit of the commodity.

In theory all tradable input prices should be calculated using border prices and non-tradable input prices using indirect border prices.[133] *In practice* water tariff studies are often limited to netting out duties and taxes for purchased inputs and using a shadow exchange rate to adjust the foreign exchange component of capital costs (Bahl and Linn, 1992: 306). The sensitivity of water charges to shadow pricing has not been widely explored. Available evidence suggests that marginal costs are more likely to be sensitive to the cost of capital and the choice of discount rate. One study showed that a 20 percent increase in the exchange rate resulted in the average incremental cost (AIC) increasing by 7 percent (Linn, 1976). In the same study, a change in the discount rate from 8 to 12 percent resulted in a 10 percent increase in AIC. It is pertinent to note here that the World Bank's calculation of the marginal cost of water supply in Kampala did not discuss or justify the choice of the single discount rate used in the calculation (field visit, Uganda, 1999).

Distortions in the output markets should also be taken into account, especially where the product has important substitutes or complements. For example, in the case of public water supply, the availability of cheap but contaminated alternatives (for example, water from local streams or open wells) may distort willingness to pay for the safer but more costly alternative. Because there is a negative health externality associated with the low-cost contaminated water, the externality distorts prices in the output market. Large consumers (wealthy households, industry and commerce) may extract ground water at a lower financial cost to themselves compared to the public water supply whereas the private extraction of groundwater may have a higher social cost than the private financial cost. In this case, private extraction should be taxed so that the private costs reflect the social costs.

Shadow price corrections are analogous to corrections for externalities and both are subject to the problem of the second-best – there is no confidence in knowing whether a shadow price correction is Pareto-superior to the alternative of doing nothing.

[132] See, for example, Dinwiddy and Teal (1996), Brent (1990), Curry and Weiss (1993), ODA (1988), Little and Mirrlees (1968, 1974, 1991), Little and Scott (1976) and Squire and van der Tak (1975).

[133] See Squire and van der Tak (1975).

Transaction costs refer to all of the "additional" costs necessary to implement an efficient marginal-cost pricing system. These costs include the educational costs required to overcome the efficiency losses of imperfect information (for example, complex bills), administration of the pricing system, costs related to additional physical requirements for the system to work efficiently (for example, metering costs), and the costs of developing a comprehensive marginal pricing structure.

In principle, each refinement to the pricing rule should be subject to an analysis of the benefit derived from the price reform vis-à-vis the cost of implementation. In practice, quantitative assessments are difficult and are often of dubious value, requiring numerous subjective judgements. One exception is the metering decision for water supply which has been subjected to cost-benefit analysis in many cases.[134] The efficacy of metering will largely depend on the cost and value of water relative to the cost of metering. If water is scarce and costly to provide, metering is much more likely to be cost-effective. It is more likely to be cost-effective to meter larger commercial or industrial consumers. It may be expected that as the cost of water supply increases (as a result of increased demand and higher supply and treatment costs), the balance of the cost-benefit analysis will shift towards the cost-effectiveness of metering.[135]

Marginal-cost pricing assumes that the service provider is operating efficiently and is making optimal least-cost investment decisions. Production and investment inefficiencies may be large and estimates of marginal costs using these as a base may be misleading.[136] Where the implementation of marginal-cost pricing results in surplus revenue generation, there may be a tendency for a service-provider to become less efficient because resources are not constrained and there may be no incentive for the service-provider to be efficient. Similarly, marginal-cost pricing may result in revenue deficits causing cash shortages, possible inefficiencies in operation and inadequate maintenance. This raises important institutional issues that are typically not addressed within the neo-classical marginal-cost pricing framework.

[134] See, for example, OECD (1987b) and Hanke (1970). The cost of metering includes the capital cost, installation cost, meter inspection, maintenance and repairs, meter reading, bill determination, accounting and administration, billing and income collection.

[135] In World Bank policy advocacy, it is generally implicitly assumed that the benefits of universal metering exceed the costs. For example, World Bank advocacy of universal metering in urban areas in Uganda contained no discussion of the likely benefits vis-à-vis the costs (field visits, Uganda, 1999).

[136] For example, the national utility in Uganda has an operational inefficiency of more than 33 percent and an investment inefficiency of more than 100 percent (field visits, Uganda, 1999).

Peak-load pricing

In the urban water sector, the most important variations in peak demand are daily (the variation in demand over the day arising from the daily pattern of water usage) and seasonal (arising from seasonal changes in temperature, rainfall and irrigation requirements). Sources of peak demand can either be random (for example, demand for water for fire fighting services) or systematic.

Marginal costs typically will vary in response to changes in peak demand. Urban water supply systems may be conceptually divided into three sub-systems: bulk supply, transmission (including treatment), and distribution. Bulk supply systems are typically designed to meet *average annual* water demand, transmission systems to meet *peak-day* demand, and distribution systems to meet *peak-hour* demand. Thus both the distribution of costs between the three sub-systems as well as the variation in the average and peak demand will affect the costs of supply.

A neo-classical approach to peak-load pricing for the urban water sector is presented below.[137] It should be noted that this is just one interpretation of peak-load pricing.[138]

The general principles of neo-classical peak-load pricing are that the capacity requirements to meet random peak demand should be priced as a fixed capacity-related charge, whereas the capacity requirements to meet a systematic peak demand should be priced as a volume-related charge. Kahn (1988) formulated the "rule of peak responsibility" which states that *all* users who contribute to peak demand should pay for the peak (that is, the cost of the capacity required to meet the peak). The corollary to this is that off-peak users should not pay for the cost of peak capacity.

The local distribution system is generally designed to meet peak-hour demand. If this is related to the peak-flow required to fight fires (as it typically is) then, according to neo-classical theory, the cost of this capacity should be charged as a fixed marginal capital cost to all consumers using the system (because all have access to the fire-fighting capability and the associated peak-flow availability, and this is a random demand).[139]

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[137] This discussion follows Hanemann (1997: 159f).

[138] There is a significant literature on seasonal demand and peak load pricing. See, for example, Greene (1970), Griffin and Chang (1991), Lyman (1992) and Mann and Schlenger (1982).

[139] Where this is not the case, the capacity costs ideally should be borne in relation to the actual contribution to peak daily demand by each consumer, that is, the charge should be a volume charge. However, metering of daily variations in peak demand is costly, hence this solution is not cost-effective and it would need to be based either on monthly demands (albeit a poor indicator of peak-hour demand) or a fixed capacity charge.

The transmission system is designed to meet peak-day demand. Peak-day demand typically occurs in the season corresponding to high irrigation demands. Because this is a systematic demand, this charge should be volume-related. However, because daily measurement of consumer demand is not cost-effective, volume-related peak-load pricing is restricted to monthly demands. Hence, according to neo-classical theory, peak-month commodity charges should include the average incremental cost of capacity expansion of the transmission network. Similarly, off-peak commodity charges should *exclude* these costs.

The practical application of peak-pricing based on these principles tends to cause disputes and conflict because peak-pricing allocates costs between consumer groups and adversely affected groups dispute the basis for the allocation. Two prominent examples are Tucson (Arizona) and Los Angeles.[140]

Reliability of supply

In terms of the neo-classical framework of marginal-cost pricing, the price of water should be adjusted in relation to its reliability. In developed countries, a very high level of reliability in the supply of urban water is generally assumed and hence reliability is implicit in the price. However, even in this context explicit pricing for reliability is sometimes undertaken.[141] In developing countries, it is not uncommon for urban water systems to be unreliable. Interruptions or discontinuous supplies may arise because of excess demand over supply, lack of system capacity to cater for peak demand and service breakdowns. Households respond to service unreliability by investing either in private storage or their own supplies. Altaf (1994) has shown that the value of private investment may exceed the cost of upgrading the public services to provide improved and more reliable services. This is a case of institutional failure, a topic that is addressed in Chapter 4.

Does pricing improve efficiency?

The assertion that marginal-cost pricing is Pareto-superior to other forms of pricing is contingent on the assumption that water demand is price-elastic (or at least moderately so). If demand is price-inelastic (or, more loosely, has a low price-elasticity), then the use of prices to pursue allocative-efficiency is largely ineffective. It is therefore important to know how responsive the consumption of water services is to changes in prices. Unfortunately, as Bahl and Linn note, "price-elasticities of demand for public services are notoriously difficult to

[140] See Martin *et al* (1984) for a description of the Tucson case. Pricing reform in Los Angeles is discussed in Chapter 4.

[141] See the discussion on the (Californian) Metropolitan Water District given in Chapter 4.

estimate" (1992: 276). Controversy exists as to the validity and accuracy of various empirical techniques and the ability to infer price-elasticities from these studies in circumstances where no studies have been undertaken. See Chapter 6.

Maximizing multiple pricing objectives

Hanemann poses the question: "should equity concerns be addressed independent of or simultaneously with efficiency concerns?" and gives the answer: "economists generally favour that the two problems be addressed independently, though this prescription by no means enjoys unanimous consent" (1997: 150). The World Bank is in favour of an efficiency-first approach:

> *It has been a long-standing policy of the World Bank that to the extent possible the price of water should be set equal to the marginal cost of supply. Modifications to the marginal-cost pricing rule may be necessary to meet objectives other than economic efficiency, but the burden of proof is typically on the party proposing the modification to show that a departure from marginal-cost pricing achieves other social objectives, such as equity. (Whittington, 1992: 85)*

In practice, the setting of urban water tariffs *almost always* involves other considerations such as revenue requirements and social equity. (See Chapter 1.) Neo-classical approaches to these issues, to the extent that they exist, are discussed here.

Setting prices to reflect "true" social marginal costs typically will result in differences between revenues and expenditures. These may be either deficits or surpluses, depending on supply characteristics and the chosen approach to pricing. Two basic solutions to this problem have been proposed: either price at the (short-run or long-run) marginal cost and use tax revenues to finance any deficits; or stipulate self-financing and revenue neutrality within the urban water sector and adapt the water pricing schema accordingly. Each approach is discussed below.

Short-run marginal-cost pricing will not generate revenue for investment in capacity expansion and will typically result in operating deficits. In this case, revenue can be generated from general taxes, an approach which is not uncommon in Europe. The recent "orthodoxy" amongst neo-classical economists is that raising revenue through taxes is generally more inefficient than pricing for self-sufficiency.[142] Another argument that is used against general fund (tax revenue) financing of urban water supply is the presumed reduction in incentives for efficient management. At a more pragmatic level, tax revenues in developing countries are typically constrained and may simply be inadequate to meet all necessary or desirable

[142] See discussion on Page 65.

expenditures. This last argument is perhaps the most compelling practical reason for revenue self-sufficiency.[143]

Where long-run marginal costs exceed average historic costs (a not untypical occurrence in the urban water sector), a long-run marginal-cost pricing schema is likely to generate revenue surpluses. In this context, there are three general approaches: pool the surpluses with a general revenue fund; reduce the surpluses to zero by introducing modifications to the tariff (for example, multi-part tariffs); and invest the surpluses to reduce inequalities in service provision within the urban sector (implement cross-subsidies). Each has very different distributional implications.

It is not uncommon for revenue neutrality to be a stipulation for the agency managing the urban water supply in a particular region or city. For example, this is typically the case for both private and public water utilities in the United States. Many neo-classical economists advocate revenue neutrality. For example, Bahl and Linn (1992: 310) provide six reasons for the attractiveness of the self-financing of urban water supply systems: it is "fair" in the sense that people pay for what they get; it avoids the need to raise finance from other sources and the potential resource allocation distortions these taxes might involve; it enhances financial (and hence potentially political) autonomy at the local level; it creates greater certainty for planning and management as a result of not having to rely on uncertain money flows from higher tiers of government; it encourages "appropriate" levels of service provision in line with local communities' willingness to pay; and self-financing is thought to provide good incentives for better management. The World Bank advances similar arguments.[144]

The main problems that arise from imposing a strict policy of revenue neutrality on urban water utilities is the inability to address questions of inequality both within and between regions (see Chapter 5).

Two-part tariffs can be used in combination with marginal-cost pricing to ensure revenue neutrality. Proponents of this approach argue that a levy (or subsidy) should be linked to the components of the service that are the least price-elastic, hence having the least affect on resource allocation.[145] The implication of this for urban water supply is that the access (or fixed) charges for high-income households and industries (who are likely to have low elasticities of demand for access to the piped system), could be set at a level much higher than

[143] For example, the Ugandan government has stipulated revenue self-sufficiency as a key objective for the urban water sector primarily for the reason of constrained tax revenues.

[144] See, for example, Serageldin (1994) and World Bank (1992, 1994).

the marginal cost. This typically will not be the case where alternative sources of water exist and for low-income consumers, unless connection is compulsory and effectively enforced.[146] In this latter case, subsidised access could have distinct equity advantages.

Ramsey (1927) showed that Pareto-efficiency in the presence of a revenue constraint (for example, revenue neutrality) requires a systematic deviation from marginal-cost pricing whereby the deviation is inversely proportional to the price-elasticity. Hanemann interprets this as follows: "one accomplishes this goal by imposing the [greatest][147] price adjustments on the customers whose quantity demanded is least sensitive to price, and the smallest adjustments on customers whose demand is most sensitive to price. The result is a form of cross-subsidisation that yields a more efficient economy than if one had simply adjusted the price for all customers in the same way" (1997: 156). Hanemann notes two obvious problems with this approach: "the formula is extremely complex and usually will require information on demand that simply is not available to most utilities"; and the cross-subsidisation may not be equitable (156).[148] No examples of Ramsey Pricing were found in the author's review of water pricing experiences.

Multi-part tariffs are a variant of two-part tariffs with different infra-marginal rates. Typical multi-part tariffs are increasing block or decreasing block tariffs. Decreasing the infra-marginal rates when there are surpluses and increasing the infra-marginal rates when there are deficits can maintain revenue neutrality. In this way the marginal rates (of the last block) can be maintained at the specified marginal cost. The (neo-classical) arguments against this approach are twofold. Consumers respond to both marginal and infra-marginal rates and hence these rates are not "efficient". It is impossible to ensure that all consumers are responding to the "right" marginal rate.[149] Multi-part tariffs may be justified on other grounds: water conservation in the case of increasing block rates and economies of scale in the case of quantity discounts using decreasing block rates. Multi-part tariffs are widely used in both developed and developing countries.

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[145] This argument is, of course, not strictly correct. Although a levy on a non-price-elastic component of a service would not affect the use of that resource, there is an opportunity cost to the payment of the levy that relates to the alternative uses to which the money used for the levy could have been put.

[146] The high price-elasticity arises particularly in situations where relatively cheap alternatives are available (for example, open wells or streams, even if these are contaminated), which is the case in most urban areas in Uganda, for example. Enforcement is unlikely to be effective as affordability may be a real constraint. High numbers of illegal connections continue to exist in urban areas in both Uganda and South Africa despite attempts at enforcement.

[147] The text contains an unfortunate error: the text reads "least", but clearly this is incorrect.

[148] The problems of estimating price-elasticities of demand are shown in Chapter 6. Ramsey pricing also requires estimates for cross-price-elasticities that are typically not available.

Another alternative is to relinquish marginal-cost pricing altogether in favour of a full-cost pricing system with uniform use-related charges equal to the average historical-cost. Bahl and Linn have the following to say about this approach:

> *Although this pricing method is not generally advocated by experts of public service pricing as optimal, it is frequently found in operation. A common practice is to ignore the multi-dimensionality of service provision in the actual design of user charges and to focus exclusively on only one dimension of service provision – service use or connection (access). When this is done, a pricing system which is designed to meet financial or historical accounting costs of a public service must, by definition, charge average historical cost per unit of consumption. This type of approach is generally easiest to implement, since it represents a simple extension of financial analysis which is generally accepted as an important method for evaluation of public enterprise performance. It does, however, forgo the opportunity to improve the allocation of resources through restructuring the pricing system. (1992: 271)*

As previously noted, practical considerations may outweigh other considerations in the choice of pricing structure.

Some economists are willing to consider equity issues within a neo-classical pricing framework. Their approaches are considered in Chapter 5.

No escape from subjectivity

Kahn, an advocate of marginal-cost pricing, concludes as follows:

> *The task of translating [the principles of marginal-cost pricing] into actual price schedules is so extraordinarily difficult that it is entirely possible to accept their validity while at the same time concluding that the task of following them is an impossible one. Few would go so far as to abandon the effort entirely. But all would point out, and correctly so, that* even the most sophisticated and conscientious effort to apply these principles inevitably involves large doses of subjective judgement *and, at the very best, can achieve the* roughest possible approximation *of the desired results. The uncertainty of the resulting estimates and the impossibility of devising and enforcing rate structures that fully embody them counsel a rounding of the edges, a tempering of the principles themselves. Such a tempering is not objectionable even on purely economic grounds: the economic costs of ascertaining and enforcing economically efficient rates can well outweigh the efficiency advantages that such rates suppose to achieve. (Kahn, 1988: I:182, own emphasis)*

The above quote provides a rare admission of the limitations of the marginal-cost pricing rule and the subjectivity inherent within the methodology. This subjectivity, together with the potentially significant distributional effects that marginal-cost pricing can have, provides a

[149] According to this particular criticism, all units of water should be priced at the marginal cost in order to achieve an efficient allocation of resources.

strong rationale for the development of a pricing methodology which integrates equity and institutional considerations.

4. Implications for a critical-realist pricing methodology

The treatment of income distribution within neo-classical theory is logically inconsistent. It is not tenable to maintain a view that Pareto-efficiency is independent of the distribution of income. The existing income distribution is a product of past social processes and, in turn, fundamentally affects future production and the distribution of wealth. Prices are not simply a product of demand and supply but are influenced by the structure of the market that is itself determined by the interplay of historical political-economic forces. In order to understand these forces it is necessary to ground the analysis in concrete pricing experiences. The importance of a historically and context-specific analysis of the market structure and its influence on pricing is demonstrated in Chapter 4.

Neo-classical economics treats externalities as an anomaly, an imperfection that needs to be corrected. But externalities and other market "imperfections" are pervasive and are the norm rather than the exception. A more satisfactory approach is to accept the existing phenomena as given, to understand the origins of these phenomena, their consequences and the prospects for change. This approach is very different to the positivistic approach adopted by neo-classical economics and is demonstrated in Chapter 6.

Neo-classical theory treats water analogously to a widget. But the water sector both reflects prevailing social, economic and political conditions as well as presenting its own set of unique characteristics. Water is essential to life, has no substitute and therefore has a particular social, cultural and political resonance. Water is ubiquitous and fugitive; it is found almost everywhere on earth in many forms and guises. Water is robust (almost indestructible and endlessly recyclable) yet also vulnerable to abuse and degradation. Water supply is dependent on stochastically distributed climatic variables. Water performs many functions. Water is used for, *inter alia,* drinking, cooking, bathing, the production of food and commodities, cleaning, navigation, recreation, ornamentation and other cultural purposes. Water has a high "options value", that is, choices today concerning the management of water may be irreversible and foreclose future options. Consequently, both the systems of consumption as well as the "systems of provision" for water are unique.[150] I argue that a critical-realist methodological approach to water pricing theory and practice is able to cater for the specificity of these unique characteristics of water whereas neo-classical theory is not.

[150] The term comes from Fine (1993).

The "correct" application of neo-classical pricing is dependent on the "correct" measurement of the marginal costs and price-responsiveness of demand. These measurements are both subjective and prone to uncertainty. (The theoretical and methodological problems related to the measurement of the price-elasticity of demand are discussed in more detail in Chapter 6.) Consequently, a low level of confidence can be placed on the Pareto-efficiency claim of marginal-cost pricing.

Neo-classical economic pricing theory is preoccupied with static allocation-efficiency. However, there is no demonstrable link between static and dynamic efficiency. In the urban water sector, dynamic efficiency may be more important than static efficiency. Neo-classical economics is not able adequately to explain the nature of dynamic efficiency. I argue in Chapter 4 that a political-economic analysis is able to provide a more satisfactory explanation of dynamic efficiency and pricing practices over time.

The neo-classical economic theory of pricing in general, and its application to urban water specifically, cannot escape from subjectivity. A critical-realist methodology is able to accept that neo-classical economic theory provides a partial, subjective analysis and is able to critically evaluate this analysis alongside those developed by other methodologies, specifically institutional economics and classical political-economy.

Notwithstanding the limitations of neo-classical theory, the theory does provide some important building blocks that can be used in the critical-realist approach to urban water pricing. These include the definition and classification of costs and benefits and some techniques for estimating costs and benefits. An understanding of benefits and costs related to urban water pricing, when combined with a critical awareness of the subjectivity involved in the definition and measurement of these costs and benefits, can assist the economic analysis of water pricing.

Chapter 4: Understanding the market for water

Towards a political economy of water pricing

Control over water in an arid region provides an important control over human affairs.[151]

Water flows uphill to money.[152]

A handful of companies dominate the international market for private management of urban water supplies. They have a combined market capitalisation of more than $50 billion and annual sales of $13 billion (water business only), which is about twice the GDP of Uganda.[153]

1. Introduction

Market structure has a profound influence on water pricing practices and outcomes.

In the nineteenth century, private provision of piped water supply systems dominated in capitalist countries.[154] The recognition of the health benefits of clean water led to greater public investment in water supply systems serving domestic users.[155] Regulation of private suppliers increased and, in most cases, public agencies took over the ownership and management of urban water distribution systems.[156] Public ownership and management became the dominant mode in the sector, although a long tradition of private management (of publicly-owned assets) exists in some places.[157] More recently there has been a trend towards greater private management of urban water supplies, typically through management contracts, leases or concessions. Rights to manage systems are generally given for a limited time period

[151] Ostrom (1953: 229).

[152] An old adage quoted in Postel (1999).

[153] Uganda GNP in 1998 was $6.7 billion (World Development Report). Market capitalisation and sales from annual reports of Thames Water, Vivendi and Suez.

[154] See, for example, Blake (1956), Mukhopadhyay (1981), Foreman-Peck and Millward (1994) and Tynan and Cowen (1998). Private companies were involved in the provision of water to London, Los Angeles and New York to name a just a few major cities.

[155] See, for example, Anderson (1988) and Foreman-Peck and Millward (1994). Foreman-Peck and Millward (1994) state that "the social costs of inadequately monitored, policed, and regulated water companies were strikingly demonstrated in Newcastle upon Tyne during 1853 and 1854. A cholera epidemic most probably was caused by contaminated river water supplied by the private water company, even though the private company had been established to supply pure water from another source" (1994: 42).

[156] Foreman-Peck and Millward (1994) cite extensive regulatory failure as a key reason for the transfer of ownership from private to public hands in Britain. See also Mukhopadhyay (1981). Private companies were also heavily criticised for providing services only to industries and wealthy neighbourhoods.

[157] Private companies have been continuously involved in the provision of urban water services in France since the 1880s (World Bank, 1999).

and outright private ownership of water assets is rare (World Bank, 1999). The extent of private investment in urban water supply systems is small.[158]

In England and Wales (though not in Scotland and Northern Ireland) water services were privatised outright in 1989. (The extent and scale of the privatisation of water in the UK is unprecedented.) In France, some 80 percent of the water supplied is by private firms through a mixture of service, management, lease and concession contracts.[159] Some 25 percent of water utilities in the United States were investor-owned in 1990. Privatised water services are generally uncommon in much of Europe though eastern European countries are now under pressure to privatise services. (Much of this pressure for privatisation comes from multilateral lending agencies.)

Private ownership and management of urban water supplies in developing countries is relatively rare, but increasing. Some prominent examples of privatised urban water supplies in cities in developing countries include Mexico City, Buenos Aires and Jakarta.

Both neo-classical and institutional economists have developed theories of market structure (reviewed in Sections 2 and 3) but these give an inadequate account of how and why certain market structures have come about. More specifically, the theories do not address and are unable to explain the distributional outcomes arising from market structures. Although the theory of "public economies" developed by Elinor Ostrom (1990) has some relevance to urban water supply, I argue that the analysis is ahistorical and does not take sufficient account of political-economic considerations.

I argue that a political economy analysis of market structure provides a more satisfactory understanding of the development of markets over time and also that it is able to explain distributional outcomes. To support this argument, I examine the political economy of water pricing in Los Angeles. The discussion, which is not exhaustive, illustrates how such an analysis might be undertaken and the kinds of conclusions that can be drawn. Using this analytical methodology as the foundation, I draw on both secondary and primary material on pricing experiences in other cities to develop some more general features of a political-economic analysis of urban water pricing.

A key point made in the chapter is that the political-economic conditions determine both the policies and practices in any particular context as well the outcomes of these practices. Theories and policies, therefore, must be adapted so as to be directly relevant to the specific

[158] See Footnote 159.

[159] Although private *management* dominates in France, private investment has not been significant, comprising less than 20 percent of total investment in the last two decades (World Bank, 1999).

political-economic context, taking into account both current conditions as well as the historical path through which these conditions came about. Policies based on neo-classical economic theory fail to do this, as demonstrated in Chapter 1.

There is an inherent contradiction in the neo-liberal position (bolstered by neo-classical economic theory) that asserts that a minimalist state is in the best interests of society as a whole. An efficient market economy with low transaction costs can only exist where there is a strong and efficient state that is able to enforce contracts. Advocates of privatisation are willing to grant the state the role of public regulation (and recognise both its importance as well as the complexities involved) but deny the possibility that the state could run, for example, an efficient water utility. Clearly this is a contradiction.

2. The limitations of a neo-classical approach to regulation

Key insights

Standard neo-classical economic analysis of the market structure with respect to urban water supply proceeds as follows: Urban piped water supply networks are usually characterised by high sunk costs, economies of scale and interconnected or networked delivery. These characteristics give rise to natural monopoly.[160] Consumption of piped water is typically "rival" (consumption by one consumer affects the availability of water to another consumer) although the extent of rivalry differs greatly depending on the specific context.[161] Urban piped water supply is typically excludable in that access to the piped network can be restricted.[162] The combination of rivalry and excludability implies that piped urban water should be priced as a private good with price a function of access and use. The existence of significant externalities (in relation to both supply and use) means that supply (and pricing) cannot be left to the market and either public provision or regulated private provision is preferable to unregulated private provision. The market for monopoly provision is contestable, at least in theory, and thus it is argued that competitive pressures can be brought to bear on the

[160] Multiple parallel networks or the sharing of the same network by different supply agencies are extremely rare.

[161] Because investment in water supply is lumpy, requiring periodic investments in typically large increments in capacity, consumption may be non-rival for a significant period over the life of the infrastructure.

[162] Access to groundwater supplies is rarely excludable in practice because of the difficulties and cost of monitoring.

monopoly market through opening the right to supply water in an area to competitive tender, that is, franchise bidding.[163]

This analysis raises three important topics within neo-classical microeconomics, namely monopoly pricing, regulation and franchise bidding. The first two topics are discussed below. Franchise bidding is discussed in the section addressing institutional economics.

Monopoly pricing

The social welfare maximisation claim of neo-classical economics is dependent on competitive markets. Where a monopoly exists, which is the case for piped urban water supply, there are two possibilities. Either the monopolist is able to practise perfect price discrimination (by making distinct offers to individual customers based on their preferences and the cost of supply), in which case social welfare is still maximised (though the distribution of welfare is in favour of the monopolist), or the monopolist is only able to practise partial discrimination giving rise to a deadweight welfare loss.[164] In either case, there is a compelling argument for the public regulation of monopolies.

Public regulation

The literature on the economics of regulation is vast and space does not permit even a cursory review.[165] Rather, this section seeks to distil a few key insights from this literature that have implications for pricing methodology.

Both the theory and practice of regulation are influenced by political economy. Chang (1997) refers to the "age of regulation" (1945 to 1970), the "age of deregulation" (1980 to present) and a transition period in between. He also shows how (and to a certain extent why) regulatory theories and practice have changed over time. During the age of regulation there was a general consensus on the need for and efficacy of regulation. Regulation was justified on the grounds of market failure and the theory concentrated on what the right policies should be. The objectives of regulation differed between the United States and Europe: the former

[163] Contestability theory, developed and expounded by Baumol *et al* (1982), asserts that the threat of entry ensures that the outcome is efficient even if the market is monopolised by a single producer. The results rely on an assumption of zero (or minimal) sunk costs that is clearly not applicable in the urban water market. This problem is "overcome" with an argument that efficiency can be attained if the right to supply (for a set period of time) is subjected to competitive bid. See discussion on institutional economics.

[164] The deadweight welfare loss arises from the fact that the monopolist can reduce supply and hence increase prices compared to those that would exist in a competitive market. See Mas-Colell *et al* (1995: 386).

[165] See, for example, Chang (1997), Bos (1994), Joskow (1989, 2000), Kahn (1988), Pelzman (1989) and Berg and Tschirhart (1995).

concentrated on monopoly regulation and static allocative-efficiency, the latter on dynamic efficiencies (productivity improvements through technology innovation). In the age of deregulation there has been a general trend towards deregulation. Numerous economic theories were developed in this period that concentrated on government failure.[166] These theories, and empirical efforts to demonstrate the benefits of deregulation, have placed greater emphasis on static efficiency gains rather than dynamic efficiency gains. Chang asserts that while various sector studies have shown static efficiency gains, it is not possible to make any definitive statements about the general dynamic effects of deregulation (1997: 715). Krueger (1980) points out that economic theory does not prove that higher static efficiencies will necessarily lead to greater dynamic efficiency and Chang (1997) points out that the static efficiency gains are likely to be small compared to the potential dynamic efficiency gains. Thus the benefits of deregulation in terms of efficiency are not self-evident.

The government failure school within neo-classical theory assumes that individuals are primarily self-seeking and that, therefore, "self-seeking is all that counts" (Chang, 1997: 722). Such a crude assumption is clearly untenable: were human beings to be totally selfish the modern economy as we know it would not be able to function.[167]

Vickers and Yarrow (1987) examine the affect that ownership has on efficiency from a theoretical perspective within the neo-classical economic framework. They conclude that "where product markets are competitive, it is more likely that the benefits of private monitoring systems (e.g. improved internal efficiency) will exceed any accompanying detriments (e.g. worsened external efficiency). ... In the absence of vigorous product market competition, however, the balance of the advantage is less clear cut and much will depend on the effectiveness of the regulatory policy" (1987: 44). [168] The empirical literature on the influence of ownership is similarly inconclusive (Foreman-Peck and Millward, 1994: 200, 322). Bhattacharyya *et al* (1994) study 225 public and 32 private water utilities in the USA using data made available from the AWWA. The use of a generalised variable cost function (with fixed capital held constant) shows that private water utilities are less efficient, on average, than public utilities, although the dispersion in efficiencies is much less for private

[166] See Stigler (1971) on regulatory capture and Krueger (1974) on rent seeking.

[167] Chang (1997) cites the fact that workers adopting a "work to rule" approach can reduce output by 30 to 50 percent whilst not violating any work codes.

[168] They use principal-agent theory to derive these conclusions. See also Rees (1985).

utilities.[169] Heilman and Johnson (1994) argue that, in the case of wastewater treatment, economic benefits arising from privatisation have not been found in empirical studies.

Regulating (or deregulating) an industry typically has consequences for distribution. Public regulation of utilities often has explicit distributional goals, for example, universal service. Whilst the argument for deregulation is typically made on the grounds of efficiency improvements (social welfare enhancement), the distributional consequences of deregulation are often not made explicit.[170]

In a classic neo-classical work on the regulation of utilities, Kahn concludes that "the central issue of public utility regulation remains the one that I identified at the time [seventeen years previously] – finding the best possible mix of inevitably imperfect regulation and inevitably imperfect competition" and that "*industries differ one from the other, and the optimal mix of institutional arrangements for any one of them cannot be decided on the basis of ideology alone*" (1988: xxxvii, own emphasis).

Within the water sector, the following trends with respect to regulation are evident:

Universal recognition of desirability of public regulation. The recognition of the need for public regulation of water supply and distribution is almost universal.[171] Regulation is generally justified on the grounds of the existence of monopoly supply and externalities (environment and health). Distributional concerns are also recognised as being important. (The way in which regulation has changed over time has been described in the introduction to this chapter.)

Application of regulatory theory. Within the United States, the focus of economic regulation is on allocative-efficiency through price regulation. Reference to marginal-cost pricing is frequent, but actual practice of this appears to be limited (see Chapter 1). Where there is franchise bidding (for a lease or concession), the price of water is usually based on competitive tender and marginal-cost considerations seem to take second place.

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[169] Bhattacharyya *et al* (1994) quote two other studies in support of their conclusions: Atkinson and Halvorsen (1986) report similar results for the electricity sector in the USA and Feigenbaum and Teeples (1983) show that private water utilities are less efficient than public utilities.

[170] Trebing, for example, argues that "the neoclassicists have essentially disregarded equity and distributional effects, and have failed to establish a framework for examining social values" (1984: 362). An institutionalist critique of neo-classical economics argues that "the neoclassical treatment of regulation and deregulation contains an ideological bias against intervention" and that "deregulation based on neoclassical analyses has not adequately addressed residual market power, social costs and economic dislocations. ... Since the negative impacts are often borne by the poor and the powerless, (on the face of it) some neoclassical analyses appear not to be value neutral, but to actually perpetuate current structures of political and economic power" (Berg and Tschirhart, 1995: 310).

[171] There are, of course, exceptions. See, for example, Lee (1999) whose ideological advocacy of privatisation is unabashed.

Implications for water pricing methodology

Regulatory theory both influences, and is a product of, the political-economic context. The relative emphasis of regulation on static versus dynamic efficiency considerations will significantly affect the choice and use of regulatory instruments. Access to cheap water, for example, may help in the establishment of an industrial base and enhance future economic growth, contributing to the dynamic accumulation of capital.

The theoretical arguments and empirical support in favour of the social welfare benefits of private ownership and management *vis-à-vis* public ownership and management are not convincing.[172] In specific circumstances it is possible that private ownership and management could result in significant welfare improvements but this will not necessarily be the case. In the water sector the benefits of private ownership and management may be proscribed by the need for public regulation. In addition, the distributional consequences of privatisation may be politically unpalatable. A key point here is that the political-economic conditions will determine the outcomes of regulation, public provision and privatisation. This point is illustrated in more detail in Section 4.

The optimal mix of inevitably imperfect regulation and competition must be determined with reference to the specific political-economic context and the characteristics of demand and supply pertaining at the time (Kahn, 1988). Taking this a step further, the actual mix of regulation and competition found in practice will be, itself, a product of the historical development of the political economy.

3. Insights from institutional economics

Key insights

Neo-classical economics asserts that individual actors (consumers and producers) together with their utility and profit maximising behaviour mediated by the market lie at the heart of economic analysis, whereas political economy, at least in the Marxist tradition, holds that an analysis of the history of power struggles between different socio-economic groups is necessary to understand economic behaviour. Broadly speaking, institutional economics may be said to fall somewhere in the "middle ground" between the methodological individualism of neo-classical economics and the analysis of (political) power embodied in political economy. In part, institutional economics may be thought of as a continuation of the historical tradition established by Max Weber (1958). However, there is much ambivalence within

[172] See footnote 198.

institutional economics about the precise relations between itself and neo-classical economics and the political economy approach respectively. For the most part, new institutional economics allies itself with the philosophical and methodological underpinnings of neo-classical economics, seeing its agenda as being largely complementary. However, some institutional economics may be viewed as contradicting, rather than complementing, neo-classical economics. To the extent that methodological individualism is rejected, and (locally and historically specific) power dynamics and social structures emphasised, the boundary between institutional economics and a political economy approach becomes fuzzy.

The two most important insights of institutional economics are that the market is just one of many institutions within society and that these institutions exert a profound influence over both the workings and outcome of the market.[173] The approach of institutional economics to resource allocation thus encompasses a broader set of explanatory variables. Price is not only a function of demand and supply in a conceptual market, it is also determined by the structure and power of institutions and the forces that gave rise to these. Thus "the search for optimality or for optimal solutions is either formally empty or can be given substance only by the introduction of antecedent normative assumptions as to whose interests count, whereas in the real world such questions have to be worked out both within institutions and through contests over institutional adjustment and reformation" (Samuels, 1987: 865).

Transaction cost analysis

Williamson (1985) argues that institutional arrangements (which provide the context within which transactions take place) are determined by both the nature and cost of transactions. His key thesis is that the primary factor responsible for the development and adaptation of various forms of economic organisation over time is the efficiency gains in transaction costs that arise from institutional changes.

Williamson may be criticised for being ideologically biased in his belief that efficiency gains through reduced transaction costs are the primary force driving institutional change. Although he gives an apology for focusing exclusively on the efficiency criterion as the primary cause of contracting forms (namely that institutional economics is underdeveloped and hence exclusive focus on this is warranted) and notes that transaction cost arguments are best used in

[173] Commons (1934) drew attention to the fact that there are different types of transactions of which the bargaining transaction (a key focus of neo-classical economics) is only one. Two other types of transactions are "managerial transactions" and "rationing transactions". The former describes a manager-worker transaction and the latter the rationing of property rights. Both of these transactions, at least to a certain extent, are involuntary as there is an asymmetry in the exchange and hence they differ in important respects from the bargaining transaction (Commons, 1934). The embeddedness of institutions within capitalism in ably demonstrated in Hollingsworth and Boyer (1997).

conjunction with, rather than to the exclusion of, other ways of examining the same phenomena, Williamson is guilty of logical error. It is not possible to prove efficiency as the primary cause if other possible causes are not properly examined (which Williamson fails to do).

Williamson does not give an adequate treatment of asymmetry in information (and ways of overcoming this) and inequality in power relationships and resource-access (and the effect of these on contracts). A further weakness in his argument is the use of comparative-static analysis to try to explain dynamic effects. For example, it is not necessarily true that an organisational mode that economises on transaction costs in the short-term will out-perform a different organisational mode in the long-term. Many context-specific factors other than (static) transaction cost economising will have an important influence over the outcome.[174] Nevertheless, Williamson's approach may be used to shed light on certain aspects of institutional arrangements relevant to the provision of water. An application of transaction cost analysis, which constitutes an extension or modification of neo-classical economic analysis, to the analysis of the market structure for urban water provision is given below.[175]

Urban water market structure – a transaction cost approach

In the neo-classical approach to water pricing, the primary question is related to the appropriate price *level* of urban water for any given set of (physical) circumstances. The key criterion for the price level is the influence that the price level has on resource allocation (optimal allocation of currently available resources being the principle goal). The institutional context is implicitly assumed (typically either a public or regulated private monopoly). The existence of the monopoly is explained on the basis of increasing returns to scale, that is, urban water services are considered to be a *natural monopoly*.[176] However, what is *not* explained is the choice between a private regulated or a public water utility and the influence this has on the price setting process. This issue is examined below using Williamson's transaction cost theory. The particular contracting choice that is examined is franchise bidding for the natural monopoly market in urban water services.

[174] There is evidence that it is becoming more costly to transact in the United States economy. Less adversarial forms of transacting may substantially reduce transaction costs (Casson, 1991).

[175] The account given here is based on Williamson (1985). Subsequently, Williamson position has moved closer to Douglass North's approach (Williamson (1998ab). North's approach is discussed later in this chapter. Nevertheless, useful insights are gained by applying Williamson's transaction cost approach to the water sector.

[176] Williamson's argument that monopoly can be explained primarily or exclusively on the basis of the economising of transaction costs is not convincing.

Contracting models and governance

Williamson (1985: 31) argues that the need for governance arises where bounded rationality (uncertainty), opportunism (self-interest) and asset-specificity (uneven playing field) coexist.[177] He further asserts that both the nature of the investment (asset-specificity) and the frequency of contract affect the choice of the appropriate governance form under different circumstances. *Market governance* is appropriate where transactions are non-specific.[178] *Trilateral governance* is appropriate where there are occasional transactions of a mixed or idiosyncratic kind. Once such a contract has been entered into, there is a strong incentive to carry the contract through. Market alternatives are not attractive because of the specific investments undertaken. Here, some form of third party support is desirable to facilitate conflict resolution and mediate disputes. *Bilateral governance* is appropriate where recurrent transactions are supported by investments of the mixed and highly specific kinds. Continuity of trading is valued (because of the specific investments) and the recurrent nature of the exchange potentially allows the cost of specialised governance structures to be recovered. Bilateral structures of governance maintain the autonomy of the parties, whereas *unified* structures remove the exchange from the market and place it within the firm subject to an authority relation (vertical integration). *Unified governance* becomes more appropriate the greater the degree of asset specificity. That is, incentives for trading weaken as transactions become more idiosyncratic. Uncertainty differentially influences non-specific, mixed and specific investments, with little influence over non-specific assets and much greater influence on more specific investments.

Using these conceptual tools, Williamson addresses a number of practical issues related to market structure such as vertical and horizontal integration, firm size and franchise bidding (1985). The application of this conceptual framework to the issue of franchise bidding in the urban water sector is given below.

Franchise bidding for the right to supply urban water

It has already been argued that the monopoly structure of the urban water industry can be explained more convincingly by appeal to the decreasing cost structure of the industry (that is, technological factors) rather than to the economising of transaction costs. Nevertheless, transaction cost theory can be used to analyse the efficacy and efficiency of alternative governance structures for the monopolised urban water industry. Of primary interest here is

[177] Williamson argues that when only bounded rationality and opportunism coexist, then the appropriate contractual model is competition, and when only opportunism and asset specificity coexist, then the appropriate governing model is planning.

[178] Because the product or service being exchanged is standardised, alternative purchase or supply arrangements are presumably possible at zero extra cost.

the choice between public ownership (and management) and private ownership and management by means of a franchise entered into through a competitive tender process.[179]

Demsetz (1968) and Stigler (1968) were the first to argue that monopoly-pricing outcomes can be avoided by using *ex ante* bidding to award the monopoly franchise to the firm that offers to supply the product on the best terms.[180] This efficiency-based argument has been used to promote franchise bidding for public utility services such as water supply.[181] Advocates of franchise bidding usually ignore or underplay the complexities and problems involved. Williamson asserts that the argument for efficiency gains through franchise bidding is deficient because both *ex ante* and *ex post* contracting features have to be examined: "only if competition is efficacious at *both* stages does the franchise bidding argument go through. The attributes of the good or service to be franchised are crucial to the assessment. *Specifically, if the good or service is to be supplied under conditions of uncertainty and if non-trivial investments in specific assets are involved, the efficacy of franchise bidding is highly problematic*" (1985: 40: own emphasis). Moreover he asserts that "the enthusiasts of franchise bidding claim too much for the efficacy of that organisational alternative" (1985: 328).

Williamson provides a theoretical framework within which efficiency arguments in favour of franchise bidding can be critically examined. This is used below with specific application to the urban water sector.

The general influence of uncertainty. In the presence of uncertainty, it is not possible to write complete contracts as all eventualities cannot be foreseen. However, open contracts pave the way for opportunism. Although aggressive self-interest will be ameliorated due the nature of the long-term contract which includes informal constraints and recognition of the mutual long-term benefit of co-operation, the "hazards of opportunism hardly vanish on this account" (333). Williamson argues that these conditions (uncertainty and opportunism) pertain to real life and are not trivial in their influence over outcomes of different institutional arrangements. In fact, "franchise bidding for public utility services under uncertainty encounters many of the same problems that the critics of regulation associate with regulation" (333).

[179] In the case of the franchise, ownership of the fixed assets may be retained by a public authority, but the rights to their use and full management responsibility (including investments) cede to a private company

[180] "The rivalry of the open market place disciplines more effectively than do the regulatory processes of the commission" (Demsetz, 1968: 65). Both Demsetz and Stigler (1968) argue that neither equipment durability nor uncertainty should pose problems provided use of the durable, contract-specific equipment is transferable.

[181] See World Bank (1996).

Because the urban water industry is highly capital intensive, franchises must be given for long periods (typically more than 20 years). Clearly, there is an extremely high degree of uncertainty over such a long contract period.

The cost of ascertaining and aggregating consumer preferences through direct solicitation. The greater the cost and/or the more difficult to ascertain consumer preferences directly, the more complicated and less efficient the franchise bidding process. Consumer preferences for levels and standards of water supply can be ascertained through customer "willingness-to-pay" surveys. These, however, are rather costly and not without problems. (See Chapter 7.)

The efficacy of scalar bidding. The more difficult it is to reduce the bidding to clearly defined and measurable parameters (scalar values of price, quality and quality) that are easily comparable, the more complex and open to abuse is the franchise bidding process.[182] In the water sector price must be related to quality of service. It is possible for competing bidders to propose different price and quality combinations that may be difficult to compare. Even if this problem is solved (for example, by agreeing on both explicit and measurable quality criteria beforehand), monitoring the quality of service is essential and therefore a significant monitoring and regulatory capability is necessary. This monitoring may not always be efficacious. It may be possible for the franchisee to conceal lower standards or quality of service. For example, reduced expenditure on maintenance may not influence service quality in the short-term. This hazard is particularly serious in the period leading up to contract renewal.

The degree to which the technology is well developed. The more mature the industry with respect to technology development the more amenable it is to the process of franchise bidding, all other factors being equal.[183] The technology used for water treatment and retailing is well developed and reasonably stable. Hence technology does not present a significant obstacle to franchise bidding.

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[182] The use of *ex ante* consumer solicitation (having the customer base decide on the credible commitments made by the bidders to individual consumers during the bidding process) and holding the winning bid to the contract thus created, may overcome the problems posed where simple scalar bidding is not feasible. However, Williamson asserts that this is not practical: "Although franchise awards can be reduced to a lowest bid price criterion, that is apt to be artificial if the future is uncertain and the service in question is at all complex . Such awards are apt to be arbitrary and/or pose the hazard that 'adventurous' bids will be tendered by those who are best-suited or most inclined to assume political risks" (Williamson, 1985: 335).

[183] "A once-for-all verdict with respect to the supply of a particular natural monopoly service is unwarranted. The better mode at an early stage of an industry's development may no longer be better later on when a lesser degree of uncertainty prevails. To the extent that difficult transition problems are apt to be posed in shifting from one mode to the other, this should be acknowledged and taken expressly into account at the outset" (Williamson, 1985: 329).

Demand uncertainty. Franchise bidding is less appropriate where there is greater uncertainty in demand. The period of franchises for water retail typically lasts for more than 20 years in the case of a concession. Water demand forecasts over periods of this length have a marked degree of uncertainty. This tilts the weight of influence in the contract heavily in favour of the franchisee.

The degree to which incumbent suppliers acquire idiosyncratic skills. The greater the degree of idiosyncratic skills required (that is the greater the asset specificity) the more uneven the playing field at contract renewal time. Although many of the skills required to manage a water retail network are common to most water retail systems, some important sets of skills are very closely tied to the local environment.[184] While the transfer of "asset-specific" staff between the incumbent franchisee and the new successful bidder is possible, it is not without difficulty and cost.

The extent to which specialised, long-lived equipment is involved. Where asset specificity of capital assets is high, and especially where such assets make up a substantial portion of the cost structure of the service, difficult problems of asset valuation arise. The water supply sector is a highly capital-intensive public service industry and hence these problems are particularly acute (Hanemann, 1997).

Political context. The greater the susceptibility of the political process to opportunistic representations and the greater the differential in capacity and ability between competing organisational forms (for example, between private companies wanting the franchise and the public sector currently supplying the service) the less level the playing field and more unfair the franchise bidding process is likely to be. The likelihood that regulation may expand its jurisdiction and the consequences of this also need to be taken into account. There needs to be an explicit recognition that the balance of power between the important interest groups has a significant influence over the outcome, affecting the distribution of resources, allocative-efficiency and resource-use efficiency.

Marginal-cost pricing. Franchise bidding gives no assurance that output will be priced "efficiently" (that is, "Pareto-optimally" in neo-classical terms). This is an interesting point because many neo-classical economists tend to advocate *both* marginal-cost pricing where services are managed by public utilities *and* privatisation through franchise bidding (with the latter usually being deemed preferable where it is feasible) without recognising the

[184] For example, effective customer relations largely depend on reputation and a history of service within that area. Customers tend to value familiarity and stability and are often wary of change. Other asset-specific skills may relate to peculiarities in the system design, equipment used and maintenance histories.

inconsistency in the arguments. Williamson notes that an elaboration of the franchise bidding process may be possible to ensure marginal-cost pricing, but that such action will have the effect of further reducing the benefits (to the extent that any exist) of bidding over regulation.

Execution problems. Even if it is assumed that the full contract period pertains,[185] in the context of uncertainty, long-term fixed-price contracts are unlikely to be satisfactory. Although price flexibility by formulae may go some way to reducing these problems, it is usually a rough correction which is not likely to be satisfactory. Cost-plus contracts can track costs more accurately. However, these are subject to monitoring problems. *The case for the advantages of franchise bidding over regulation is severely weakened once issues of monitoring become important for franchise bidding*. The counter argument goes as follows: because agents have a stake in renewing the contract, the incentive to cheat or be opportunistic during the contract will be significantly reduced and hence franchise bidding (even with monitoring) is still better than monopoly regulation. However, Williamson argues that there is much scope for opportunism-with-guile in franchise arrangements that may not threaten potential contract renewal. *There is a danger that political skills* (used to win the contract and undertake successful re-negotiation of the contract) *may override the economic skills* (of running an efficient enterprise) and hence the advantages of franchises over regulation may again be questioned.[186]

Bidding parity at contract renewal. It is unlikely that the competitive playing field will be level at contract renewal for economic, administrative and political reasons. The economic advantage of the incumbent franchisee arises from the "fundamental transformation", that is, the introduction of specificity (as soon as a bilateral contract has been entered into) and the economic advantages arising from this. Administrative advantages arise from superior access to information for the purposes of asset valuation related to franchise transfer. Political advantages arise from the reluctance of both the incumbent franchisee and collaborating politicians to expose the existing contract and performance to scrutiny (and possible litigation).

In the light of the above arguments, Williamson is far less sanguine than most neo-classical economists (for example, Demsetz, 1968, Stigler, 1968 and World Bank, 1996) about the efficiency of franchise bidding *vis-à-vis* other organisational forms for a "natural monopoly".

[185] Contract periods are very unlikely to be cut short: the contract is designed for the full duration of the contract; the long term nature of the contract provides the incentive for investment in durable assets; an aborted contract would result in non-trivial transaction costs (litigation and delays); and those that awarded the contract would lose face.

[186] In addition, there may be enormous scope for influence arising from disproportionate economic power. Suez Lyonnaise des Eaux, for example, has annual sales of about $6 billion compared to total sales in the Ugandan water sector of $16 million.

He asserts that problems associated with franchise bidding may be as intractable as those associated with regulation, especially where assets are specific and have a long economic life, and where there is uncertainty (all of which are present in the case of urban water supply).

Williamson's arguments are convincing.[187] From an economic theory point of view, there appears to be little or no advantage to privatisation through franchise bidding compared to a regulated private or state-owned monopoly. Economic theory, *per se*, therefore cannot offer guidance as to the most appropriate form of governance for a natural monopoly and the assessment of the efficiency of the different models must therefore be left to an appeal to other considerations or as a matter for empirical investigation.

Cursory overviews of franchise bidding in the urban water sectors in South Africa and Uganda are presented below to illustrate the point that choices related to franchise bidding, and consequently the outcomes, have much more to do with underlying political-economic dynamics rather than the Pareto-efficiency arguments for franchise bidding.

Franchise bidding in South Africa [188]

The recent political changes in South Africa have been a catalyst for a fundamental review of water policy in South Africa. Prior to 1994, private sector engagement in the water sector was largely limited to service contracts such as traditional design and construction activity undertaken by engineering consultants and private contracting firms.[189] The new government, facing large capital investment requirements to meet service goals in the water sector and, at the same time, unwilling to expand public expenditure significantly, introduced a policy of encouraging private sector participation in the water sector.[190]

The only two sizeable concession contracts have been signed in South Africa to date – Nelspruit and Dolphin Coast.[191] Nelspruit ostensibly decided to give a concession for water and sanitation services because its service area had expanded from 24 000 people to 240 000 (as a result of local government reform in South Africa) – with an expected increase in revenue of only 17% – and because Nelspruit was only able to borrow about $2 million whereas the investment need to expand services was of the order of $50 million.[192] The

[187] See also Dasgupta (1993), Farrell (1986) and Dasgupta and Stiglitz (1988).

[188] This brief discussion is elaborated on in Chapter 7 with reference to the underlying political economy.

[189] There were a few exceptions: management contracts existed for some towns and township areas and build-operate transfer schemes existed for a few water and wastewater treatment works.

[190] The conditions giving rise to this policy are discussed in more detail in Chapter 7.

[191] Only Nelspruit is discussed here in a cursory way. The key point made here could equally well have been with reference to the Dolphin Coast concession.

[192] The information is from Goïz and Harrison (2000).

decision was taken in August 1996 and the concession contract signed in April 1999. Key features of the contract include a stipulation that there would be no forced retrenchments of existing staff and that staff conditions would be the same or better. These conditions reflect the key concerns of the Congress of South African Trade Unions (COSATU), a powerful labour lobby in South Africa.

Johannesburg has sought to engage the private sector in its management of water supply and sanitation services. Although the incumbent management was in favour of a concession-type model, the Municipal Workers Union was strongly against this and was successful in removing this option from the reform alternatives under consideration. Consequently, the Johannesburg Council has opted for a management contract.[193]

One conclusion to be drawn from the South African experience is that the form of private sector involvement and the outcomes of the reform process are highly dependent on the political-economic context. Both neo-classical and new institutional theories are unable to shed light on these political-economic aspects of institutional reform for the reasons set out in Chapter 3. In South Africa there is a tension between government policies to encourage municipal service partnerships with the private sector and a strong labour movement which is fearful of the possible job losses and job insecurity that may result from this. (The ideological force of the World Bank in policy design is a possible third factor. However, the direct influence of the World Bank is considerably less in South Africa compared to countries which are extensively reliant on World Bank loans and funding.) The difference between government policy and actual practice (with very little progress with privatisation over the last six years) would seem to indicate that organised labour exerts some influence on government (see Chapter 7). In this context, economic theorising can help to inform the parties but is in itself likely to have only a marginal influence on the outcome.

Franchise bidding in Uganda [194]

The Ugandan water sector is in the process of reform. The government is committed to private sector participation in the sector. Two privatisation models are being seriously considered at present: a concession for Kampala, Entebbe and Jinja or a lease contract for about 30 of the largest towns in Uganda (including Kampala, Entebbe and Jinja). The government's arguments for private sector participation are two-fold: to reduce existing inefficiencies in the sector (a short-term goal) and to attract private investment into the sector

[193] Pickering (personal communication, 2000).

[194] The data on which this section was based were collected in Kampala and other urban towns in Uganda during an urban water sector reform project in the period August 1999 to July 2000. The data comes from government and consultant reports and interviews with influential government officials.

(a longer-term goal). On paper, the potential efficiency gains look impressive.[195] However, significant risks are attached to the reform process: there is no guarantee that there will be sufficient private sector interest and competitive bidding; the regulatory capacity in Uganda is weak exacerbating the informational and power asymmetries highlighted above; and country political and economic risk means that private operators are likely to both place a high premium on bids and to require government guarantees (sovereign guarantees on loans and mitigation of foreign exchange risk).

Although it is government policy to promote increased private sector participation in the water sector, there is strong evidence that this is not a really a locally driven and owned policy, least of all in the urban water sector. The World Bank has played a significant role in policy development in Uganda and it can be forcefully argued that the Ugandan policies are really those of the World Bank, given the extent of its influence over the financial flows available for development in Uganda. For example, the World Bank has strong financial leverage over the National Water and Sewerage Corporation (NWSC) through its loans; the "institutional reform" (or more accurately *privatisation*) study was undertaken with World Bank financing; World Bank had veto rights over the choice of consultants and a strong say over how the recommendations of the study are implemented (or overridden) given the contingency of NWSC survival of further World Bank financing.[196] Of course, this is not a unique nor recent phenomenon. World Bank influence over Ugandan water policy has its roots in the series of IMF structural adjustment programmes (starting in 1980 during the oppressive Obote dictatorship) which led to ever greater debt dependency.[197] These programmes are critically examined by Mamdani (1994: 128) who shows how the interests of capital (both international capital and the local *mafutamingi*) came to predominate over those of the peasant farmers and co-operatives.

In this context, the choice of institutional arrangement for the water sector is clearly contingent on factors other than the economic theory of franchise bidding.

[195] I have estimated these gains to be of the order of $10 million per annum whereas the total revenue potential is currently about $23 million per annum.

[196] The consultants recommended a lease for 30 towns. The World Bank essentially overrode this recommendation by pressing for a lease for NWSC and a handful of additional towns, and providing the financing for further study of this particular option only.

[197] Uganda's debt-service ratio (measured as the ratio of export earnings required to service the debt) jumped from 19% at the start of the first IMF structural adjustment programme in 1980 to 90% at the end of the second programme in 1990 (Mamdani, 1994: 132).

Market structure – the role of culture and ideology

In contrast to Williamson (1985) (see discussion above), North (1990) uses a dynamic analysis to understand the evolution of institutional forms over time. His is a much richer analysis which is more helpful in understanding the prevalence of certain institutional forms in the urban water sector in different contexts. North's behavioural and methodological assumptions are summarised below and, following that, his approach is used as a guide to understanding the different institutional forms found in the water sector.

North defines *institutions* to include any form of constraint that human beings devise to shape human interaction, be these formal or informal. *Formal constraints* are codified and refer to the constitution, legislation, common laws, bye-laws and contracts (political rules define the structure of the polity and economic rules define property rights). *Informal constraints* are defined by social convention and hence are part of socially transmitted culture; they are codes of conduct, norms of behaviour and conventions; they include the extensions, elaborations and modifications of formal rules, socially sanctioned norms of behaviour and internally enforced standards of conduct.

North (1990) agrees with the bounded rationality and self-interest premises of Williamson (1985). However, he rejects Williamson's assertion that efficiency is the primary driving force behind the evolution of contracting and institutional forms. North's assumptions of fuzzy knowledge and incomplete feedback allow him to explain the persistence of non-optimising behaviour in terms of institutional constraints. Thus North rejects the evolutionary competitive assumption which underlies neo-classical economics, namely that even if all individuals are not rationally self-maximising, "competitive forces will see that those who behave rationally will survive and those who do not will fail; and that therefore in an evolutionary, competitive situation [scarcity and competition are fundamental assumptions of neo-classical economics], the behaviour that will be continuously observed will be that of people who have acted according to such standards" (1990: 19). North questions the usefulness of equilibrium analysis for the analysis of institutions because of the possibility of multiple equilibria in institutional form and, more fundamentally, because of the dynamic change of institutional forms over time.

North (1990) has extended the thinking within the transaction cost school of new institutional economics by embracing the influence of ideology and other informal and formal institutional constraints on the form and functioning of institutions, particularly their evolution over time.

North asserts that institutions reduce uncertainty by defining and limiting the sets of choices of individuals, that is, institutions define the "rules of the game" in society. Hence they structure

incentives (in the economic, social and political spheres) by changing the "price" that individuals have to pay. Although individual agents continually attempt to maximise their own welfare (that is, there is a dynamic interaction between individual agents and institutions) there is no guarantee that institutional forms will evolve in a way that increases the efficiency of property rights (and hence the overall efficiency of the economy) over time. The primary reasons for this are uncertainty, the cost of obtaining information, asymmetry in information and poor or fuzzy feedback. These result in the persistence of poor models of reality and provide scope for ideology, dogma and other informal and formal institutional constraints to play an important role in the way in which societies function. Inefficient property rights persist because the market for political rights is "inefficient" (in terms of the neo-classical conception of static efficiency). In turn, this market remains inefficient because of the persistence of economic interest groups that wield inappropriate influence.[198] "Because much of economic history is a story of humans with unequal bargaining strength maximising their own well-being, it would be amazing if such activity were not frequently at the expense of others" (North, 1990: 134).

The inclusion of "ideology" and "culture", even if these are rather narrowly defined, (and noting the importance of formal and informal institutional constraints more generally) as partial explanatory variables in the evolution of institutions is an important advance over the work of Williamson. North's explanation of why inefficient property rights persist is plausible. However, there is a methodological weakness in his argument. North moves from individual action (on organisations) to organisational action (on institutions) seamlessly as if they are one and the same thing. Thus North's conception of institutional evolution is stated as follows: "Institutions, together with the standard constraints of economic theory, determine the opportunities in a society. Organisations are created to take advantage of those opportunities, and, as organisations evolve, they alter institutions. The resultant path of institutional change is shaped by (1) the lock-in that comes from the symbiotic relationship between institutions and organisations that evolved as a consequence of the incentive structure provided by those institutions, and (2) the feedback process by which human beings perceive and react to changes in the opportunity set" (1990: 7). *North does not show how the interests of organisations are, or become, aligned with individual interests, and how competing interests between the organisation and individuals within the organisation are resolved.* These

[198] "These inefficiencies [in property rights] exist because rulers would not antagonise powerful constituents by enacting efficient rules that were opposed to their interests or because the cost of monitoring, metering, and collecting taxes might very well lead to a situation in which less efficient rights yielded more tax revenue than efficient property rights. The efficiency of the market for political rights is the key to this issue. If political transaction costs are low and the political actors have accurate models to guide them, then efficient property rights will result" (North, 1990: 52).

matters are not as straightforward as they seem.[199] Without a theory which explains how individual self-interest or maximisation relates to organisational interests, North's theory remains, at best, incomplete and, at worst, seriously flawed.

Notwithstanding this weakness, it is possible to examine the practical efficacy of North's analysis with reference to actual market structures found in the urban water sector, including the dynamic development of institutional forms over time. This discussion is very much illustrative in nature.

Privatisation, politics and ideology

The question arises: why have different institutional forms (and in particular, different patterns of ownership) evolved in different contexts? The question of causality in relation to privatisation is a vexed one. Nevertheless, North's general approach may be used as a starting point for the examination of these issues.

The political and ideological frameworks informing and influencing the institutional structure in specific countries or regions can be divided into three broad categories: (1) a strong ideologically-based belief in the superiority of either nationalisation or private enterprise (*vis-à-vis* the other and with respect to services in general and the water service in particular), (2) a general preference for either public ownership or private sector involvement in urban water supply, and (3) an agnostic view on the relative efficacy of public or private ownership and management of water supply. Although it may be expected that the boundaries between these categories will be blurred, they still can provide a useful schema. For example, there is likely to be little disagreement with the view that, prior to 1989, eastern European countries were operating within a framework of a strong ideological preference for public ownership that precluded an examination of private ownership as a plausible and possibly attractive alternative. Similarly, the social-political context in most western European countries (at least from about 1900 to 1980) was largely one in which there was a general preference for the public ownership and provision of urban water services, premised on the view that water was an essential public good.[200] There was a sea-change in the political and ideological landscape in the United Kingdom when Margaret Thatcher came into power: from a general preference

[199] For example, Olson (1970) showed that groups which exist to further the interest of their members are not automatically self-interested in the way that individuals are assumed to be, at least the logic of individual self-interest cannot be applied in a straight forward way to group interest. Casson (1991) examines the role of leadership in groups. Hindess (1989) argues that political parties, trade unions, capitalist enterprises and state agencies are examples of actors whose actions cannot be reduced in any systematic and coherent manner to the rational choice model of individual action encapsulated in methodological individualism.

[200] The dates correspond approximately with the public ownership of water supply in London (1902) and the election of the conservative Thatcher government in the United Kingdom (1979). The fight for public ownership of water supply in London began in 1851. See Mukhopadhyah (1981).

for the public ownership and public provision of public services to at least a general preference for (and arguably a strong ideological belief in) the private ownership and provision of these same services. It was in this context that the privatisation of water services in England and Wales took place.[201] Privatisation in England and Wales was advocated on the grounds of predicted improvements in economic efficiency (Maloney and Richardson, 1995). There is a convincing argument that the underlying motivation for privatisation had more to do with macroeconomic beliefs about public debt than with efficiency gains.[202] At the very least, the choice for privatisation was hardly an agnostic one, in the sense of examining the evidence of efficiency gains arising from privatisation in the water sector elsewhere.[203] Furthermore, arguments against privatisation were not seriously countenanced.[204] Opponents of privatisation argue that this mode of organisation is not necessarily more efficient than public provision, noting that the existing evidence is ambiguous and that, even if it were to be more efficient, the distributional effects are inequitable and undesirable (Schofield and Shaoul, 1999). (There is an implicit assumption in this argument that income distribution is at least as important a goal as efficiency.) Opponents of privatisation also argue that the regulation of private companies is not effective because the scope for penalising private companies is limited and, consequently, consumer interests are not effectively protected under privatisation (Schofield and Shaoul, 1999).

An analysis of this kind could be applied to South Africa, though the limitations of such an analysis are readily apparent. The African National Congress (ANC) had traditionally been an opponent of the privatisation of public services including water. Ideologically, the ANC was socialist in orientation. Thus the reasons why the ANC has pursued a privatisation strategy

[201] It is also important to note that the political and ideological context in Scotland was quite different to that in England and privatisation of water services was strongly resisted. For a brief account, see Maloney and Richardson (1995: 91f). See also Summerton (1998) and Kinnersley (1998).

[202] This view is widely held and well founded. The sector required major new investments as a result of a need to conform to European environmental and water quality standards and Thatcher wished to remove current debt and, in particular, projected future debt from government accounts. See, for example, Kinnersley (1994), Maloney and Richardson (1995: 57) and Foreman-Peck and Millward (1994: 331).

[203] Such an analysis was not undertaken. In any event, the published evidence is inconclusive. See footnote 168.

[204] Maloney and Richardson (1995), who undertook a political analysis of the policy changes resulting in water privatisation in the United Kingdom, show that the prevailing governing framework was pro-privatisation, that there were strong *managerial interests* in privatisation and that "outsider groups" including trade unions and environmentalists were marginalised: "They were clearly stakeholders in the sector yet had little or no influence" (1995: 89). They further noted that the "problem for these outsider groups is that the 'interests of the Treasury in securing early flotations have been foremost – along with the aims of existing managers' (Riddell, 1991: 111)" (Maloney and Richardson: 1995: 89). See also Feigenbaum *et al* (1998) who argue that privatisation in Britain was systematic and ideologically driven, with the objective of "irrevocably converting Britain from a mixed to a neoliberal market economy" (83).

must go beyond a North-like analysis of ideology and culture.[205] A similar point applies to the "new" Labour Party in the United Kingdom. Previously aggressively anti-privatisation, "New Labour" is now progressing with privatisation of public enterprises the Conservative Party was "too timid" to touch

In the light of the above, it is evident that culture and ideology *do* influence the structure of the urban water market. Whilst such an analysis (even if undertaken in much more detail) is a useful starting point, it is inherently limited as its conception of culture and ideology are too narrow. North is not able to begin to explain why cultures and ideologies evolve as they do. In other words, North's analysis is still too superficial; it fails to take into account the underlying political-economic forces affecting the development of the economic, political and cultural context within which the contending ideologies operate.[206] In the case of privatisation in the United Kingdom, for example, Foreman-Peck and Millward point out that the important ideological changes were themselves a "reaction to the experience of economic history" (1994: 332).

An institutional theory of price determination

Tool (1991) has reviewed the work of a number of institutional economists and proposed an "institutional theory" of price determination. He makes the following points: exchange in a non-auction setting does not reduce to the maximising tenets of neo-classical economics; price discretion on the part of the producer predominates (that is, price-taking is rare); price discretion typically is based on a mark-up on production costs; and private pricing decisions should be subject to public appraisal. The key point is that pricing is primarily discretionary, emphasising the need for public review of prices. This is particularly relevant to water given its social importance.

[205] Marais poses the pertinent question: "How is it that a liberation organisation stoutly linked to a socialist trade union federation and in many ways shaped by long and intimate relationship with a communist party could so rapidly and resolutely adopt the practices and implement policies of right-wing social democrasy?" (2001: 260). This point is taken up in Chapter 7 (Conclusions) with reference to a political economic analysis of South Africa.

[206] Feigenbaum *at al* (1998: 41) argue that privatisation may be used as a strategy by certain interest groups or classes as a means of re-aligning institutions and decision making process with the effect of privileging their interests *vis-à-vis* other groups or classes. They argue that the broad privatisation movement is better understood as a political movement rather than an administrative tool (to better achieve defined social goals) or an economic phenomenon (to maximise individual utilities). While this may be true, they do not show why political movements develop as they do and why and how they are able successfully to change the institutional landscape. Such an analysis requires an understanding of the political-economic dynamics.

Public economies

Ostrom (1997) seeks to bridge the gap between markets for private goods and state provision of public goods. Her analysis was developed with common-pool resources and public goods in mind, where exclusion is problematic. It was developed for cases where both market and state provision of services led to sub-optimal outcomes and sought to show both why an alternative model of provision should out-perform these two alternatives and explain the existence of certain modes of provision in existence in the United States. This analysis has possible relevance to the provision of urban water because although exclusion is possible, it is not normally desirable.

She defines the concept "public economies" (in contrast to market economies) as being composed of collective consumption units. Collective consumption units are able to arrange for production, patterns of access, use and appropriation. A collective consumption unit could be a unit of government but this is not necessarily the case. A collective consumption unit's primary role is to solve the problem of provision (distribution). The mode of production can be regarded as a separate question in terms of this analysis.

Ostrom develops a "polycentric theory" of governance to explain the complex patterns of service provision found in metropolitan areas in the United States. This theory is based on the following assumptions: urban public goods differ substantially in their production functions and the numbers of people simultaneously affected; individuals with relatively similar, but always evolving, preferences for public goods tend to cluster in neighbourhoods; preferences within neighbourhoods are more homogenous than across entire metropolitan areas; multiple "provision units" allow for performance comparisons and results in better service delivery; and, multiple "provision units" allows for fiscal equivalence whereby beneficiaries are primarily responsible for costs (Ostrom, 1997: 8). Ostrom asserts that redistribution is best assigned to very large units of government (state or national government). The theory has been applied extensively to the provision of police services in metropolitan areas in the United States.

This theory possibly could be used to explain the fact that there are over 50 000 water companies in the United States, most of whom serve a population of less than 3 300.[207] It also could be applied to a developing country context where multiple supply technologies exist (piped water with individual connections and public standpipes, and local sources such as springs, wells or boreholes).

[207] *The Economist*, 24 February 1996.

The theory may be criticised on at least four counts. First, it assumes that production and provision can be separated and that they each pose separate questions. In the case of water supply, a cogent argument can be made that the mode of production significantly influences the arrangement of the provision of services. This is particularly the case where large private companies are involved in production. Second, the logical application of the principle of fiscal equivalence will lead to inequitable outcomes. This is a particularly important point in the case of water supply. Third, decentralisation of public services can lead to an increase in corruption and not the reverse.[208] Fourth, whilst Ostrom's theory attempts to bridge the gaps between political and economic analysis, it does not address the fundamental political-economic issues underlying the institutional arrangements, explain how these have evolved or show how they influence outcomes in terms of the distribution of resources.

Public versus private consumption

As a brief aside, it is worth noting that the discourse in this thesis has been "overwhelmed" by the dominance of the private (individual) consumer in the neo-classical theory of consumption where household (and firm) demand for water is both the starting and end point of the analysis of demand. (This must necessarily be so in consonance with the methodological individualism of neo-classical economics.) Whilst institutional economics has provide some sort of counter-balance on the supply-side (addressing the structure of the "market" for the provision of water), no such counter-balancing force has been presented on the demand side. Fine (2000c), in his paper "*Wither the welfare state: public versus private consumption*", attempted to redress this imbalance. Whilst succeeding in demonstrating the conceptual poverty of approaches based on methodological individualism, he was unable to propose an alternative.[209] Nevertheless, Fine does point out that an understanding of public consumption must be developed with reference to an understanding of the political economy of capitalism: "Consequently, it is necessary to provide for a political economy of capitalism, including attention to its underlying structures, processes and tendencies, and how these are reproduced and transformed." Such a project is beyond the scope of this thesis. Nevertheless, the fact that the "problem of pricing" being addressed in this thesis is largely in the context of provision of

[208] Arrow (1997) made this point, citing the experience of education services in New York City. Ostrom's reply was that the corruption originated from the "other people's money" syndrome and that the only way to counter to this was to apply the principle of fiscal equivalence. This reinforces the equity criticism of Ostrom's theory. It is important to note that the World Bank's advocacy of decentralisation is premised on the assumption that this will lead to reduced levels of corruption (World Bank, 1999). This has certainly not been the case in Uganda where the decentralisation of water services to local government has proved disastrous (field visit, Uganda, 1999).

[209] "In addressing public consumption, the paper has shifted to a critical overview of a number of approaches to the welfare state, but without providing an alternative" (Fine, 2000c).

water through large-scale piped systems in cities to poor households in so-called developing countries serves to illustrate the point. This is a far cry from Schama's "fountains of ancient Rome ... building civic culture [and] creating a sense of civic belonging and responsibility", albeit an idealised vision (1995: 288).

Implications of institutional economics for water pricing

Institutional economics points out that the market is just one of an array of institutions which affect the structure of demand and the outcome of economic transactions. Fundamental changes in institutions, and in particular the balance of power between institutions or economic interests, may significantly affect the pattern of demand and economic outcomes. Therefore an analysis that ignores the institutional structures underlying and affecting markets is incomplete.

Pricing rules typically will be a function of the institutional and ownership form. In particular, there is likely to be a difference in the pricing rules adopted by publicly-owned, privately-owned, privately-owned-regulated and privately-owned-franchised water utilities. The former are more likely to pursue an array of objectives in their pricing strategies (hence pricing rules are likely to be heterodox). The latter are likely to have won the contract on the basis of an agreed projection of the average cost of water supply and will typically (though not necessarily) pursue average historical cost pricing. Pricing rules for regulated water utilities will depend on the nature of the regulation.

Economic theory does not prove that privatised water utilities (either directly regulated or regulated in conjunction with franchise bidding for entry) are necessarily more efficient than publicly-owned water services providers. This is essentially an empirical matter on which the evidence is mixed.

If it is accepted that equity issues are important in the urban water sector, and it would be hard to argue against such a position (see Chapter 5), then it can be shown that no universal theoretical prescription for an "optimal" pricing rule exists. This means that pricing policy must be grounded in an understanding of the specific and historical political-economic context.

The existing institutional and ownership forms are not primarily a product of efficiency considerations as asserted by Williamson. Institutional economics is not able adequately to explain how (and why) these institutional and ownership forms evolve over time.

Although institutional economics provides valid and useful criticisms of neo-classical economics, it does not go far enough. It fails to examine the underlying political-economic context to any significant extent. The influence of the political-economic context on the

market structure, and consequently on water pricing, is illustrated in the next section. The argument is that urban water pricing cannot be understood without a political-economic analysis of the historical experience of specific cities.

4. The political economy of water pricing

Political economy *vis-à-vis* the politics of water pricing

It is obvious that water allocation and pricing are political.[210] There are often significant benefits to be gained by certain classes (or specific interest groups within classes) through the development and control of water resources and the accompanying water projects.[211] Furthermore, it is hard to divorce water from its strong cultural and social affinities. Abu-Zeid, President of the World Water Council notes: "The *cultural and socio-economic values of water are still a very elusive subject.* The importance of one or the other will vary from one society to another and from time to time, depending on specific historical background, cultural heritage, extent of fresh water availability and the socio-economic conditions of the concerned region" (Abu-Zeid, 1998, own emphasis).[212]

Classic case-studies used for discussions on the politics of water allocation and pricing include the following:[213] the Middle-East – the allocation of scarce water resources between Israel, Jordan, Lebanon and Palestine;[214] the Nile River basin – the building of the high Aswan Dam; and disputes over water rights between the riparian nations, especially between Egypt, Sudan

[210] The words "rival" and "river" come from the same Latin root "*rivus*"; a rival was a person sharing the same river (Biswas, 1993). Wittfogel (1957) asserted that every society is based on hydropolitics. His thesis that oriental despotism was based on the control of irrigation systems has since been disproved. Nevertheless the broader point he was making, namely the importance of the linkages between state, class and society, and access to water resources, still stands. The history of political conflict over water is very long. See, for example, Hatami and Gleick (1993).

[211] Singh, for example, concludes that "it has been shown that state policies in irrigation over time have been framed to meet the requirements of specific interests. These have ranged from the need for expansion and consolidation of empires, the interests of the upper castes and the landed, the colonial revenue and allied requirements, and in post independence India the needs of the landed, educated elites like the engineers and bureaucrats, the politicians, contractors and industrialists. ... The nature of irrigation development has discriminated against certain social groups, as well as those who have not been able to manoeuvre state policies to their advantage, or lost out in the competition for the pursuit of state power and patronage. ... Localised struggles against large dams, and in pursuit of sustainable and equitable development, have the potential of redrawing the social relations in the Indian countryside" (1997: 239).

[212] Cultural and social values, except to the extent that they translate into individual utility (and by extension, economic demand and willingness to pay), do not carry any weight in neo-classical economics. (See Chapter 3.)

[213] For general overviews, see De Villiers (1999), Elhance (1999), Ohlsson (1995) and Postel (1997).

[214] See, for example, Hillel (1994), Lindholm (1995), Starr and Stoll (1988), Sherman (1999), Lowi (1993), and Allan and Court (1996).

and Ethiopia;[215] the Aral Sea – the "greatest man-caused ecological catastrophe our planet has yet seen" (De Villiers, 1999: 130);[216] the Indian sub-continent: the sharing of the Indus River between India and Pakistan, the sharing of the Ganges River between Nepal, India and Bangladesh and disputes between states in India;[217] south-east Asia: the sharing of the waters from the Mekong River between China, Laos, Thailand, Cambodia and Vietnam;[218] China: the damming of the Yangt'ze River;[219] United-States: groundwater mining in the south-western United States; the sharing of water from the Colorado River; the pricing of water to agriculture and to cities in California; the water disputes between the United States and Mexico; and the export of water from Canada to the United States;[220] and, Chile: water markets.[221]

These studies are mentioned because they all have relevance to urban water pricing.[222] The studies are generally strong on the politics of water supply, but weak with respect to political-economic analysis. Some of the literature emphasises the potential for military conflict over water resources though these writings can be criticised for being alarmist.[223] The political economy studies that do exist, relate to the political economy of large dams, irrigation, rural

[215] See, for example, Waterbury (1979), Hultin (1995) and Collins (1990).

[216] See, for example, Postel (1997).

[217] See, for example, Corell and Swain (1995), Upreti (1993), Salman and Uprety (2000), Wood (1999) and Crow *et al* (1995).

[218] See, for example, Öjendal (1995) and Bakker (1999).

[219] See, for example, De Villiers (1999), Brown (1995), Jackson and Sleigh (2000).

[220] Reisner (1986) leads the genre with a classic account of water politics in the United States; Martin *et al* (1984) provides a case-study of surface and ground water pricing in Tucson, Arizona; Gottlieb (1988) gives an account of the water cartels in California. The Council of Canadians, who have identified the export of water to the United States as a campaign issue, requested a legal opinion from the West Coast Environmental Law Association as to the status of water as a commodity under NAFTA and WTO rules. They concluded that water could be construed as a commodity under NAFTA and WTO trade rules with potentially significant third-party consequences for Canada.

[221] See Bauer (1998), whose analysis shows the following: that the functioning and outcomes of water markets in Chile are heavily influenced by the underlying political-economic structures; that the distributional consequences of water markets have been inequitable, favouring those with access to capital resources and hurting poor peasant farmers; that the benefits of water markets have often been exaggerated seemingly for ideological purposes; that transaction costs are high and externalities are pervasive, requiring extensive mediation in the market. On the basis of his analysis, Bauer cautions against undue faith in markets and argues for "moderation over faith in theory" (1998: 9).

[222] Evidence of the strong and increasing linkages between water use for cities, agriculture and the environment was presented in Chapter 1. See Postel (1999).

[223] For example, in De Villiers' "*Water Wars*" (1999), the title proclaims this potential loudly, but the emphasis may be more of a marketing device on the part of the publisher because the text puts forward a more moderate view. Some assert that views emphasising the potential for conflict (for example, Elhance: 1999) are overly pessimistic. Wolf (1998) states that "the more valuable lesson of international water is as a resource whose characteristics tend to induce co-operation and incite violence only in the exception" and Priscoli, editor of *Water Policy*, writes that "water is far more humanity's learning ground for building community than it is a cause of war" and further that the "history of social organisation around river basins and watersheds is humanity's richest record of our dialogue with nature ... it is among the most fertile areas of learning how the political and technical interact" (Priscoli, 1998).

development and water markets.[224] Studies specifically focussing on the political economy of urban water pricing are rare.[225]

A recent World Bank conference entitled "The political economy of water pricing" was dominated by neo-classical economists and failed to get to grips with the historical power struggles and how these fundamentally influence water pricing practices.[226] In fact, there appears to be a redefinition of the meaning of political economy with the term referring to the "difficulties of designing and implementing 'optimal' pricing reforms", where optimal refers to Pareto-efficiency.[227]

In the following section, the pricing of water in Los Angeles is evaluated with reference to the specific and historical political-economic conditions and processes influencing the development and management of water supply. On the basis of this analysis, and with reference to experiences in other cities, including examples in South Africa and Uganda, conclusions are made with respect to the validity and importance of this type of analysis for a thorough understanding of urban water pricing.

The political economy of water pricing in Los Angeles

Space does not allow a full examination of the political economy of water pricing in Los Angeles. Nor is this necessary, for the purpose of this section is to *illustrate* what such an analysis might look like and the kind of conclusions that can be drawn from such an analysis.

The political-economic analysis commences with the early establishment of Los Angeles as a Spanish community in 1781. Key episodes in the history of the development and management of the water supply system are highlighted and analysed from a political-economic perspective. The influence of this history on contemporary arrangements and practices is demonstrated. Some conclusions, specific to Los Angeles, are drawn.[228].

[224] See Singh (1997), Okwudili (1983), Ribeiro (1994) and Bauer (1998).

[225] See Ostrom (1953) who analyses power relations in the history of water supply development in Los Angeles, Bennett (1995), who examined the politics of protest in Monterey (Mexico), and Watson (1992), who studied the impact that social movements in the *favelas* in Sao Paulo had on water services provision.

[226] See Dinar (2000).

[227] See, for example, Dinar (2000). Professor Michael Nelson, chairing a workshop on political theory and policy analysis, made the following remark: "When you look up political economy in the dictionary it says something like the following: 'economics in the policy making process' ". This is clearly a facile understanding of political economy.

[228] A brief historical overview of some key events in the history of water supply to Los Angeles is given in Eberhard (1999b).

Communal water rights – a decisive early advantage

The Spanish *pueblo* system of communal water rights played a significant role in giving the Los Angeles community a "kick-start". Ostrom comments:

> *In no other phase of modern life has the impact of the Spanish origin of Los Angeles been so great as in the establishment of the general policy of community control of water resources. From the Spanish* pueblo *rights Los Angeles derived* prior claim *to the waters of the Los Angeles River and thus secured a vital advantage in forging ahead to pre-eminence in southern California. The Spanish tradition of communal enterprise provided, in part, the foundation of the later institutional pattern for the administration of water resources. (Ostrom, 1953: 27)*

Los Angeles was the second civil *pueblo* to be organised in the Spanish domain that now constitutes the State of California. Explicit rules were developed for governing water distribution over and above the provisions declaring water to be subject to the common use of the *pobladores* (citizens granted title to the *use* – rather than ownership – of parcels of land in the *pueblo*, with the title being subject to strict obligations). The City of Los Angeles later used these *pueblo* water rights to eliminate competition for the use of water from the Los Angeles River water supply (including underground water). The resulting monopoly of the rights to the basin's water resources enabled the city to prevent competition by other communities and individual farmers and thus to concentrate economic growth (comprising industry, commerce *and* irrigated agriculture) within the city boundary (Ostrom, 1953: 232).

Origins of the powerful Department of Water and Power

Notwithstanding the communal origin of water supply, private enterprise was given a hand in the development of the first piped water supply and distribution system. It can be stated unequivocally that they botched it.[229] The two primary effects of this unhappy episode were an insertion in the City Charter that severely proscribed the possibility of private management in the future and the limitation of direct political interference in the management of the water agency. Kahrl (1982) describes this latter development as follows:

> *Development of the city's [new] system had to wait, however, until a method could be devised to ensure that management of the water supply would be fully protected from political interference of any kind. ... [The previous arrangement had] left the management of the system almost entirely exposed to the changing whims of the electorate [and] was immediately discarded. In its place, the city charter was amended to establish a newly constituted Board of Commissioners which would be almost entirely insulated from political considerations or public pressure.*

[229] The events leading to the transfer of the management of water supply from private enterprise to public management are described in Eberhard (1999b).

> *The charter provisions adopted in January 1903 created a five-member board,* none of whom would ever have to stand for popular election ... *[but were] appointed by the mayor. ... [and whose] control of the finances of the city's water [was] almost autonomous. ... [T]hese essential aspects of the commission's powers have never been eroded. And so its ability to pursue policies of its own making without reference to popular reaction or the concerns of elected officials, has been protected. (Kahrl, 1982: 17f, own emphasis)*

Kahrl may have overstated the case for autonomy because, in practice, approval for all large projects has to be obtained directly from the electorate through the necessary bond elections. Nevertheless, it is true that the Commissioners and the Department of Water and Power came to wield enormous power and influence as evidenced by the fact that it remains the largest and most influential municipal water agency in the United States to this day.

Water and the politics of power: the case of Owens Valley

When, in 1905, water demand exceeded the total supply available, the city was able to secure the necessary funds and general political support to develop a new supply of water from the Owens River to meet its needs. The availability of "excess" water from the expropriation of water in the Owens Valley enabled the city, in turn, "to expand its territorial limits, to reclaim the San Fernando Valley and to inaugurate a new era of urban growth and development" (Ostrom, 1953: 232).

The potential of the Owens Valley to supply water to Los Angeles was discovered in 1890 by Frederick Eaton, a prominent local engineer.[230] Mulholland, the superintendent of the Los Angeles City Water Department, revealed the plan to a delegation of city officials in 1905. The city officials approved the plan enthusiastically and supported the proposal that Fred Eaton make preliminary arrangements to acquire the necessary land and water rights. It is apparent that, right from the start, there was a double agenda: "Eaton, who had plans to convert his vision into a fortune, had already taken steps to acquire water rights on the Owens River. ... Using the subterfuge that he was trying to develop large cattle holdings in the Valley, Eaton purchased and turned over to the city 22 670 acres of land in Owens Valley with all appurtenant water rights" (Ostrom, 1953: 13).

When it came to light that a syndicate linked to the Owens Valley project had purchased large tracts of land in the San Fernando Valley and made a profit of one thousand per cent, Harriman, a socialist candidate in the municipal elections in 1907, made the "water plot" one of the central issues of his campaign, with the following allegation:

[230] Eaton had, on previous non-concurrent occasions, served as superintendent of the Los Angeles Water Company, the city engineer of Los Angeles and major of Los Angeles (Ostrom, 1953: 11).

> *Big business, realising the wonderful possibilities of profit to be made in exploiting land and water in the vicinity of Los Angeles, conceives a gigantic plan and starts to carry it out with official aid. This plan involved the gobbling up of all available lands in and near the San Fernando Valley (about 100 000 acres); the securing of the Owens River water to irrigate these lands, by first creating a fake water famine and frightening people into building an aqueduct, ostensibly to increase the city's water supply, but in reality to irrigate these lands thereby putting about $50 million profit into the corporation's pockets, while the city gets none of the aqueduct water. Brand, agent for the interests, secured options on large holdings in San Fernando Valley; Eaton goes to Owens Valley and buys the water rights; and Mulholland prepares the minds of the people with his reports of a "water shortage" when there is abundance. (Ostrom, 1953: 56)*

These allegations gave rise to a rushed investigation whose findings were inconclusive and ambiguous: "had this board had the necessary time to develop all facts along lines suggested by individuals, a knowledge of human nature indicates that men would have been found who had succumbed to temptation" (Ostrom, 1953: 58). The investigation itself was fraught with intrigue related to such fundamental issues as the composition of the board (Hoffman, 1981). City residents were divided over the findings of the commission though only a minority continued actively to oppose the water bureau.

The actions of the bureau in the Owens Valley caused significant hardship, suspicion and mistrust amongst residents of the Valley. This commenced with Eaton's subterfuge pertaining to the initial land purchases in the Valley and was intensified in 1923 during a drought when the bureau purchased more land and water rights in the Valley:

> *Beginning in 1923, the water bureau plunged into the bitterest struggle in its history. ...*
>
> *Owen Valley interests organised into pools to secure the greatest bargaining advantages and demanded that the city buy on their terms. The city bought whatever rights it could until it had exhausted the water bearing lands not committed to the pools demanding excessive prices. The stalemate in bargaining was accompanied by a deluge of protest against the department's purchasing methods and relations with the people of Owens Valley [deteriorated]. Valley leaders came to the city to protest to civic groups and public officials. Demands that the city buy all of the ranches grew to include demands for the purchase of all the town properties as well, and to pay reparations for intangible damages done to the prosperity of business enterprise and to the economic livelihood of the town residents and agricultural labourers. (Ostrom, 1953: 62)*

Mulholland, the head of the Water Bureau, refused to entertain these demands, believing the Owens Valley leaders lacked integrity and moral responsibility. In the face of this intransigence, the campaign became violent. The diversion works were commandeered and

the aqueduct and some city wells were dynamited.[231] Although the Los Angeles Record as a result of these disturbances vilified Mulholland, the overall influence of this campaign on municipal politics was fairly small. The appropriation of water rights from the residents of Owens Valley nevertheless had broader and longer-term consequences.

The portents of a power struggle over water in the western part of the USA were already seen in 1879.[232] However, what was not foreseen was the strength of the urban areas to compete for this water and to be able to expropriate this water as a result of the dynamic accumulation of wealth.

The appropriation of the Owens River water was only a (small) part of a much more significant and fundamental process occurring in Los Angeles, namely, the dynamic accumulation of capital. The continued accumulation of wealth was threatened by the lack of water. The prior accumulation of capital by the city arising from the *pueblo* enabled the city to expropriate the water from the Owens Valley. The windfall gains made by key actors in the process are part of the same process of capital accumulation.[233] Even though from a (static) resource allocation efficiency point of view it would have been more efficient to use the Owens Valley water to irrigate land in the Owens Valley rather than transport that same water at great cost to irrigate land in the San Fernando Valley, the capital accumulation that had already occurred in Los Angeles facilitated the further transfer of resources from peripheral areas to the centre. The fundamental driving force of the whole process was capital accumulation; resource "efficiency" issues were peripheral to this process.

It is probably true that long-run marginal-cost pricing would have delayed the implementation the of the Owens Valley scheme (though not necessarily true that this would have resulted in greater overall resource allocation efficiency).[234] It is almost certainly true that if marginal-cost pricing had been implemented, irrigation in the San Fernando Valley would not have been economic with the consequence that the Owens Valley water would have been much more expensive than otherwise. This undoubtedly would also have hindered the development

[231] The commandeering of the works enabled water to be diverted from the aqueduct and to flow down to Lake Owen. In addition to the damage caused by withholding water from Los Angeles, the act was of symbolic importance because the building of the aqueduct had caused Lake Owen to dry up.

[232] "Lands have no value without water. If the water rights fall into the hands of irrigating companies and the lands into individual farmers, the farmers will then be dependent on the stock companies, and eventually the monopoly of water rights will be an intolerable burden on the people" (Powell, 1879, "Reports on the arid regions of the United States" in Ostrom, 1953: 229).

[233] Just as the City was in a privileged position to gain from the appropriation of the Owens Valley water (it could both afford it and was in a strong negotiating position) so were the key actors. Eaton had the right connections and experience to be able to obtain prior knowledge of the scheme *and* access to capital to be able to purchase land before the impending price increases arising from greater demand.

[234] See Chapter 3.

of industry. Both effects (inhibited agricultural development and reduced industrial development) would have retarded the dynamic accumulation of capital in Los Angeles.[235] Of course, it is not possible to spell out what the growth path of Los Angeles would have been were the Owens project to have been significantly delayed. Other centres on the west coast, in particular San Diego and San Francisco, were competing for the scarce capital resources necessary for development. Their development lagged behind Los Angeles which remains to this day the most important economic centre on the west coast.

The political economy of current day water pricing in Los Angeles

The pattern of current day water pricing in Los Angeles reflects, to some extent at least, past experiences. Los Angeles' Department of Water and Power and the Metropolitan Water Board still have enormous power and influence, a legacy of decisions made early in the twentieth century. Although the tariff structure has changed over time, some of its characteristics appear to be relics of the past and the city is clearly resistant to moves towards marginal-cost pricing, or pricing approaches which support the "sustainable development" orientation of environmental economists, such as conservation pricing and water markets.[236]

Recent events, as reported by the *Wall Street Journal*, portend a replay of the Owens Valley saga early this century and further confirmation of the predictions made by Powell in 1879 (quoted above):

> *A few years ago, the Basses, with a $7 billion empire in oil and real estate, raised a few eyebrows when they began quietly buying up $80 million in irrigated farm land in the sprawling Imperial Valley south and east of [Los Angeles]. They were going to raise cattle. But it became clear, soon enough, that the Basses' real interest was in the perpetual federal water rights conferred with the 40,000 acres they acquired. Seen as a long-term arbitrage play, the strategy goes something like this: Eventually, water supplies for this area of vast urban sprawl and water-hogging agriculture [that is, southern California] will grow tight; those with the water, and the right to sell any surplus, stand to make megabucks.* (Wall Street Journal, *1997)*

The Metropolitan Water District, in an interesting role reversal, accuses the Bass of being "profiteers trying to create a 'water cartel' in hopes of making a huge fortune on a resource delivered to them essentially for free" (*Wall Street Journal*, 1997). On the other hand, the billionaire Bass brothers are saying that the Metropolitan Water District, one of the world's biggest utilities, is "a monopolist" and a "water thief" (*Wall Street Journal*, 1997).

[235] The growth of Los Angeles was significantly boosted by industrial development during the 1920s and 1930s fuelled by oil and the "explosion" of the car industry. See, for example, Marchand (1986).

[236] Present day pricing structures are described in Eberhard (1999b).

Wodraska, the general manager of the MWD, warned: "This is going to get nasty" (*Wall Street Journal*, 1997).[237]

This brief account illustrates the enormous potential for power-play and arbitrage in the area of water rights and the fact that the economics of water markets cannot be examined outside of an analysis of the political economy of who has acquired access to water rights and how this will influence possible and likely outcomes.

Implications of political economy analysis for pricing methodology

The principle points emanating from this case study of water pricing in Los Angeles are summarised below:

Political economy and Owens Valley. The expansion of Los Angeles into a world-class metropolis was, to a significant extent, based on the abundant availability of cheap water. This water was obtained by the construction of a massive water project (by the standards of the day) and the expropriation of water rights from the Owens Valley early this century. The implementation of Average Incremental Cost (AIC) pricing would have made this water prohibitively expensive, particularly in the crucial early period. The prior accumulation of wealth in Los Angeles (arising from a combination of fortuitous factors including its initial endowment of good local water resources) enabled the well-connected City bureaucrats to out-compete and politically out-manoeuvre rural residents in the Owens Valley. The effect was to concentrate wealth which had serious equity consequences. Belated political legislative intervention has sought to ameliorate the negative equity consequences and ensure that such events are not repeated. However, the advantages of the Owens Valley water supply to Los Angeles continue today largely unabated.[238]

Political economy and Imperial Valley. The Owens Valley saga has a potential latter day counterpart. The increasing disjuncture between the cost of developing new urban water supplies and the low price of agricultural water in California (which is heavily subsidised) in the context of privatised water rights creates conditions for arbitrage and windfall profits with

[237] De Villiers reports that "the deal floundered when [the Basses] discovered that the [irrigation] authority owned the water rights, not the farmers" (1999: 274). The irrigation authority decided to play the game itself and the Bass brothers sold the land and bought interests in United States Filter Corporation, the world's largest water treatment company (Postel, 1999: 111).

[238] Water in Los Angeles is much cheaper compared to San Diego and other large coastal cities in southern California. As a result of Los Angeles' exclusive access to Owens Valley water resource (the capital cost of which is now fully paid for), the city is much less reliant on more expensive alternatives available through the Metropolitan Water Board.

negative equity consequences. The actions of the Bass brothers in the Imperial Valley lend weight to such a contention.[239]

Marginal-cost pricing. Throughout the history of water supply development in Los Angeles there has been a general and strong (largely political) resistance to marginal-cost pricing. Greater water scarcity and ever increasing marginal costs of supply augmentation have forced water utilities, in some instances, to implement selective forms of marginal-cost pricing in recent years. These new structures place higher prices on peak summer usage, require new developments to pay the full incremental costs of water supply augmentation necessary to support the new development, and penalise "excessive" domestic use by charging the marginal cost of supply through a two-tier pricing system. However, the MWD backed away from its implementation of the new development charge and defended its basic premise of historic average cost pricing as follows:

> *Economists argue that setting the price of a product equal to its long-run marginal cost will lead to efficient allocation of resources. Unfortunately, there are a number of issues associated with such pricing methodologies in the water industry. First, calculation and estimation of long-run marginal cost is inexact. Second, as a wholesaler facing significant hydrologic variances that alter available supply and short-run cost, setting the price at the long-run marginal cost can result in two unintended consequences – excess supplies and excess revenues. Both of these consequences can be moderated through scaling and other rate designs, but these adjustments lead to changes in the price signal. At Metropolitan, we utilise traditional embedded cost rate making standards to set our basic rate which produces 65-70% of our revenues and use short-run marginal cost methods to set our seasonal rates. (Thomas, personal communication, 1998)*

It is clear from this that both the interpretation and implementation of marginal-cost pricing is influenced by the political-economic context.[240]

Equity and retail tariffs. Although efforts have been made by Los Angeles to implement a retail tariff structure that protects low-income households from high water bills, this reform could not implemented without introducing significant concessions for the middle class which was able to exert a degree of pressure and influence on the pricing system that is disproportionate to its numbers.[241]

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[239] Of course, the extensive subsidisation of wealthy irrigation farmers in the Central Valley, for example, can also be explained with reference to a political-economic analysis. See, for example, Reisner (1986).

[240] Resistance on the part of property developers to the new development charges was significant (Wodraska, 1998: personal communication). Property developers have also successfully influenced pricing reforms in Tucson, Arizona. See Martin *et al* (1984).

[241] See the detailed account given in Eberhard (1999b).

Equity and water rights. The privatisation of water rights and the marketability of these rights, whilst potentially increasing total "value added" per unit of water use (by reallocating use from less productive to more productive uses) carries with it the significant risk of increasing inequality. The experience of Owens Valley is testimony to this. This risk still exists today as is evidenced by the possible arbitrage play by the wealthy and powerful Bass brothers. The nature of these risks and the likelihood of their materialising are dependent on the political-economic context.

Resource sustainability. Historically, pricing has not been effective in ensuring resource sustainability in Los Angeles and California. Although recent changes to pricing structures and levels are likely to dampen demand, it is nevertheless unlikely that this, on its own, will ensure resource sustainability. Continued reliance on political and legislative intervention will be necessary which again underpins the importance of the political-economic context within which such legislative and political interventions take place.

A further conclusion to be drawn from this review and analysis of the political economy of water pricing is that, in practice, actual pricing structures and levels are always more likely to reflect the political-economic context than obey neo-classical pricing rules.

Why political economy matters – some further illustrations

The influence of the political economy on water development and pricing is not unique to Los Angeles. Reference can be made to a number of other cities where studies show the importance of a political-economic analysis.[242] Detailed conclusions pertaining to the influence of political economy on the market structure, pricing practices and outcomes will necessarily be specific to each city examined. Nevertheless, it is possible to make a number of points that have broader applicability.

The discussion proceeds with the following key questions in mind: What institutional patterns exist in the urban water sector? Through what processes have these institutional structures come into being? What consequences have these processes had for the distribution of outcomes?

Los Angeles and Tucson: examples of local government democratic pricing

Urban water pricing decisions are largely decentralised to the local (city) level in the United States. (This is also a common practice in most developed and some developing countries.) In Tucson and Los Angeles, locally elected politicians make policies and final decisions on

[242] See Eberhard (1999ab).

tariffs. The state or federal government imposes some outside constraints. For example, cities in California are required to prepare five-yearly urban water management plans, cities in Arizona are required to demonstrate sustainable water resource planning and use, and all cities in the United States must comply with various federal water quality and environmental provisions.

The power of citizens to influence water pricing is demonstrated in the cases of Los Angeles and Tucson. Powerful minority constituencies in each city have influenced tariff reform. The influence of business interests in general, and property developers in particular, on the tariff structure is readily apparent. Business tariffs have been consistently lower than domestic tariffs in these two cities historically although the gap has narrowed more recently. Low-income residents are catered for through the provision of a small free allocation of water in Tucson (though a fixed monthly connection fee is payable) and a direct monthly credit in Los Angeles. Median usage in Los Angeles is 40 kl/month and, considering the overall level of wealth, the credit of $5 that is equivalent to 8 kl per month is not generous but can nevertheless enable a household to get by without compromising health.[243] The price of water for "reasonable use" (variously defined in each city) has been kept at or below the historic cost figures.[244] The tariff reforms appear not to have disadvantaged low-income families and have, overall, shifted costs to larger consumers of water despite the resistance on the part of larger consumers.

The experiences of Tucson and Los Angeles show that within a context of decentralised local level water management in which pricing decisions are made by locally elected political representatives, with increasing pressure being placed on the water resource, and in the context of a developed economy with universal access to in-house metered water, it is politically feasible to implement a full cost recovery (revenue neutral) progressive rising block pricing with high marginal tariffs which have the dual benefit of increasing incentives to use water prudently and catering for affordability constraints (through life-line tariffs for low levels of consumption or direct credits).

Botswana: a public water utility model

In Botswana, the public water utility was established with the dual mandate of universal access and financial autonomy (with the exception of government payment for provision of standpipe water to unserved areas). Beyond the broad mandate (derived politically through the

[243] An innovation in Los Angeles is the extension of the water credit to households living in apartments (who typically do not have individual meters and who were previously excluded from the benefit) by adding it as a credit on the electricity bill.

[244] In Los Angeles, the definition of "reasonable use" is particularly complex and arguably weighted in favour of owners of larger properties (ergo wealthier households).

democratically elected parliament), utility management is essentially depoliticised. The water utility has managerial autonomy, being accountable to the defined mandate and not directly to political representatives. The utility has operated on a commercial basis and has implemented tariffs that aim to meet three objectives: full recovery of costs, affordability for basic requirements (life-line tariffs) and wastage reduction through providing incentives to conserve water (high marginal tariffs for higher consumption levels). The implementation of the last objective has not been popular, particularly amongst businesses, and consequently is under threat of revision (the tariff structure is applied equally to domestic and non-domestic uses). The effective and financially viable agency appears to have been able to implement tariffs that benefit most consumers (basic use is subsidised, reasonable use is moderately priced, services are reliable and service coverage is high in urban areas).

The Botswana water utility appears to have been able to avoid middle-class subsidy capture.[245] The effectiveness of the utility is somewhat of an exception when compared to many public water utilities in developing countries.[246] This may be attributed to various factors: the relative economic strength of the country, especially the fiscal strength of all state institutions because of diamond revenues, a particular experience of colonialism, the country's geo-political location close to a very much more developed economy, and a strong public service ethic within the civil service.[247] However, a full understanding of the factors contributing to the success of the Botswana water utility would require a more detailed political-economic analysis.

Jakarta: historical legacies and political patronage

Jakarta is a city of contrasts, with a small central beautiful area originally developed during the Dutch colonial area which absorbs a disproportionate share of public expenditure and a large periphery consisting largely of slums with a severe lack of basic infrastructure. This pattern of development is a legacy of Dutch colonisation when expenditure in (then) Batavia was focused in the areas where the European colonisers lived:

[245] The World Bank asserts that "price subsidies to infrastructure almost always benefit the rich disproportionately. In developing countries, the poor rely on private vendors or public standpipes rather than private connections for water supply and they are infrequently served by sewerage systems" (World Bank, 1994: 81). See Stigler (1970).

[246] Public utilities in developing countries are often characterised by the absence of clear mandates, political interference in the day-to-day management of the utility, poor performance and dependence on government for subsidies. See, for example, World Bank (1994). This is also the case in Uganda (field visit, Uganda, 1999).

[247] Botswana is one of just a handful of "upper middle-income" economies in Africa (World Bank, 1999).

> *Every budget was weighted in favour of European interests in the city. Most of the biggest items, such as road building and maintenance, street-lighting, drinking water provision, and payment of municipal personnel were items of expenditure largely on behalf of Europeans, since they were the ones who lived along and used roads most; street-lighting and drinking water were largely restricted to these areas. (Abeyasekere, 1987)*

Indonesian independence did not significantly shift this original bias. President Sukarno's desire to create national symbols appears to have been a greater priority than improving basic infrastructure:

> *Man does not live by bread alone. Although Jakarta's alleys are muddy and we lack roads, I have erected a brick and glass apartment building, a clover-leaf bridge, and our superhighway. I consider money for material symbols well spent. I must make Indonesians proud of themselves. They have cringed too long. (Sukarno, quoted in Porter, 1996).*

Furthermore, the independent government wished to slow the growth of large cities, making this a policy priority during its first 15 years in power and banning migration into the city. The government feared that investment in urban areas would exacerbate in-migration and hence deliberately allowed conditions in the city to deteriorate (Porter, 1996). Although a "village improvement programme" was initiated in 1969, the focus was on roads and not on basic water supply and sanitation (Abeyasekere, 1987). Efforts to stem the growth of Jakarta were futile.[248]

The water supply infrastructure was not expanded adequately to cope with rapid population growth. Porter quotes the following account of typical conditions in those parts of the city without infrastructure (the greater proportion of the city):

> *The disposal of human waste created problems. The community built toilets put over the Cideng River. They were at least tolerably efficient when the river flowed but they were a disaster in the dry season or when the river was in flood. The river had long been too polluted to drink. [W]ells were dug but their water became too contaminated for consumption. It could still be used for washing though one had to queue for quite some time to obtain a supply. Drinking water became a precious and expensive commodity. It was distributed by traders who carted it in metal containers suspended from a pole slung over their shoulder. ... [Poor families in central Jakarta] spend up to 5% of their incomes to buy a meagre eight litres of water per person per day, a minuscule amount. (Jellinek, 1985 in Porter, 1996)*

Water services in Jakarta have historically been funded by the central government. The water utility has been under-resourced (only 20 percent of households have access to potable piped water sources) and the system has been subject to patronage and corruption. Evidence of nepotism was apparent during the privatisation of water services in Jakarta in 1998 when

[248] The population quadrupled from 1.8 million to 6.5 million people in the period 1950 to 1980 and was estimated to be 8.3 million in 1990.

concessions were granted to Thames Water and Lyonnaise des Eaux.[249] It is clear that the outcomes of the privatisation process are contingent on the political-economic context which also provides the conditions in which corruption and nepotism can take place. A more detailed investigation of the processes leading up to privatisation (beyond the scope of this thesis) would yield a much richer set of information that would be able to explain how these processes came about and the distribution of the outcomes.

Shifting costs onto new development: Tucson and Los Angeles

Both Tucson and Los Angeles made efforts to shift the cost of developing new water supplies onto new property developments that were the proximate cause of new (incremental) water demand. These pressures were resisted by developers and, in the case of Tucson and the Metropolitan Water District of Southern California, the policies were rescinded. The apparent "consensus" around the principle that those responsible for the increase in consumption should bear the cost of system expansion collapsed when the effects of the implementation of the consensus was felt. The debate around the responsibility for system expansion costs raises important equity issues. These issues are all the more acute in the context of a developing country where the wealthy already have a water supply and a relatively stable demand and where the bulk of system expansion is often needed to extend the system to cater for lower-income households.[250]

The political economy of price reform: Tucson and Los Angeles

An analysis of how tariff structures have changed over time in Tucson and Los Angeles is instructive as both are "rich" cities situated in what have become water resource poor areas. Both cities originally implemented standard two-part tariffs (fixed monthly fee and constant volumetric tariffs). Both subsequently changed their tariff structures to decreasing block tariffs favouring large water consumers.[251] Plentiful water resources were available to both cities at this time.[252] The primary motivation for this change was the desire to attract and keep large water users (industries) and to promote economic growth.

[249] For example, PT Garuda Dipta Swasta, which has a joint venture with Lyonnaise des Eaux of France to provide water to the western half of Jakarta, is part-owned by Liem Sioe Liong who is a long-time friend of then President Suharto. PT Kekar-Thames Airindo, which has a joint venture with Thames Water International to provide water to the eastern half of Jakarta, is part-owned by Suharto's eldest son, Sigit Harjojudanto (*Jakarta Post*, 6 February 1998).

[250] Such is the case in Jakarta as noted above. It is also typically in the case in cities in many developing countries including South Africa and Uganda.

[251] Tucson changed its tariff to this form in 1964, Los Angeles much earlier.

[252] A large groundwater aquifer in the case of Tucson and the supplementary water from the Colorado River Aqueduct in the case of Los Angeles.

Los Angeles changed its tariff to a standard two-part tariff in 1977 in response to a significant drought; however, prices for industrial water were still lower than domestic water. Tucson changed from a declining to a mildly inclining two-block structure in 1974 and to a much steeper inclining block tariff in 1976 (the "water furore").[253] This "radical change" arose primarily from a financial crisis stemming from poor planning and fast urban growth rather than a shortage of water *per se*. Since then this tariff structure has essentially been retained and become even steeper over time, though commercial industrial prices continued to be lower than domestic prices (with a surcharge on peak seasonal consumption rather than absolute consumption). Water tariffs in Los Angeles were fundamentally restructured in 1993 with the implementation of a rising two-block tariff, with the second tier explicitly set at the marginal cost of supply. (Industrial and commercial water prices were conceptualised in a similar fashion to those of Tucson, that is, a surcharge on peak summer consumption related to average winter consumption.) The "radical" change in pricing structure in Los Angeles was precipitated by the 1987-1992 droughts, with water restrictions being implemented in the latter part of the drought. In both cities, even though tariffs were structured so as to mute the effect on low-income and water-wise domestic consumers, the increased bills among large domestic consumers caused such extensive political reactions that tariff structures were revised in both cities to accommodate the disaffected wealthy minority constituencies.

Equity effects

A striking feature of the pricing experiences studied is the general absence of a rigorous equity analysis, the Los Angeles tariff reform of 1992 being the exception. When Los Angeles restructured its tariffs in 1992, considerable attention was paid to the effects on equity. The tariff restructuring resulted in consumer tariffs being reduced for 70 percent of domestic

[253] The pricing system followed the conventional approach of cost recovery using a two part tariff (which included a discount on the unit cost of water for monthly consumption greater than 100 kl/month) until 1974. A mildly increasing block tariff was introduced in 1974. However, the combination of peak capacity constraints and revenue shortfalls prompted the Water Department to revise its rate structures. The proposed changes (initiated by the civil engineering consultants traditionally used by the water department during a periodic rate review) coincided with a change in political representation in Council. The "New Democrats" had been elected on a generally pro-conservation, pro-"green" and anti-"urban sprawl" agenda and had gained control of the council. The new Council supported the proposed changes that sought to reallocate costs towards consumers responsible for the costs and to dampen peak summer demand through seasonal and rising block pricing. The new tariffs caused a furore in the summer of 1976 and led to the recall of the New Democrat councillors. However, the story is more complicated than the water issue alone because the New Democrats were perceived by the business community to be anti-growth and by implication anti-business. There appears to be some truth in the assertion that the water issue was used (or manipulated) by the business community as a means of removing the New Democrats from office. Support for this view point stems from the fact that once the New Democrats were removed from office the business community (as represented by the Chamber of Commerce) wholeheartedly supported essentially the same tariff structure that the New Democrats had passed. (As an important aside, this point illustrates the fact that the real political motivations for certain actions may not be what they are represented to be.) The principles of the new tariff system have remained essentially intact since 1976. The difficulties caused by the "radical" change of the pricing

consumers with costs shifted onto larger (wealthier) consumers (City of Los Angeles, 1992). However, the negative outcome for a small minority of relatively wealthy residents in the San Fernando Valley resulted in further adjustments to the tariff, reducing consumer bills for larger consumers. This was considered to be (or marketed as) an improvement in equity by the Citizen Committee that oversaw the tariff review. However, this committee was weighted in favour of the San Fernando residents. Using an alternative frame of reference, the equity improvement is questionable.

The role of water services and water pricing in capital formation

The study of water development in Los Angeles in the early part of this century suggests that water played a key part in the development of Los Angeles as a major industrial and economic centre in the United States. The analysis also shows that if marginal-cost pricing had been implemented, prohibitive prices could have been an important stumbling block during the early capital accumulation process. Key industries (including agriculture) benefited (and continue to benefit) from cheap water.

It can be argued that water also played a part in the development of New York as a world-class financial centre. Chase Manhattan Bank has its origins in the private Manhattan Water Company. The subterfuge around the creation of this company, with its monopoly of the water supply and freedom to pursue business interests of its choice, facilitated the growth of the Manhattan Bank and gave it an early advantage over its rivals.[254] This theme is taken up in the concluding chapter.

Understanding the privatisation – nationalisation – privatisation cycle

Private enterprise dominated the provision of water services in the late nineteenth century. In most countries this gave way to the dominance of public sector provision of services from the early twentieth century onwards. More recently, private sector involvement in the management of water services is increasing.

The World Bank (1999) provides the following explanation: Early experiences with private sector investment and management of water services proved unsatisfactory because of inadequate regulation. Regulation issues were poorly understood and there were disagreements about how the benefits of the public fire-fighting service should be paid for. Disputes between the government and private companies were lengthy and costly and resulted in most systems being taken over by governments. Governments are inherently inefficient providers and have systematically under-priced and under-resourced water services. In Europe, increasing

system (which was by all accounts not so radical) resulted in an explicit policy of small incremental change (rather than significant change) in water policy and tariffs which remains to this day.

[254] The story is well told in Koeppel (2000).

political pressures to meet more stringent environmental standards, linked with the capping of public expenditures,[255] have increased the pressures on public water services providers who are turning in greater numbers to the private sector to seek private investment. In developing countries, public service provision has been particularly inefficient, governments are short of capital for investment, and therefore governments are turning to the private sector "to be their saviours", to increase efficiencies and to provide private capital for investment. Private sector involvement is much more likely to be "successful" (that is, to be "efficient") now than in the past because the regulatory issues involved are much better understood.

This analysis can be criticised on a number of accounts: It fails to look at these developments in the light of capital formation, the key driving force of capitalism; it fails to examine the consequences of privatisation in terms of the distribution of outcomes; it fails to recognise the positive externalities attached to the provision of piped water and wastewater services, arguably a much more important motivation for the public provision of services;[256] and it is contradictory in its argument that governments will be able to effectively and efficiently regulate private enterprise (in the presence of sunk costs, asymmetric information and other constraints) yet are unable to manage water services effectively themselves.

Privatisation as ideology

The advocacy of privatisation by agencies such as the World Bank could be understood from an ideological perspective. For example, it could be argued that the underlying motivation for privatisation is that it allows private capital greater access to the potentially lucrative monopoly water market.[257] World Bank policy is itself a product of political economy and it can be noted that the governance of the World Bank is dominated by the advanced western capitalist economies.

The conditions which have enabled private firms much greater (and rapid) access to this market in recent years can only be explained adequately with reference to the broader political-economic framework. This point is taken up in the concluding chapter. For now, the Postel's caution is apt: "there is ample reason for heightened vigilance [because] given the pace at which privatisation is occurring, it seems unlikely that adequate rules and regulations

[255] This is tied to the monetary targets related to the common currency.

[256] Private companies failed miserably to provide safe water supplies to the broader urban population. See, for example, Blake (1956) and Koeppel (2000).

[257] It is interesting to note that the privatisation of wastewater services is seldom advocated. It is unlikely to be coincidental that the prospects for profits in this business are much less than is the case for water supply.

are in place in many cases to protect the resource base, ecosystems and the poor" (Postel, 1997, xxix).[258]

Institutional memory: the case against privatisation in Los Angeles

The early experience of privatisation in the case of Los Angeles has created an institutional memory embodied in the City Charter which renders the future privatisation of the service highly improbable.[259]

Privatisation outcomes

What effect will privatisation (through long-term concessions) have on the distribution of decision-making and benefits? The exact (short-term) distribution will depend on the specific concession contract. In most cases, the contract gives the private company a clear mandate and responsibility. The price for the (near-term) future is fixed and guidelines for setting prices in the longer-term are set out in the contract. Future uncertainty makes price fixing beyond the near-term impossible. However, this flexibility in turn provides the private company with the potential to influence future prices and arrangements to its own benefit. Thus the key danger of privatisation is not the near-term results (which are likely to be positive in most cases) but the longer-term outcomes. How the longer-term works out depends very much on the power relationships between the contracting parties (determining the likelihood of effective enforcement of regulations). It may be argued that there will be a tendency for the distribution of the power in key respects to shift to the company over time (through regulatory capture) and that, likewise, this will lead to shift in the distribution of the benefits.[260] If this argument is correct, then the ultimate consequences of this are likely to be the concentration of power, capital and benefits and an increase in inequality.

Responses to significant price increases

The restructuring of tariffs in Tucson and Los Angeles, that had the effect of significantly increasing water bills, generated significant consumer opposition, even in the context of relative consumer affluence. In the case of Tucson it resulted in a shift to an explicit policy of incremental change. In Los Angeles the tariffs were revised to accommodate the disaffected

[258] Postel cites the recent privatisations in Buenos Aires, Dakar (Senegal), Casablanca, Mexico City, Malaysia and Adelaide (Australia) and notes that some 30 to 40 more are in progress. She further notes that many of these contracts are being awarded to a handful of giant French and British water companies creating a concentration of power and control inimical to the interests of the poor. Just two French companies supply water to over 100 million people (Postel, 1997: xxx).

[259] Stated intentions by Republican politicians to privatise water services in Los Angeles have never materialised (Wodraska, personal communication, 1998). This is probably largely the result of the constitutional provision which requires that privatisation be put before the electorate and be supported by a two-thirds majority.

[260] Foreman-Peck and Millward note that "the US experience of regulatory capture and/or over-investment is clear" (1994: 201).

wealthy consumers who represented a powerful interest group. These two experiences provide salutary (though slightly different) lessons for advocates of radical tariff reform.

Resistance on the part of consumers to large tariff increases is an understandable and natural phenomenon. However, the likely consequences of this resistance to tariff reform ought to be understood by the tariff reformer. Failure to do this may undermine the objectives of the original reform. In Tucson the tariff reform was used as a pretext for certain interest groups to achieve essentially unrelated political ends. However, the process generated a lack of trust between citizens and elected representatives that were to have longer-term implications.

In both Tucson and Los Angeles the negative response of wealthy consumers to tariff increases was underestimated. In both cases, the tariff reform had shifted costs significantly to larger wealthier consumers. In both instances, wealthy consumers succeeded in having the primary negative effect of the tariff (increased bills) ameliorated. If tariff reform advocates are serious about shifting costs onto larger consumers, it will be necessary for them to plan and develop strategies to counter the reactive but politically significant responses of the minority of large consumers who are adversely affected by the changes.

5. Implications for a critical-realist pricing methodology

In light of the preceding discussion, it is possible to put forward the following "stylised facts" concerning the political economy of water pricing.

History matters in at least three respects. The original allocation of property rights and the distribution of resources matters. Current outcomes are a function of these past allocations, that is, there is path dependence. Current institutional forms are influenced by past forms, that is, there is institutional memory (or to put it more strongly, institutional sclerosis). These points have been demonstrated in the preceding section.

The initial and early appropriation of resources has a major influence on future outcomes, often bestowing decisive advantages on the individuals and organisations able to secure the initial property rights and to exploit these for their own benefit. Put another way, the initial playing field was highly unequal. The origins of Chase Manhattan Bank and the growth of Los Angeles into an major national economic centre are prominent examples. The specificities of the political economy of water played an important role in each instance.

The initial unequal distribution of resources and wealth is perpetuated within the capitalist system through informational and capability asymmetries. For example, wealthy people in strategic positions and with access to privileged information were able to secure windfall

profits in both Los Angeles and New York. Imperfect markets, in particular the absence of price-taking on the part of producers and the presence of informational asymmetries, are prevalent in capitalist economies. Numerous examples of these within the urban water sector have been provided. Within such a system, poor households historically have "lost out" with severe social consequences. Early private capitalist ventures in water supply development were notorious for paying scant attention to the needs of poorer communities. [261]

Social crises have provided the impetus for the reform of urban water supply within capitalist economies, initially through regulation and then later predominantly through direct public management. The extension of the political franchise and the consequent increase in the voice of affected communities through both the national and local democratic systems played an important role in extending and improving water service provision to poorer communities.[262]

The law and legal processes historically have been subject to disproportionate influence by the wealthy. Examples of this include the commission of inquiry into the Owens Valley saga, the formation of Chase Manhattan Bank and the rescinding of development charges in Tucson. Gross inequalities in power and wealth, together with monopoly markets and informational asymmetries, provide opportunities for rent seeking and arbitrage plays. The Bass brothers foray into water in Californian is an example of this.

The development of urban water supplies within capitalist economies is part of a broader capital accumulation process, taking place at the local, national and international levels. The distributional outcomes of this capital accumulation process are particularly significant within the water sector because of its importance for health and environmental sustainability.

The polity is crucial as this will determine the "social contract" between government, capitalist interests and society, and determine the distributional and environmental outcomes.[263] Social movements can influence resource allocation and can improve access to

[261] In many instances, the outbreak of Cholera epidemics in urban cities can be attributed to the failure of private water companies to provide services to poor communities. See Foreman-Peck and Millward (1994: 42) and Koeppel (2000).

[262] See Foreman-Peck and Millward (1994) and Koeppel (2000).

[263] See Hirst (1997) in Hollingsworth and Boyer (1997).

resources among poor communities,[264] but this influence is constrained by international political-economic considerations and the role of multilateral and bilateral development and finance agencies.

[264] See Bennett (1995) and Watson (1992).

Chapter 5: Water thirst

Taking justice and inequality seriously

> *All human beings have an inherent right to have access to water in quantities and of a quality necessary to meet their basic needs. This right shall be protected in law. (Gleick, 1998: 501)*[265]

> *Households with half the mean income will spend twice the average percentage [of household income] on water, while those with twice the median income will pay half. Indeed it is expensive to be poor in Khartoum. Among the poorest households, the only major item of expenditure available for sacrifice is their food budget. It is therefore probable that the high cost of water in the squatter area is a major contributor to the high rates of malnutrition which prevail there. (Cairncross and Kinnear, 1992: 188)*

> *Economics has a thousand ways to talk about efficiency and none to talk about equity. (Robert Solow, 1986)*[266]

1. Introduction

The fundamental theorems of welfare economics can be summed up succinctly as follows: "every competitive equilibrium is a Pareto-optimum; and every Pareto-optimum is a competitive equilibrium" (Dorfman *et al*, 1958). It is remarkable that the issue of equality is completely absent from this theorem even though it provides the justification for neo-classical pricing theory. Amartya Sen has pointed that a Pareto-optimum situation could be completely disastrous from a social point of view (Sen, 1985: 10).

The consideration of equality lies at the heart of moral philosophy. Equality can be considered in many different spaces, for example, utility, liberty, capabilities, opportunities, wealth and outcomes. The choice of space is contested and no agreement exists within moral philosophy as to which space should enjoy priority. Utilitarianism prioritises the space of individual utilities, John Rawls' "justice as fairness" prioritises liberty and the equal holding of primary goods and Sen prioritises the equality of capabilities. The implications of these three approaches for water pricing are explored in this chapter. The moral philosophy of utilitarianism underpins the neo-classical approach to pricing where equality of utility (preferences) is prioritised. The approaches put forward by Rawls and Sen support, as a

[265] Gleick (1998: 491) asserts that this right is implicit in the Universal Declaration of Human Rights which states: "Everyone has a right to a standard of living adequate for the health and well being of himself and of his family, including food, clothing, housing ... ." (Article 25, Universal Declaration of Human Rights, United Nations General Assembly, 1948).

[266] This remark was made by Robert Solow when introducing Amartya Sen at the award of the Frank Seidman Distinguished award in Political Economy, 1986.

minimum, a "basic needs" approach to water provision and pricing where an "adequate" level of water use is secured for everybody. A more radical interpretation of both Rawls and Sen would support the examination of antecedent diversity and may justify a more fundamental redistribution of resources so as to ensure equality in the holding of primary goods (Rawls) and equality of capabilities (Sen).

Some neo-classical economists are willing to consider equity issues (other than equality of utility) within a neo-classical pricing framework. Two approaches are reviewed in this chapter: social welfare functions and basic needs pricing justified by externalities. Both of these approaches are limited as they fail to take into account the political-economic context within which these analyses take place and hence are not aware of important factors which are likely to influence the outcomes of the analyses.

Neo-classical economics provides a theory of welfare measurement. But this theory is of limited value because it relies on the assumption that the value of a dollar's worth of demand for a good is independent of the wealth of the consumer. It is possible to use social welfare functions to overcome this, but the choice of social welfare function is subjective and value-laden. The distinct danger of this approach is that the political-economic context is ignored.

Contingent valuation presents an alternative methodology for assessing consumer demand and welfare. In this method, a fictitious market is postulated and respondents are asked to bid for different quantity-price combinations of goods. The most forceful criticism of this method (as applied to water) is that households are presented with a "double-contingency", that is, they are asked to value a service outside of their experience *and* to value an unknown future quantity of water consumed.

I will argue that nonparametric density distributions provide a more transparent and value-neutral mechanism for analysing welfare effects of price reforms compared to the other available alternatives. In this chapter, the mathematics of this method are explained and an application of this method is presented using primary data collected for Grahamstown (South Africa). Empirical evidence generated by alternative methodologies is also reviewed in the chapter and the inherent limitations of these methodologies are demonstrated.

A specific focus on equality and justice is warranted in the context of urban water pricing because of the profound inequalities present in the sector (especially in developing countries) and the devastating social consequences of these inequalities.[267] Nevertheless, the consideration of equality is just one component of urban water pricing. I argue that the

[267] These have been illustrated in Chapter 1.

critical-realist methodological approach to pricing proposed in this thesis is able to incorporate equality considerations successfully within a comprehensive urban water pricing framework.

2. Some philosophical considerations

Equality of what?

Sen, in his monograph *Inequality Re-examined* (1992), poses two fundamental questions: Why equality? and, Equality of what? With respect to the former, he makes the important point that *all* prominent theories in political philosophy (dealing with social arrangements) are egalitarian in the sense that they use equality as the key criterion of evaluation within their theory. Sen points out:

> *It is arguable that to have any kind of plausibility, ethical reasoning on social matters must involve elementary equal consideration for all at* some *level that is seen as critical. The absence of such equality would make a theory arbitrarily discriminating and hard to defend. (Sen, 1992: 17)*

With respect to the second question, Sen points out that it is the different bases for equality (what he terms "basal equality") that define the points of dispute between different social theories.

The premise "*equality of some kind is of fundamental importance*" is accepted as the departure point for this chapter. Given this premise, two questions are explored: What should the basis of this equality be? and, What implications does this choice have for a critical-realist approach to urban water pricing?

Three views are considered: utilitarianism (as it is embodied within neo-classical economic theory), Rawls' "justice as fairness", and Sen's "equality of capability". These views have been chosen because they represent three prominent conceptions of equality, each of which has very particular implications for the treatment of equality in the context of urban water pricing.[268] Each of these approaches is evaluated below with the view to informing a critical-realist approach to urban water pricing.

Utilitarianism and neo-classical economic theory

Sidgwick presented a clear statement of classic utilitarianism along the following lines: a society is just when it is arranged so as to achieve the greatest net satisfaction summed over

[268] These three views do not, of course, cover the full spectrum of possibilities. The purpose of this chapter is to illustrate some key themes. A comprehensive approach would require an examination of all (or at least more) of the contributions to the debate on equality in political philosophy.

all individuals belonging to it (Sidgwick, 1907). The key principle underlying modern utilitarianism is "giving equal weight to the equal interests of all the parties" (Hare, 1981a: 26).[269] In terms of utility, utilitarianism values changes in utility incurred by different individuals equally. Thus, utilitarianism sees value, ultimately, only in individual utility, which may be defined in terms of some "mental characteristic, such as pleasure, happiness or desire" (Sen: 1992: 6). It is important to note that if utility is defined entirely in terms of individual choice (preferences), then interpersonal comparisons are not permitted and judgements about welfare are rendered an impossibility (Sen, 1992: 6).

Welfare economics is fundamentally utilitarian; social welfare is maximised through the maximisation of the sum of individual utilities. In turn, welfare economics provides the fundamental justification for the Pareto-efficiency claim. The problems of this claim are even more profound than suggested in Chapter 2, particularly in the context of entrenched inequality. Sen presents a forceful criticism of utilitarian theory in this context:

> *In so far as utility is supposed to stand for individual well-being, it provides a rather limited accounting of that, and it also pays no direct attention to the freedom to pursue well-being.*
>
> *This way of seeing individual advantage is particularly limiting in the presence of entrenched inequalities. In a situation of persistent adversity and deprivation, the victims do not go on grieving and grumbling all the time, and may even lack the motivation to desire a radical change in circumstances. Indeed, in terms of a strategy for living, it may make a lot of sense to come to terms with an ineradicable adversity, to try to appreciate small breaks, and to resist pining for the impossible or the improbable. Such a person, even though thoroughly deprived and confined to a very reduced life, may not appear to be quite so badly off in terms of the mental metric of desire and its fulfilment, and in terms of the pleasure-pain calculus. The extent of a person's deprivation may be substantially muffled in the utility metric, despite the fact that he or she may lack the opportunity even to be adequately nourished, decently clothed, minimally educated, or properly sheltered. (Sen, 1992: 7)*

This fundamental discontinuity between utility and well-being is vividly described by Sen. More especially, the misleading nature of utility metrics may be particularly important where social differences are entrenched, for example, in the cases of class, gender, caste or community (Sen, 1992).

[269] Hare's starting point is that "moral statements in their central use express prescriptions, and these have to be universalizable" (1981b: 7). His reasoning proceeds as follows: "If we know that in making a moral judgement we are prescribing universally for all similar cases, we shall not prescribe for others what we are not prepared to prescribe for ourselves were we identically placed. This will lead us to give equal weight to equal preferences of all. ... Thus we shall be, as utilitarians do, counting everybody as one and nobody as more than one, and shall be trying to maximise the satisfaction of everybody's preferences, treated impartially. ... If this method were applied directly to acts, it would enjoin us to judge them by their utility, in the sense of preference satisfaction" (1981b: 7).

A further important criticism is provided by Elster who puts utility and preferences in historical perspective, arguing that utility and preferences can only be understood in terms of how these developed over time, and the historical influences and processes affecting this development. He poses two relevant questions:

> *Why should individual wants and satisfaction be the criterion of justice and social choice when individual wants themselves may be shaped by a process that preempts the choice? And, in particular, why should the choice between feasible options only take account of individual preferences if people tend to adjust their aspirations to their possibilities? (Elster, 1982: 219)*

The importance of the political-economic context within which preferences and utilities are formed and especially the historical development of the political economy are self-evident.

I draw two primary conclusions from the above discussion. Utilitarianism in general, and the use of utilitarianism in neo-classical economics theory in particular, does not provide an adequate approach for tackling issues of justice and equality, especially in a context of entrenched inequality. The formation of preferences and utilities can only be understood in a historical context and it is therefore necessary to undertake context-specific political-economic analyses in order to understand prevailing distributions of welfare (however defined) and the effects that these have on outcomes.

Justice as fairness

Rawls' "justice as fairness" was developed as an alternative to utilitarianism and is an attempt to put forward a systematic case for an intuitive approach to the challenges of justice and equality.[270] Rawls proposes that justice is the "first virtue" of institutions with the implication that justice has priority status in society:

> *Each person possesses an inviolability founded on justice that even the welfare of society as a whole cannot override. For this reason justice denies that the loss of freedom for some is made right by a greater good shared by others. It does not allow that the sacrifices imposed on a few are outweighed by the larger sum of advantages enjoyed by the many. (Rawls, 1971: 34)*

Rawls' theory is based on two principles.

> *Each person is to have an equal right to the most extensive total system of equal basic liberties compatible with a similar system of liberty for all.*[271]

[270] Although Rawls contrasts his approach to those of intuitionists, Rawls' approach can itself be described as intuitionist, albeit of a more systematic variety. See Rawls (1971: 34f) and Kymlicka (1990: 50f).

[271] This was later restated as "Each person has equal right to a *fully adequate scheme* of equal basic liberties which is compatible with a similar scheme of liberties for all" (Rawls *et al*, 1987:5, own emphasis).

> *Social and economic inequalities are to be arranged so that they are both to the greatest benefit to the least advantaged, consistent with the just savings principle; and attached to offices and positions open to all under conditions of fair equality of opportunity.*[272] *(Rawls, 1971: 302)*

Two priority rules are invoked: the priority of liberty and the priority of justice over efficiency and welfare.[273] Finally, these concepts are tied together into a "General conception of Justice":[274]

> *All social primary goods – liberty and opportunity, income and wealth, and the bases of self-respect – are to be distributed equally unless an unequal distribution of any or all of these goods is to the advantage of the least favoured. (Rawls, 1971: 302f)*

Rawls' theory of justice has spawned an extensive literature. Much of this literature is critical of Rawls, whilst at the same time acknowledging the important contribution that Rawls has made to political philosophy.[275] An exploration of this secondary literature lies beyond the scope of this thesis. The discussion that follows is restricted to making a few key points which have relevance to a critical-realist approach to urban water pricing.

"Justice as fairness" defines equality much more broadly compared to utilitarianism: it asserts that there is to be equality in primary goods which includes liberty and opportunity, income and wealth, and the bases of self-respect. There is thus to be a *resource-based* (as opposed to utility or preference based) equality in both means and ends. The "difference principle" ensures that inequality in primary goods is *only* socially desirable *if* this inequality benefits all, including (and especially) the least advantaged. Thus there is a specific focus on the least well-off.

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[272] This was later restated as " ... to the *great* benefit of the least advantaged" (Rawls *et al*, 1987: 5, own emphasis).

[273] These may be formally stated as follows: "First priority rule (the priority of liberty): The principles of justice are to be ranked in lexical order and therefore liberty can be restricted only for the sale of liberty. There are two cases: (1) a less extensive liberty must strengthen the total system of liberty shared by all; (b) a less than equal liberty must be acceptable to those with the lesser liberty. Second priority rule (the priority of Justice over Efficiency and Welfare): The second principle of justice is lexically prior to the principle of efficiency and to that of maximizing the sum of advantages; and fair opportunity is prior to the difference principle. There are two cases: (a) an inequality of opportunity must enhance the opportunities of those with the lesser opportunity; and (b) an excessive rate of saving must on balance mitigate the burden of those bearing the hardship" (Rawls, 1971: 302).

[274] Much of Rawls' theory of justice is occupied with providing the motivation and justification for these statements. Briefly, Rawls employs two arguments – an intuitive argument and an argument based on a social contract. The first is straight forward, the second entails an elaborate construction of an "original position" and a "veil of ignorance". The method by which Rawls derived his theory of justice is not of primary concern here.

[275] Sen, for example, acknowledges an indebtedness to Rawls in his thinking on justice and inequality, whilst at the same time departing from Rawls quite fundamentally (Sen, 1992: xi). There is also an extensive literature debating the exact claims of the theory and Rawls has spent a lot of effort clarifying these claims. See, for example, Rawls (1985).

Rawls fails to specify the contents of the primary goods in any detail and thus the implications of the theory in terms of practical application remain somewhat vague. Nevertheless, it would be reasonable to suppose that the equal holding of primary goods would imply that universal and equal access to adequate water services would be secured in a just society as conceived by Rawls.

Rawls' theory is unable to escape the criticism that it is essentially subjective (though this does not necessary diminish its challenge to utilitarianism nor its importance).[276] There is no *a priori* reason why liberty should have such complete priority within a lexicographical ordering nor is Rawls able convincingly to demonstrate that the principles of justice he proposed would be the result of rational consideration (Rawls' "reflective equilibrium").[277] Hence Rawls' theory is subject to an adaptation of McCloskey's methodological maxim: a theory of social justice is to be preferred which is accepted by society, that is, which has proved to be most persuasive.[278] There is, of course, no reason why a society could not (or should not) choose Rawls' theory of justice, but this choice cannot be arrived at through "reflective reasoning" alone as Rawls attempts to do.

A more fundamental criticism of Rawls' theory of justice is that it presents *a* vision (Rawls' vision) of a just state without accounting for how a society might reach such a state (or indeed, for how societies have arrived at their current *unjust* states).[279] From this point of view, the theory can be criticised for being idealistic and of limited practical relevance. Nevertheless, the theory does pose important questions and can provide an important starting point for a debate on justice and equality.[280]

Equality of capability

Sen (1992) notes that a choice for the primacy of equality in one space (for example, liberty) will necessarily result in inequality in other spaces (for example, wealth). Key issues which arise from this are the choice of the space in which equality is to be judged, and an

[276] Hare, for example asserts that "one of Rawls firmest intuitions is that utilitarianism is wrong" (1981b: 6).

[277] Rawls later modified his principle of liberty to a lesser version in response to a strong criticism from Hart (1973). See Footnote 271.

[278] See McCloskey (1983). It is possible to argue that Rawls' theory is an attempted justification for liberal democratic capitalism, however, more radical interpretations exist of the implications of, and requirements for, the equal holding of primary goods subject to the difference principle. See, for example, Kymlicka (1990: 50f).

[279] It would be hard to argue that the current distribution of "primary goods" in society (to borrow Rawls' term) is just in any way. Bauer (1981) makes a bold attempt with his "producers' rights to the product" argument, but this is refuted by Sen (1985).

examination of the implications of this choice for inequality in other spaces. There are, of course, no *a priori* rules which can guide us in this choice. Clear thinking can help to make the choices and underlying assumptions explicit. It is likely that some choices will be more contentious than others and hence an objective of the reasoning undertaken by Sen (and also here in this thesis) is to find and define the space (or spaces) of equality over which there is likely to be most agreement.

Sen proposes that "equality of capability" should occupy the "basal equality" space (Sen, 1992). Capability is defined as the "capability to function" and a capability set is defined as a "person's freedom to choose from possible livings". Sen thus makes a distinction between capabilities (a freedom to function) and achieved functions, that is, between the freedom to choose to achieve different functions and the actual achievement of functions (for example, nourishment and good health). This distinction is motivated by the belief that it is important to attach both an instrumental *and intrinsic* value to freedom. In this sense, the approach is not dissimilar to Rawls' priority of basic liberties. Sen argues:

> *The gap between* resources that help *us to achieve freedom and the extent of* freedom itself *is important in principle and can be crucial in practice ... Freedom is one of the most powerful social ideas, and its relevance to the analysis of equality and justice is far reaching and strong. (1992: 37, original emphasis)*

This is remarkably similar to Rawls' priority of liberty. However, Sen contrasts his approach to Rawls' focus on primary goods:

> *Capability represents* freedom *whereas primary goods tell us only about the* means *to freedom. ... Equality of freedom to pursue our ends cannot be generated by equality in the distribution of primary goods. We have to examine interpersonal variations in the transformation of primary goods (and resources more generally) into respective capabilities to pursue our ends and objectives. (Sen, 1992: 84, 87, original emphasis)*

But this misses the point, because the priority of liberty comes before the equal holding of primary goods in Rawls' schema. The confusion appears to arise in the respective definitions of liberty and freedom.

A distinct limitation of this conceptual approach is that capability sets, like utilities, are not directly observable whereas functionings are. So from a practical point of view it is likely to be more feasible to relate well-being to achieved functionings rather than using capability sets (freedom to function). Either way, the evaluation of the equality of capability or functions must still be measured in a particular space. Sen suggests the beginnings of a basic set of

[280] Nozick, for example, states that "political philosophers must either work within Rawl's theory or explain why not. [Our considerations are illuminated by] Rawls' masterful presentation of an alternative conception" (1974: 183).

capabilities for primary evaluation: "the ability to be well-nourished and well-sheltered, the capability of escaping avoidable morbidity and premature mortality, and so forth" (1992: 45). Of course even these capabilities have to be weighted *vis-à-vis* each other and an ordering will necessarily be incomplete as a result of inevitable ambiguities.

Despite these limitations, Sen argues that "the informational base of functionings is still a much finer basis for evaluation of the quality of life and economic progress than various alternatives commonly recommended, such as individual utilities or commodity holdings" (1992: 53). This is certainly true in the sphere of water supply. Ready access to potable water is clearly a basic functioning which is essential to the realisation of other primary capabilities such as nourishment and health. From a capability perspective, therefore, there is a strong argument for equality in the functioning space of adequate potable water supply.

Capability and efficiency

The question posed by neo-classical economists arises in this context: how do the equality considerations of equal functionings in the space of water supply relate to efficiency (or aggregative) considerations, that is, the maximisation of social welfare? There are essentially three types of answers to this question. The first is to assert that efficiency considerations are dominant and therefore to reject the equality debate, or at least reject it as being irrelevant to economics. The second is to reject the question altogether by asserting that a utility-based conception of welfare is irrelevant. (This entails a wholesale rejection of neo-classical economics.) The third is to accept a broader conception of social welfare which is not narrowly utility-based but which includes aggregative considerations within an "equality of capability" framework. This latter approach is recommended by Sen (1992: 136f). Notice that this represents a reversal of priorities from "efficiency first" (neo-classical economics) to the priority of "equality of capability", but does not dismiss aggregative considerations as unimportant.

A key economic argument against the priority of "equality of capability" is that "equality of capability" itself (or policies to achieve greater "equality of capability") distorts incentives, reduces the aggregate welfare and hence is detrimental for everyone. The fundamental basis of this argument is that outcomes are a result of individual choices (concerning the activities undertaken and the level of application in these activities). The corollary of this argument is that, for a given set of preferences, relative prices in a competitive market provide the "correct" incentives and ensure the maximisation of utility and hence social welfare. Any adjustment to prices necessarily distorts incentives and hence reduces welfare. This argument

is undermined if it is recognised that the more fundamental distribution of outcomes is the result of "antecedent diversities" in the ability to productive (Sen, 1992: 142).

For example, in the context of urban water supplies in developing countries, the productive capability of a household is clearly impaired if members of a household are required to spend many hours a day collecting water and if use of this water increases the risk of disease.[281] In this case it can be argued that the incentive distortion of providing subsidised water supplies, say, is much less than the aggregative welfare loss arising from the overall inequality of capabilities in society (the lack of access to a safe water supply). This is a mild interpretation of the antecedent diversity argument.

Sen makes a broader point in this context:

> *In general, the possibility of incentive distortions may be a good deal less with egalitarian policy in this case [antecedent inequalities in capabilities arising from gender or age] than in the standard economic models involving individuals whose fortunes diverge because of their own* chosen *levels of application. ... Egalitarian policies to undo inequalities associated with human diversity are much less problematic from a point of view of incentives than policies to undo inequality arising from differences in effort and application, on which much of the incentive literature has tended to focus. (1992: 142)*

This argument can be taken much further. For example, it can be argued that the "fortunes" (or ill-fortunes) of individuals arise primarily from "antecedent diversity" in the ownership of the means of production and have much more to do with the relative shares of the returns on production accruing to capital and labour.[282] If the essence of this analysis is accepted, then equality of capability can only be achieved if there is a fundamental redistribution in the ownership of the means of production.

In any event, the logical force of the argument put forward by Sen points towards the need to understand the reasons underlying the "antecedent diversity" in the welfare of individuals, households, classes and societies. Such an understanding can only be accomplished through a context-specific political-economic analysis of the historical processes leading to the present inequalities.

[281] In South Africa, for example, many rural households spend more than two hours per day collecting water, and in Uganda, water collected from shallow wells in urban areas is prone to contamination (Palmer, 2000: personal communication; Ssebabi, 2000: personal communication).

[282] In this context it may be pointed out that the determination of the "appropriate" return on factors of production in joint production is manifestly an impossible task. Hence the actual allocation of shares is necessarily the result of conflict and is determined by the political-economic context.

Equality and contest

Three alternative views of justice and equality within political philosophy have been briefly reviewed above. These are by no means exhaustive but serve to make the point that alternative approaches to the questions posed by inequality exist and that there is no consensus in the literature on the "right" approach. This adds weight to the critical-realist approach which recognises open systems as a fundamental fact of life.

Each view has different implications for the treatment of inequality within the water sector. The utilitarian view supports a neo-classical treatment of welfare and hence marginal-cost pricing. Rawls' "justice as fairness" supports a "basic needs" approach to the provision and pricing of water (in which a basic level of provision is universally secured for society as a whole). Sen's "equality of capability" approach emphasises the need for equality in freedoms to function. When translated into practice this would seem to imply support for a basic needs approach to the provision and pricing of water. (In other words, its practical content in this instance does not differ from Rawls' "equality in the holding of primary goods".)

A more radical interpretation of Sen's "equality of capability" extends to production. Equality in this sense could only be addressed through an understanding of the historical political-economic reasons for the current distribution of the ownership of productive resources (and the distribution of the surplus arising from production). In this light, both utilitarianism and Rawls' theory of justice can be criticised for being ahistorical, that is, for being unable to explain (or at least not being interested in explaining) why inequality exists and how it came about.

Neo-classical theory is based on the utilitarian philosophy and is primarily concerned with maximising utility based on preferences. It is essentially marginalist, posing the following question: Accepting current circumstances as given, how can resources be re-allocated so as to improve Pareto-efficiency? This approach is not concerned with the question of equality (except in so far as to require that marginal utility be treated with equal value between individuals).

In Rawls' theory of justice, liberty assumes absolute priority and justice has priority over efficiency and welfare. Rawls' difference principle seeks to cater for efficiency considerations by allowing for differential holdings of primary goods, but this is only justified if the inequality in holdings benefits the least well-off.

Sen argues for an incorporation of efficiency considerations within a "equality of capability" framework. Here efficiency is defined much more broadly to mean "the efficiency with which

the defined objective is achieved". There is an implicit recognition that the relevant objectives will be socially determined, and hence the political-economic context is crucially important.

In summary, I contend that the meanings of justice, equality and efficiency in any given context are socially determined and, further, that the meanings and importance attached to each of these concepts are inevitably contested. The nature and outcomes of this contest are the product of the specific political-economic histories.

Within the urban water sector (and especially in developing countries), issues of justice, equality and efficiency are undoubtedly prominent. Thus the practice of urban water pricing will be heavily influenced by how the contest over the meanings is played out. In this context, it is not possible to understand urban water pricing practice in any specific location without understanding the political-economic history.

3. Neo-classical pricing and equity – a critical review

Some economists are willing to consider equity issues within a neo-classical pricing framework. Two possible approaches are discussed below. In the first approach, a social welfare function is postulated and on this basis the optimal trade-off between efficiency and inequality modelled. The second approach treats "basic needs" as an externality (the cost of inequality) and dispenses with the social welfare function.

Welfare function approaches to the efficiency-inequality trade-off

A number of different models have been developed which attempt to model the optimal trade-off between efficiency and equity in the context of a public service.[283] None of the models explain all facets of the optimal trade-off between efficiency and equity in a satisfactory manner and no synthesis model which predicts the relationship between efficiency and equity for the general case exists. Nevertheless, on the basis of a review of these models, Bahl and Linn came to the following two tentative and general conclusions. First, if the price-elasticity of demand for access is high, and if access fees are not related to income, then a larger share of the agencies budget should be raised through use-related tariffs. For example, if access is denied to poor households because they cannot afford the access fees, then these fees should be lowered and user charges raised. Second, if access fees can be related to income, and if the price-elasticity of demand for access is low (over the relevant income and price range), and if

[283] See Munasinghe and Warford (1978), Feldstein (1972ab), Munk (1977) and Ng and Weisser (1974).

demand for the commodity is highly price-elastic but income-inelastic, then a larger share of income should be derived from access charges (Bahl and Linn, 1992: 276).[284]

I identify and discuss below the analytical and practical problems which would have to be addressed before a general model addressing optimal pricing to achieve dual efficiency and equity goals could be successfully developed and applied.[285]

Successful application of models of this type require knowledge about the price-elasticities of consumer demand for different consumer categories and for different dimensions of public service. It will be shown in Chapter 6 that these price-elasticities are difficult to estimate.

The final incidence of charges for, and benefits from, a public service must be identified. For example, if water is used as an input in an industrial process, the benefit (or otherwise) of a subsidy or tax may or may not be passed on to the consumers of the product produced. Therefore, factor-supply elasticities and price- and income-elasticities of the final product also need to be known. Furthermore, even if the product is a final product, gains may be capitalised into the land value, for example, which may create a benefit for the land owner rather than the consumer of the service.

The problem of second-best pricing raises questions as to the validity of shadow pricing as a means of improving efficiency. Even if the validity of shadow pricing is accepted, there is uncertainty with respect to the choice of technique and the accuracy of measurement.[286]

Given the necessarily subjective nature of social welfare functions, the choice of function and weighting values used is inevitably socially contested. This points to the need to understand the underlying political-economic dynamics. The social welfare functions typically used in the models assume that the same additional unit of disposable income in the hands of the poor is worth somewhat more than in the hands of the rich. This assumption has been criticised by Harberger (1978) who asserts that these welfare functions tend to over-estimate the altruism of individuals.

[284] These results for a two-part tariff are similar to those of Feldstein for two services (1972a). If it is possible to consider each dimension of the service (access and use) as separate services whose demands are independent of each other, then the Munasinghe-Warford model can be reformulated for each dimension. However, if demands are related (and it is likely that they will be), then the problem is more complex.

[285] Five points were identified by Bahl and Linn: (1) estimating price-elasticities, (2) final incidence of benefits, (3) calculation of shadow prices and social weights, (4) differentiation of prices by income group, and (5) manner of income redistribution (1992:276f). The following discussion uses these five points as a framework, however, some have been elaborated on and new ones have been added.

[286] I discuss issues related to shadow pricing more fully in Chapter 3.

Basic needs pricing

Basic needs of consumers can be treated as an externality of consumption, providing an alternative methodology to social welfare functions. The approach advocated by Harberger (1978) is described below.

The approach assumes that rich and poor consumers have different demand curves which are both modified by the social benefit arising from small quantities of water. These curves are depicted in Figure 3 (which come from Bahl and Linn, 1992). On the basis of these assumptions, consumption would be socially optimal at Q_{POOR} and Q_{RICH}, with the corresponding prices P_{POOR} and P_{RICH}. It may be seen that P_{POOR} is less than P_{RICH} and that P_{RICH} is equal to the marginal cost of production. Of course the problems related to the definition and estimation of marginal cost, identified and discussed in Chapter 3, still pertain.

The main point of the analysis is to show that the "altruism" of society only extends in a limited way, that is, up to some point where additional consumption by poor consumers has no further "social" benefit. In this approach, individuals are not really altruistic at all; they are merely matching their "true" benefits and costs.

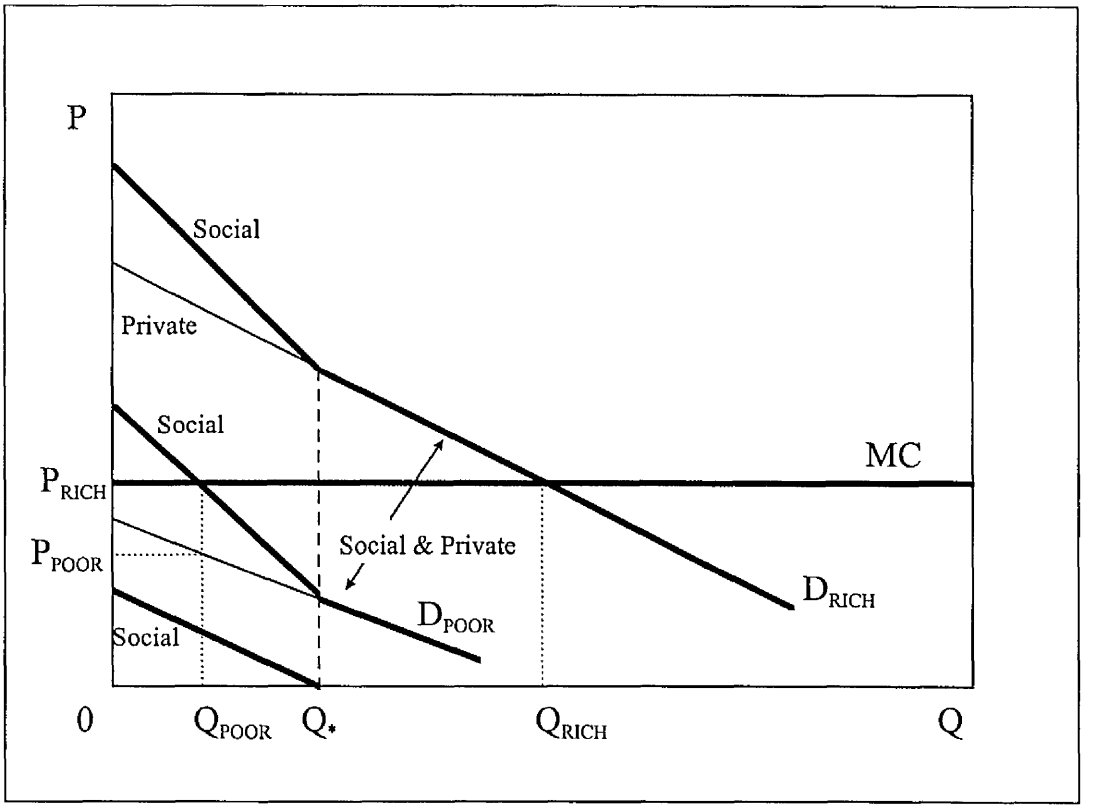

Figure 3: Basic needs pricing – an externality approach

Measuring the externalities associated with water consumption is difficult. Nevertheless, if the overall framework is accepted, then the above argument is, at least in some sense, intuitively plausible:

> *The rest of society wants the recipients of [subsidies] to spend more money on feeding and clothing their children, not on what are judged to be [luxury][287] or trivial items. (Harberger, 1978: 9)*

This approach requires value judgements with respect to the definition of basic need and the social value of this basic need consumption. Hence the analysis is unable to escape from two more fundamental questions: Who gets to decide? And, How are these decisions made?

Subjectivity and context

In the above discussion it was recognised that pricing decisions have distributional outcomes. Two theoretical rationales were provided for including distributional considerations within a neo-classical pricing framework. First, it was argued that the use of a social welfare function with distributional weights could account for welfare distribution within a Pareto-efficiency optimising framework. Second, it was shown that inadequate consumption amongst the poor causes externalities which can be corrected through a "basic needs" pricing framework thus increasing Pareto-efficiency. An overriding theme in the discussion was that both the choice of technique and its method of application are inherently subjective. A key implication of this is that choices will be governed by a combination of ideology and the political-economic context.

4. Measuring social welfare and inequality

The measurement of social welfare and inequality is a particular concern in relation to water pricing in developing countries because water is a basic necessity and because of the prevalence of highly skewed income distributions in these countries.

The theory of welfare measurement

Consumer welfare

Assuming a rational, continuous and locally non-satiated preference relation with differentiable consumer expenditure and indirect utility functions, the welfare effect of a change in the price of a commodity can be measured either as the equivalent variation (EV) or

[287] The word "sumptuary" meaning "limiting private expenditure in the interests of the State" was used. This would appear to be an inappropriate word in the context. Perhaps the word "sumptuous" was intended?

as the compensating variation (CV). The EV can be thought of as a measure of the amount of money a consumer would be indifferent about accepting in lieu of the price change. The CV measures the compensation that would have to be given to a consumer after the price change in order to bring the consumer back to her original utility level. In general, the values of EV and CV will be different, though each method is equally valid as a way of measuring the change in consumer welfare.

The EV and CV may be expressed in terms of the Hicksian demand curve as follows:

$$EV\ (p^0, p^1, w) = \int h_1\ (p_1, p_{-1}, u^1)\ dp_1 \qquad (1)$$

$$CV\ (p^0, p^1, w) = \int h_1\ (p_1, p_{-1}, u^0)\ dp_1 \qquad (2)$$

where p_{-1} is the vector of the prices of other goods which are all held constant, and where the integral is in the limits p^0 to p^1 for good 1.

Because the Hicksian demand curve (h_1) is not directly observable, the calculation of EV and CV requires the mathematical transformations described in Chapter 3. Where there are no wealth effects arising from the change in the price of a good, EV will equal CV and both are equivalent to the change in the Marshallian consumer surplus.

Marshall defined consumer surplus as "the excess of the price which he [the consumer] would be willing to pay rather than go without the thing, over that which he does pay" (Marshall, 1920). Thus changes in consumer welfare can be approximated as the change in Marshallian consumer surplus arising from either a price change or a quantity restriction. This can be directly measured using the observable market (or Walrasian) demand curve (x_1). For a price change:

$$AV\ (p^0, p^1, w) = \int x_1\ (p_1, p_{-1}, w)\ dp_1 \qquad (3)$$

over the integral limit p^0 to p^1 where AV is the average variation.

Where wealth effects and/or price changes are small, then the "error" in AV will be small.

Much of the literature concerning welfare analysis in relation to water demand uses Marshallian consumer surplus as the measure of consumer welfare. This is justified by the expectation that the AV error will be small. For example, Dandy (1992: 1759) states:

> *Other measures such as compensating variation or equivalent variation may be superior on theoretical grounds, but Willig (1976) and Randall and Stoll (1980) have shown that differences will be small for commodities (such as water) which have a small income-elasticity of demand.*

This approach to the evaluation of consumer welfare is *only valid* for the evaluation of *individual* consumer welfare. The approach therefore requires that the changes in the welfare

of each individual (or possibly household)[288] be measured and also that price-elasticities of demand for individual households be calculated. This data typically are not available and hence an analysis of this type is not possible. An alternative is to measure the welfare change of a so-called representative household. However, this approach is clearly problematic, especially in a context where welfare inequalities between households are significant.

An alternative measure of consumer welfare changes

Dinwiddy and Teal (1996) propose the following practical approach for the measurement of welfare in the context of cost-benefit analysis, an approach which is equally applicable to price reform. Assuming that monetary measures can provide useful measures of changes in social welfare, Dinwiddy and Teal have shown that the measurement of welfare effects of a public sector policy or project can be summarised in the following two measures (1996: 56):

$$dW = \sum p_i \, dC_i \qquad (4)$$

$$dW = \sum C_i dp_i + dY \qquad (5)$$

The first equation says that the change in welfare (dW) can be evaluated in terms of the sum of changes in the value of consumption in commodity markets, that is, at the market prices faced by the consumer and the changes in consumption (dC_i). The second (equivalent) expression says that welfare change can be evaluated in terms of changes in consumer prices (dp_i) and income (dY). Dinwiddy and Teal note that "the rationale for using market prices in the welfare measure is that these prices represent consumers' valuation of commodities, there is no implication that they reflect Pareto-efficient outcomes" (1996: 265).

While it is generally preferable to examine welfare effects in the context of the overall economy, Dinwiddy and Teal assert that a partial equilibrium analysis may often be used to good effect as "the only necessary additions to welfare change in the primary market are social consequences from other markets subject to some form of distortion" (1996: 265).

This method of calculating welfare effects assumes that the (implicitly social) value of a change in consumption is the same for both a poor and a rich consumer. This is a highly problematic assumption which is clearly untenable in the context where there are wide disparities in income and where the good in question is water.

Making inter-household welfare comparisons

It may be expected that, in general, for a given quantity and price of the particular good consumed, the greater the household income and wealth, the smaller the price-elasticity of

[288] The transition from individual welfare to household welfare is not straightforward (Deaton, 1997).

demand. On the other hand, larger households are likely to have a higher price-elasticity of demand compared to smaller households, *ceteris paribus*. Inter-household welfare comparisons are complicated by differences in household characteristics. Deaton and Muellbauer have developed a model, based on Engel's approach, which enables more plausible inter-household comparisons (1980: 193). At the most basic level, the welfare comparison is conducted with reference to a standardised household. The analysis can then be extended to incorporate different household characteristics, such as the adult-child composition. Inter-household welfare comparisons are complicated in the case of urban water use because the nature of usage changes as consumption increases.

Making reliable inter-household welfare comparisons is a particularly difficult task where there are wide disparities in income, consumption and household size in a community, conditions typically found in developing countries.[289]

Willingness-to-pay

Willingness-to-pay is an alternative approach to the analysis of water demand and consumer welfare. The premise here is that the supply of a service should match the demand for the service as measured by the consumers' willingness-to-pay. The implicit assumption of this approach is that the value of a dollar's worth of demand for a good is independent of the wealth of the consumer. This assumption has been criticised in relation to the neo-classical approach to consumer welfare presented above. Nevertheless, this approach enjoys widespread support. A brief critical review of this approach is presented below.

Where no market for urban water exists, researchers have used contingent valuation studies to estimate consumers' willingness-to-pay for water. This methodology has been both advocated and popularised by the World Bank. Essentially, contingent valuation or willingness-to-pay (WTP) studies create a hypothetical market for water by setting up an auction or bidding process ("game") with respondents (potential consumers) in a structured survey. Various techniques are introduced purportedly to reduce the three kinds of bias that may arise, namely, strategic bias, starting point bias and hypothetical bias (see Whittington *et al*, 1990). For example, starting point bias may be tested for by creating two sample populations which use high and low opening bids respectively. Much of the literature is sanguine about both the accuracy and efficacy of these studies (Singh *et al*, 1993, World Bank Water Demand Research Team, 1993, Whittington *et al*, 1989, 1990, 1991, 1993, 1998). However, there have been few instances where pre-project WTP studies have been compared to actual

[289] See, for example, the data presented for Grahamstown, South Africa on page 157.

payment records.[290] Two studies that have done an after-the-fact review are Griffin *et al* (1995) and Whittington *et al* (1993). These studies concluded that contingent valuation studies of willingness-to-pay were a better predictor of behaviour than other approaches. However, while this may be true for individual households, it is not true for the community as a whole. The first study ignored the time dimension, that is, how long households take to connect once the system has been built. The second study is misleading because actual connections have been much slower than predicted by the WTP study and this is not mentioned at all in the study (Cairncross, personal communication, 1997).

Cairncross and Kinnear (1992: 183) are critical of contingent valuation studies:

> *Most studies have used the "conditional" approach, in which the potential consumers are asked how much they would be willing to pay for the given level of service, although the response to such questions may be biased in several ways. Respondents may be unaccustomed to answering hypothetical questions, may answer in such a way as to finish the interview as soon as possible, or may give deliberately false replies with a view to pleasing the interviewer, or to obtaining a water supply at the cheapest possible price. A further weakness of the approach is that it can only focus on the consumer's decision whether or not to use and pay for the water supply. The method cannot be used to assess the degree to which charging for the water will lead consumers to reduce their consumption; those who do not currently pay for water have difficulty enough in stating how much they use at present, without having to guess how much they would use under hypothetical circumstances.*

These criticisms are valid. Experience in other fields suggests that contingent valuation tends to over-estimate willingness-to-pay (Loomis *et al*, 1996). At a more fundamental level, contingent valuation undertakes an income-blind valuation: "if a poor person places a value of one [dollar] on something, it has a higher value for that person than a one [dollar] valuation from the rich person; therefore to derive a social valuation by aggregating all individual valuations is highly problematic" (Van Horen, 1996: 18). Goldblatt (1997: 119f) notes two further limitations of contingent valuation studies. The first, which he calls "double contingency", refers to the fact that consumers are asked to value a service outside of their experience, namely both an improved *level* of service (for example, yard taps compared to communal taps) *and* an unknown future *quantity* of water consumed. In this context, volumetric based bids for water are particularly problematic. The second limitation is that contingent valuation studies are unable to take into account the effect of political and social factors and the influence that these may have on both demand and payments. Goldblatt (1997) cites the example of consumer boycotts in South Africa prior to 1994 and the hypothesised "culture of non-payment" arising from this.

[290] Cairncross contends that there have been only two cases in which actual behaviour is compared to that predicted by willingness-to-pay studies (Cairncross, 1997, personal communication).

The contingent valuation studies undertaken in Uganda suffered from all of the weaknesses identified here (field visit, Uganda, 1999).

Social welfare functions

The standard neo-classical approach to the evaluation of consumer welfare (presented above) is not able to account for the social evaluation of inequality. Social welfare functions have been developed for this purpose and are briefly described here.

Atkinson (1970) gave prominence to the use of social welfare functions for the measurement of social welfare. Generically, the social welfare function has the form:

$$W = V(x_1, x_2, \ldots x_N) \qquad (6)$$

where the x's are some measure of welfare or living standard, such as per capita income and where N represents the total population.[291]

Deaton says that the social welfare function should be thought of "as a statistical 'aggregator' that turns a distribution into a single number that provides an overall judgement on that distribution and forces us to think coherently about welfare and its distribution" (1997: 135).

In general, it is desirable that W exhibit the following three properties. First, if the value of one of its arguments increases, the value of W should not diminish. Second, social welfare should only depend on the list of welfare levels in society and not on who has which level of welfare. Third, more equal distributions are preferred to less equal ones. An equity preference is guaranteed if the welfare function is quasi-concave. This implies that social welfare will be increased by any transfer of x from richer to poorer provided the transfer is not sufficiently large to reverse their positions.

A social welfare function with these properties can be used to generate a number of different kinds of measures of social welfare such as inequality, absolute poverty, and distribution.[292]

In order to use the social welfare function for these purposes, it must be assumed that the function V is homogenous of degree one. The welfare function then can be rewritten as follows, where μ is the mean of the x's:

$$W = \mu\, V\,(x_1/\mu, x_2/\mu \ldots x_N/\mu) \qquad (7)$$

This enables the mean value of x to be separated from the distribution of x.

[291] The x's could also denote a measure of household welfare, in which case N would be the number of households.

[292] Illustrations of different welfare functions are presented in Deaton (1997: 136f).

There is a distinct danger when reducing the measure of welfare, inequality, poverty or distribution into a single scalar number. This is because there is always substantial uncertainty about how to weight the distribution (for example, the degree of preference for equality or reduced poverty, and how to measure the poverty line in the latter case). Another reason is that the representation of welfare inequality or extent of poverty by just one number hides the richer detail that lies beneath its calculation.

Nonparametric depiction of social welfare

On the basis of the above reasoning, Deaton (1997) advocates the use of graphical techniques for representing distributions. One common technique is the use of Lorenz curves (or integrals thereof) which gives graphical representation to measures of inequality. However, simple density functions, and in particular nonparametric density functions, can often be a very useful tool for analysing distribution and Deaton is a strong advocate of this approach (1997: 169). An advantage of using nonparametric density functions is that they are not dependent on any particular economic theory (and consequently the assumptions implicit in, or explicit to, the theory). Rather, nonparametric density functions allow the data to speak for themselves, unfiltered and untainted by theory. Mukherjee *et al* (1998: 35) term this "exploratory data analysis". They qualify this with a caution though: "Data themselves do not tell you anything unless you engage with data in a dialogue which is theory-inspired. It is necessary to fire questions at the data so as to get hints and clues from them." Exploratory data analysis explores the data from different angles; it also proceeds by carefully examining the residual remaining after readily detectable fits have been removed, and makes extensive use of analytical graphics. A further aspect of this approach is to incorporate sensitivity or "fragility" testing.

Nonparametric density functions, in particular the joint density of welfare and consumption, can be used to describe the differential effects of price reform on the well-being of the rich and poor. This may be a particular useful tool for assessing the welfare effects of water price reform in developing countries. Nonparametric density functions are discussed in more detail below.

Nonparametric density functions

Nonparametric density functions have the potential to offer a value neutral approach to the evaluation of the welfare effects of price reform in the urban water sector. In this section the mathematics underlying nonparametric univariate and bivariate density functions are described.

Univariate functions

Histograms and normal density functions provide a visual representation of the position and spread of the data and are all that is needed for many purposes. For example, Deaton shows the histograms of (log-)normal distributions for per capita expenditure for South African households. In this case the log-normal distributions closely approximate the actual distributions as represented by histograms (1997: 170). However, there are a number of disadvantages to histograms: the choice of the number and the size of categories is arbitrary, this choice may affect the distribution where data points are clustered near the category boundaries, and the representation is discrete which poses problems for certain kinds of analysis (for example, mapping density functions against each other).

One way to get around this problem is to use a nonparametric density function. In lay terms, the idea of a nonparametric density function is to create a continuous density function that is as close as possible to the original data by using a kind of weighted moving average. The nonparametric density function has the form:

$$f(x) = 1/nh \sum_{i=i...n} K(.) \qquad (8)$$

where n is the number of observations, h is the bandwidth and K(.) is the kernel function. The kernel function K(.) has the form:

$$K((x-x_i)/h) \qquad (9)$$

At each point x, all values in the population or sample are related to x via the kernel function. The kernel function should have three properties: it should be positive and integrate to unity over the band, it should be symmetric around zero and it should be decreasing in the absolute value of its arguments (Deaton, 1997: 173).

The Epanechnikov Kernel is a popular choice:

$$K(z) = 0.75 (1 - z^2) \quad \text{for } -1 \leq z \leq 1$$
$$= 0 \quad \text{for } |z| > 1 \qquad (10)$$

Other functional forms for the kernel are discussed in Deaton (1997: 173). The choice of bandwidth is of some significance as excessive smoothing can hide important information.[293]

Bivariate functions

An important advantage of the nonparametric density function presented in the above section is that the analysis can be extended easily to two-dimensions.[294]

[293] Methods for estimating an appropriate initial bandwidth are discussed in Deaton (1997: 175).

A question related to the choice of bandwidth arises in this case: should the same bandwidth be used in both dimensions? This question is resolved by transforming the data such that the transformed variables have equal variance and are orthogonal to one another. The bivariate kernels can then be applied symmetrically to estimate the density functions and the data transformed back in the final stage.

All of these operations can be done in one stage. For the Epanechnikov kernel, the bivariate kernel has the following form:

$$K(z_1, z_2) = (2/\pi)\,(1 - z_1^2 - z_2^2)\,1\,(z_1^2 + z_2^2 \leq 1) \qquad (11)$$

The data are transformed using its variance-covariance matrix before applying the kernel smoothing. This can be accomplished by defining

$$t_i^2 = (x_i - x)'V^{-1}(x_i - x) \qquad (12)$$

where V is the 2 x 2 variance-covariance matrix of the sample, and calculating the density estimate as:

$$f(x_1,x_2) = 2(\det V)^{-1/2}/(\pi N h^2) \sum_{i=1\ldots N} (1 - t_i^2/h^2)\,1\,(t_i \leq 1) \qquad (13)$$

Deaton summarises this exposition as follows:

> *The bivariate estimates display the empirical structure underlying any statistical relationship between two variables. Just as the univariate densities are substitutes for histograms, bivariate densities can be used in place of cross-tabulation. In the context of welfare measurement, bivariate densities can illustrate the relationship between two different measures of welfare, calories and income, or income and expenditure, or between welfare measures in two periods. They can also be used to display the allocation of public services in relation to levels of living* [and] to illuminate the distributional effects of pricing policies. *(1997: 179, own emphasis)*

The practical application of bivariate density analysis will be illustrated in the next section.

The empirical evidence

Given the important influence that the reform of water prices may have on welfare and equity, the lack of empirical literature on the subject is remarkable. Four kinds of studies are briefly examined here: the determination of the income-elasticity of demand, the demand for access to water, the results of contingent valuation studies, changes in welfare using the Marshallian consumer surplus method and nonparametric bivariate density analysis.

[294] In principle this analysis can be extended to multi-dimensions, however, in practice this creates a number of difficulties: there is a computational cost, very large sample sizes are required and the presentation of the results is difficult (Deaton, 1997: 179).

The income-elasticity of water demand

Income elasticities reported by Hanemann (1997) for the United States are shown in Figure 4. The results display a wide range with the majority of studies reporting an income-elasticity of less than 0.5.

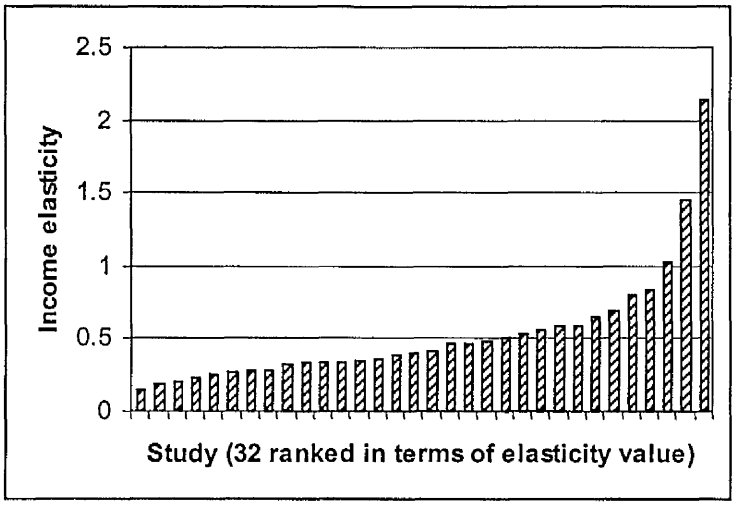

Figure 4: Income-elasticities for the USA (32 studies)

Katzman (1977) calculated arc income-elasticities by income group in a developing country context and obtained the following results: 0.24 - 0.3 for the poor to middle range and 0.32 - 0.39 for the middle to rich range. Cairncross and Kinnear (1992) found the income-elasticity of demand to be zero amongst households in informal settlements buying water from vendors.

The empirical estimation of the income-elasticity of demand for water is open to the same criticisms raised in Chapter 6 with respect to the estimation of the price-elasticity of demand. I assert that, in general, either arc-type measurements of income-elasticities of demand or nonparametric bivariate analysis of the consumption and income density distributions are preferable methods of analysis as these are not susceptible to the problems of parametric regression analysis.

The demand for access

There is very little data available on the price-elasticity of demand for access to urban water supplies. In theory, the price-elasticity of demand for access should be zero if connections are made compulsory. However, in practice this is usually not workable, especially in developing countries. Evidence from Columbia suggests that a significant number of urban households will choose not to connect to the public water system despite legal connection requirements (Bahl and Linn, 1992: 298). The price-elasticity of demand for official connections is likely to be a function of how easy it is to connect illegally to the network and how much this costs relative to an official connection. For example, in Bogotá and Jakarta, illegal connections

have been quite common in poor neighbourhoods and have been related to the high cost of connections (Bahl and Linn, 1992: 298). McPhail (1994) also concluded that in the urban areas of Tunis, it appears that the most important obstacle in connecting to the piped water system is the utility-required cash down payment. Some attribute this to a failure in the household credit market rather than the cost of the connection (see Singh *et al*, 1993). Alternatively, illegal connections could arise as a result of an unfulfilled demand due to a the lack of institutional capacity or adequate infrastructure to make the connections (McPhail, 1993). The price-elasticity of demand for connections is also likely to be a function of income and is likely to be much higher for low income households compared to high income households. If alternatives are available, then the price-elasticity of demand is likely to be higher than otherwise.

Contingent valuation methods can be used to assess the willingness-to-pay for individual household connections to a piped water system. However, poor households in developing countries generally will not be able to pay the full capital cost of the connection and hence the value of undertaking contingent valuation surveys *solely* for this purpose is questionable.

Contingent valuation

Goldblatt (1997) notes that remarkably few studies have been undertaken in the water supply sector in general.[295] It is also apparent from his review that even fewer willingness-to-pay studies on water have been undertaken in urban areas.

The available evidence on water vending suggests that where public supplies are not adequate, it is the poor who end up paying most (per unit) for water and it is not unusual for these households to spend up to 20 percent of their income on water and sometimes even more than this (Goldblatt, 1997: 25; Cairncross and Kinnear, 1992).

A number of studies found willingness-to-pay surprisingly high (Whittington *et al*, 1989, McPhail, 1993). However, it is not possible to generalise from these results.

Meta-surveys have been undertaken in an attempt to understand the key factors affecting willingness-to-pay. Determinants of willingness-to-pay may be divided into three categories: socio-economic and demographic, the nature of the supply and available alternatives, and the perception of the role of government. Although household income was found to be an important determinant, it is not necessarily the overriding determinant (Goldblatt, 1997: 30). Gender and education have been found to be statistically significant determinants of willingness-to-pay. The difference in the characteristics of existing and proposed

[295] Goldblatt's (1997) excellent review of contingent valuation studies is used as the primary source for the evidence presented here.

improvements to supplies is a strong determinant of willingness-to-pay; so is the amount that people are currently paying for water. It has been found, not surprisingly, that people are willing to pay substantially more for private connections than access to a public tap (Goldblatt, 1997: 30). Lastly, the attitude of the community towards government and the perception of the role and responsibility of government as well as the *likelihood and expectation* that the government will provide subsidised services significantly influences willingness-to-pay. The World Bank has noted that "the sense of entitlement and equity may be a significant obstacle to the charging of realistic prices for water" (World Bank Water Demand Research Team, 1993: 58).

Goldblatt (1997) undertook a contingent valuation study of willingness-to-pay in two informal urban settlements in South Africa. His study found that there was almost universal agreement amongst the households surveyed that payments for water supplies were necessary; some 64 percent of households would only connect to a piped water supply system if their monthly expenditure was below five percent of their income (thus the results were broadly supportive or the traditional "five percent rule"); this amount equated more or less to the operating cost of a full level of service *but only for a very small amount of water* and could not cover operating costs for the *likely* consumption from a private connection nor the capital costs.

There were two very distinct limitations to the study. First, households could estimate how much they were willing to pay on a monthly basis but were unable to estimate *how much* water they would consume with a private household connection, and in particular the marginal value of the increased consumption.[296] Second, the survey was unable to determine how *political and social factors* affect willingness-to-pay. The report noted that the results of a willingness-to-pay study "[do] not negate the possibility that political will is the transcendent force controlling the speed of improvements in water supply" and further that it does not provide answers to "the *moral questions concerning the welfare role of government*, and whether water supplies, and other urban services, are a good vehicle for pursuing welfare strategies" (Goldblatt, 1997: 117). For example, Goldblatt argues that "although poor urban residents are willing to pay an amount adequate to cover the [costs of] their water supplies, *it [may] not [be] appropriate to expect low-income households to spend five percent of their income on water alone*. Given the importance of water as a basic need, it could be argued that it provides a useful vehicle for subsidisation of the poor" (1997: 117). In fact, the results of the survey support this argument. Households *were* having to pay for water from vendors from public standpipes and *were* consuming *less than 15 lcd* which is generally regarded as

[296] Goldblatt notes that the results "suggest that respondents made their bids based on a percent of budget available for water supply or on a total monthly amount they were willing to pay and not on a valuation of a quantity of water *per se*" (1997: 120).

inadequate. This may have to do with supply constraints (wide spacing of public taps), but it is equally probable that the small consumption arises from financial constraints, that is, the high cost of the water from vendors. The last point is that the reliability of willingness-to-pay surveys to predict consumer behaviour can be ascertained only by conducting follow-up studies in the communities after they have received improved water surveys.

The author collected data on willingness to pay for water in urban areas in Uganda (Eberhard, 2000). Where alternative sources of water are not readily available, willingness to pay for water is high, up to $3 per kl which is more than six times the price of water from the piped network. "Willingness", in this sense, is a misleading term; it is more likely that households are faced with worse alternatives or no real choice at all. Households "afford" these high payments in the sense that they actually make them, but many households spend more than 10% of their incomes on water, suggesting that sacrifices on other important expenditure items are being made. It is therefore not surprising that the availability of alternative water sources significantly affects the willingness to pay for vended water or standpipe. Average consumption from standpipes is between 10 and 15 litres per capita per day (lcd). Many households rely on informal water sources for additional needs (primarily bathing and washing). The consumption of water from standpipes is not price sensitive (average consumption from standpipes charging very different prices for water is very similar).

A considerable proportion of households without private connections currently spend $6 per month for water from standpipes and/or vendors (20% of households spend less than $40 per month on all expenditure items, hence for 20% of households an expenditure of $6 accounts for more than 15% of household expenditure). Households who are currently paying $6 per month for public standpipe water could "afford" (arguably) a private connection provided they did not have to pay for the physical cost of the connection nor a fixed monthly fee, and the household was able to limit its consumption to 11 kl per month (equivalent to about 75 lcd for a family of 5). (Average consumption for private connections is 32 kl per connection per month.) The high cost of connection ($200) is a real barrier to accessing the piped network. New private connections also are constrained by the absence of an adequate secondary and tertiary distribution network in many places.

In summary, contingent valuation surveys of willingness to pay cannot be used to demonstrate price-quantity relationships, nor are they useful for predicting the *rate* of connecting to a network, although they can give an indication of a maximum amount that households may be willing to pay on a monthly basis for improved water supplies. The latter result needs to be interpreted cautiously as it does not take into account the political and social context of

services provision. Also, typically there may be a proportion of households who may prove to be *unable* to pay for services even though they may be *willing* to pay.

Consumer surplus and welfare

Renzetti (1992), noting that very few studies have been undertaken which examine the welfare effects of water price reform, undertook such an analysis for Vancouver, Canada. Renzetti's starting premise was that marginal-cost pricing will maximise social welfare. He noted that marginal-cost prices, in fact, can be interpreted in different ways and he tested three different types of marginal-cost pricing (Ramsey pricing and two forms of seasonal two-part short-run marginal-cost pricing with a revenue constraint) against both the currently employed pricing practice and average historic cost pricing. In order to analyse the overall welfare effects of a change in the pricing schema used, he assumes that *the distribution of household water demand is identical to the distribution of incomes* and then makes use of a "representative household" to make the Marshallian consumer surplus welfare evaluations. The consumption data set for this "representative household" is obtained by dividing aggregate residential water purchases per month by the number of residential consumers. Residential water demand estimates are calculated using a two-stage least squares approach with an instrumental variable for price (to avoid simultaneity bias) (Renzetti, 1992: 153).

The results of the regression analysis of water demand show an income-elasticity of less than 0.1 which flatly contradicts the assumption used to generate the "representative household". The estimates of the price-elasticity of household demand were found not to be statistically significant but were used nevertheless, ostensibly because "they are quite close to the estimates of summer and winter price-elasticities reported by Howe and Linaweaver [1967]", and notwithstanding the fact that these estimates were calculated 25 years previously (Renzetti, 1992: 154). (No other justification was given for the use of the statistically insignificant results.) The price-elasticity for demand for water is also calculated as an average point-elasticity irrespective of consumer income. This is obviously a problem for the validity of the welfare analysis undertaken. A separate demand equation was calculated for aggregate industrial demand and the price-elasticity of demand for industrial water was estimated to be -1.9. Renzetti did not comment on the fact that the calculated elasticity is large compared to those reported in other studies, nor did he suggest any reasons for this.

The change in aggregate welfare was estimated by measuring the change in each user group's (residential and industrial) Marshallian consumer surplus. First the Marshallian surplus for the representative household was estimated, then this was aggregated over all income levels. While Renzetti notes that "it is well understood that the change in welfare of a heterogeneous population is not perfectly indexed by a change in aggregate Marshallian consumer surplus"

he defends his choice of method by making two assumptions: the demand for water is independent of the demand for outputs from the commercial sector, and the industrial sector is either perfectly competitive or faces a linear demand curve (1992: 158). These are not particularly plausible assumptions. Quite apart from this, Renzetti's analysis in unable to take account of the distributional outcomes between households.

Renzetti found that implementing a revenue constrained two-part price with a fixed charge to make up the deficit and a marginal price based on off-peak short-run marginal costs and peak long-run marginal costs would result in an overall increase in welfare of about 4 percent compared to average cost pricing. In contrast to this, implementation of Ramsey prices would result in a net reduction in aggregate welfare of 13 percent compared to average cost pricing.

The price changes result in an increase in aggregate consumer surplus in the industrial sector and a reduction in aggregate consumer surplus in the residential sector. This is because the demand of water was estimated to be much more price-elastic in the industrial sector compared to the household sector and the marginal-cost pricing rule reduced the commodity charge for industrial consumers.

The restrictive assumptions necessary for the calculation of the overall welfare effect of price reform using the Marshallian consumer surplus mean that the results obtained from the analysis may be misleading. The use of a representative household and the assumptions required to sustain this are especially problematic. Moreover, the method is not able to analyse the inter-household welfare distribution implications of water price reform, a topic that is particularly important in a developing country context. I conclude that Renzetti's methodology is not suitable for the analysis of the welfare effects of water price reform.

Distribution analysis using density functions

No studies of distribution or inequality in relation to the provision and pricing of water using density functions have been reported in the literature. Deaton (1997) used this approach to study the distributional implications of reform to the price of rice in Thailand and the implementation of an age-qualified state pension in South Africa.

Nonparametric density functions appear to be a promising methodology for use in the analysis of the distributional implications of water policy and pricing reform. The author applied this method to a case-study of water pricing in Grahamstown, South Africa (Eberhard, 1999c). The analysis is based on census data (by enumerator area), the municipal valuation roll and water consumption data from the municipal billing system.

It is not easy to link the census data directly to water consumption data. The Central Statistics Service does not release household level data in such a way as to make a direct link to water consumption information possible. However, average household income per enumerator area (typically a geographically contiguous grouping of 100 to 300 households) can be calculated and used to good effect.

Average household income. Average monthly income per household in each enumerator area (EA) in Grahamstown together with the cumulative population across these is shown in Figure 5. (Data were obtained for 83 enumerator areas.)[297] The discrepancy in average incomes between the areas with low and high monthly incomes is striking. This data could be used to target tariff policies. For example, connection pricing policies (the cost of a new connection and the monthly or annual fee) could be based on area characteristics if other more suitable information is not available.

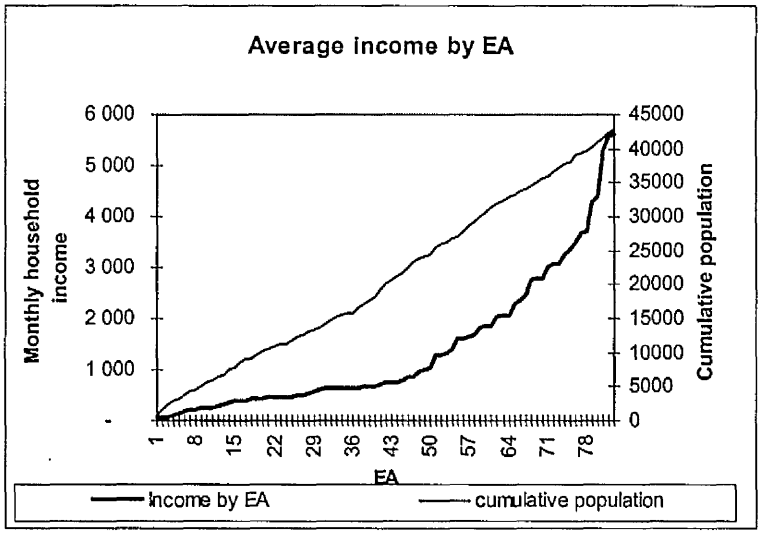

Figure 5: Average household income (Rands) by Enumerator Area (EA) in Grahamstown

Household size distribution. The census data also provide information on household sizes which are presented in Figure 6. The data show that average household sizes of more than 6 are not uncommon. Of more interest is the distribution of household size within the enumerator areas. It is not uncommon for one-sixth of households in an enumerator area to have a household size of more than 10 and for maximum household sizes to be up to twenty. This analysis suggests caution with respect to the progressivity claim of steep increasing block price structures.

[297] Enumerator areas with less than fifty households were discarded.

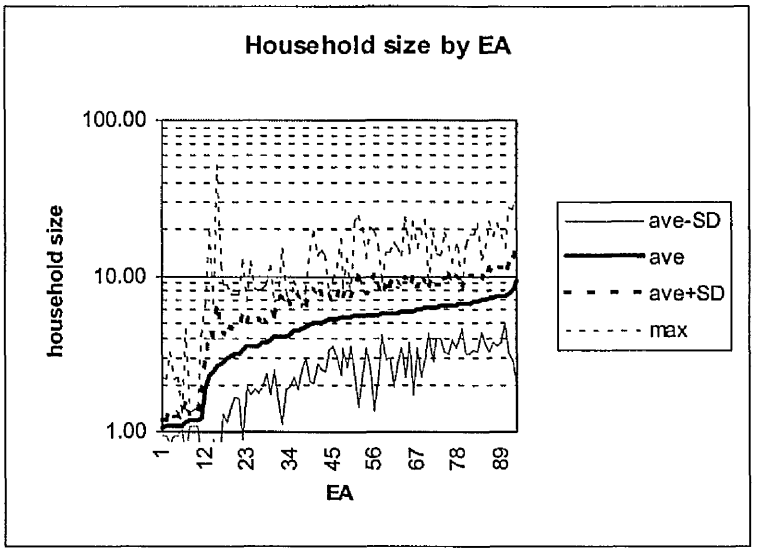

Figure 6: Household size distribution by enumerator area in Grahamstown

Census data, when analysed by enumerator area, can provide a useful cross-check on the likely outcomes of different pricing policies and may be used to improve the targeting of price subsidies in the absence of more suitable information.

The valuation roll provides another useful source of information for the pricing policy analyst. Typically, the valuation roll provides information on the land and/or property values in the municipal area, the type of land-use (for example, business, residential or institutional), the property area and amount of general rates levied. In contrast to the Census information, this data can be correlated with water consumption information.

In the case of Grahamstown, the valuation roll was obtained. (Unfortunately, the roll was only available for "Grahamstown West" – this area was formerly zoned as "white" under apartheid policies.) Non-parametric analysis was used to map the density distributions of water consumption against residential property values and property areas respectively in Grahamstown West. The results of this analysis (presented in the Appendix 2) show there are quite clear relationships between the density distributions of property value and consumption, and between property area and consumption, although there is a significant spread in the data. In the case of property value, there is a significant density concentration where property values are in range R40 000 to R80 000 and water consumption in the range 10 to 30 kl per month. However, there is no obvious relationship between consumption and property value where consumption exceeds 30 kl per month. In the case of property area, these are clustered in the range 400 to 1200 m^2 with corresponding consumption in the range 10 to 30 kl per month. Again, there is no obvious relationship between property area and consumption where

consumption exceeds 30 kl per month. This analysis could be extended to examining the incidence of different price reforms (in relation to both annual rates assessments, annual or monthly fixed charges and linear or non-linear consumption related charges).

The results of this analysis show that nonparametric density analysis may be a powerful tool for examining the incidence of different water pricing reforms. Alternative multiple-regression-type analyses have significant limitations which are discussed in Chapter 6.

Summary and conclusions

The review of the neo-classical theory of welfare measurement revealed a number of inherent limitations. Consumer well-being bears little relation to welfare as measured by the utility metric. The theory of consumer welfare is dependent on the measurement of individual consumer welfare. In practice, welfare measurements often rely on the constitution of a "representative consumer" but this hides important inter-household effects and the aggregation of welfare effects across consumers using this construction is not strictly valid. Aggregate welfare measures typically rely on the highly problematic assumption that the value of a change in consumption is the same for rich and poor consumers alike. Although social welfare functions are able to address this issue, their use gives rise to other own problems – the choice of welfare function and the weights used are subjective and the results may hide more than they reveal. It is not the subjectivity itself that is a problem, but the tendency for the subjectivity to be unacknowledged or insufficiently emphasised in practical applications.

Contingent valuation methodology is flawed with respect to both theory and practice. Theoretically, households are required to leap across a double contingency – to value a service both outside of their experience and with an unknown future quantity-price combination. In practice, surveys also may suffer from strategic and starting point biases. The political-economic context will typically have an overriding influence on consumer demand and welfare yet contingent valuation methodology is unable adequately to take this into account.

Nonparametric density functions provide a promising methodology for analysing the distributional effects of price reform because it is not theory laden, it enables the "data to speak for themselves" and it is transparent.

There is remarkably little literature reporting empirical measurements of welfare and inequality within the water sector. The available literature was reviewed and its limitations and weaknesses pointed out. An application of nonparametric density analysis to distributional issues in an urban water context in South Africa was demonstrated. This showed that this

approach has considerable potential though it also has limitations which are imposed by data constraints.

5. Implications for a critical-realist approach

An analysis of justice and equality inevitably involves subjectivity. This does not present a valid objection to the consideration of these topics.[298] Political philosophers endeavour to develop a coherent framework within which justice and equality can be evaluated. Three viewpoints were presented: utilitarianism, Rawls' "justice as fairness" and Sen's "equality of capability". The differences between these philosophical approaches arise largely (but not exclusively) from the choice of the basal equality space and the relative emphasis put on this space. It was pointed out that the choice of space in any context, and indeed the meanings attributed to the concepts of justice and equality, will be socially determined and contested, and will be dependent on the specific political-economic history. Therefore, an analysis of justice and inequality which ignores the *contestedness* of the meanings of justice and equality and ignores how current injustices and inequalities came into being will be of limited value.

The prominence and importance of justice and equality issues in the water sector in general, and the urban water specifically, was noted. The practice of urban water pricing will be heavily influenced by how the contest over the meanings is played out. Consequently, it is not possible to understand the practice of urban water pricing in any specific location without an understanding of the political-economic history giving rise to present circumstances.[299] Further, it was argued that Sen's emphasis on the "freedoms to function" provides the analytical space to examine *antecedent diversities* in functionings and capabilities, including entrenched inequalities arising from gender, race, class and age. In order to meet Rawls' "equality of primary goods" and Sen's "equality of capability" goals, an approach to urban water pricing should seek, at a minimum, to secure universal access to and use of a specified threshold consumption necessary to be healthy and productive. A more radical interpretation of Rawls and Sen would imply greater emphasis on the redistribution of primary goods to ensure equality of capability. The feasible means to achieve these goals remain unexplored by Rawls and Sen.

Different approaches to the measurement of welfare and inequality were critically reviewed. The specific weaknesses of traditional social welfare evaluation within neo-classical economics

[298] It may be noted here that the analysis of efficiency likewise requires numerous and important subjective judgements. (See Chapters 2 and 3.)

[299] A methodology for undertaking a political-economic analysis of urban water pricing was presented in Chapter 4.

were highlighted. Various alternatives were examined, including contingent valuation and nonparametric density analysis. Empirical evidence was presented and evaluated. It was noted that there is a remarkable paucity of systematic evaluation of the welfare and equity effects of price reforms in the water sector. Primary data for Grahamstown were analysed using distributional analysis and bivariate nonparametric density functions, demonstrating the potential benefits of these techniques to supplement the understanding gained from a political-economic analysis of water pricing in any particular context.

In conclusion, the review of justice and inequality presented here reinforces and extends the conclusions presented in Chapter 4. Moreover, to borrow from words of an earlier period, a *sole* focus on inequality is to 'make the great error of reformers and philanthropists ... to nibble at the consequences of unjust power, instead of redressing the injustice itself' (Mill, 1965: 953).

Chapter 6: The water environment

Ensuring sustainability

> *The decimation of the Aral Sea in central Asia ranks among the more dramatic in a long list of natural areas destroyed, degraded, or at grave risk from human use and abuse of water. The damming, diverting, and polluting of watercourses with little regard for the environmental services they provide has wreaked havoc on the world's wetlands, deltas, lakes, and riverine habits. Of all the threatened forms of biological diversity on earth, aquatic life may be the most in jeopardy. (Postel, 1992: 61)*

1. Introduction

Water is inextricably linked to the natural environment and the development of a pricing methodology would be incomplete without consideration of the relationship between water pricing and the environment.

Environmental concerns became prominent in the water sector in the early 1970s. Engineering solutions to the problems of "water scarcity" dominated the debate at that time. Issues related to water resource quality and ecological stress came to the fore in the 1980s. The field of environmental economics grew rapidly in response to the popularisation of these concerns in the "water crisis literature" (my term). A combination of factors has led to increased opposition to large dams and the search for new solutions to meet future water demands and to manage water stress. I argue that both technologically-based and narrow environmental economics-based solutions are ill-conceived as they fail to take adequate account of political-economic considerations. (Section 2 presents a detailed criticism of the neo-classical based environmental economics approach.) Postel (1997) takes the search for solutions a step further by calling for the development of a "water ethic". While this is admirable, the conditions under which such an ethic might develop are left unexplored. I argue that the social value attributed to the environment, and hence the nature and effect of social interaction and management of the environment, are fundamentally contingent on the underlying political-economic dynamics. The nature of these dynamics is illustrated with reference to the debate around large dams.

The efficacy of pricing to achieve "efficient" resource use is dependent both on the definition of efficiency and on the actual effect price changes have on water demand. Much of this chapter is devoted to examining the theory and empirical measurement of water demand in detail. It shows that the practice of demand measurement is formally inconsistent with neo-

classical demand theory and demonstrates that insurmountable methodological and practical hurdles exist (Section 3). This renders empirical price-elasticity estimates of demand largely meaningless for all intents and purposes.

I discuss alternative definitions of efficiency and argue that X-efficiency and *optimal beneficial use* provide more satisfactory definitions of efficiency which are more explicitly cognisant of the political-economic context and which are able to be pursued in conjunction with the consideration of equity and environmental sustainability concerns (Section 4).

Finally I conclude that water resources management is fundamentally a product of the underlying political economy.

I make two original contributions in this chapter. The critical review of the econometric and theoretical literature on water demand is more comprehensive and detailed than any that exists in the literature at present. It presents a serious criticism of the practice of empirical analysis in the field with important practical consequences. These consequences, when combined with the critical review of the environmental literature on sustainable development, present new insights into urban water pricing which contribute substantively to the critical-realist approach to urban water pricing advocated here.

2. Water pricing and the environment

Environmental concerns influence water pricing in many ways. Space does not permit a comprehensive review and the discussion therefore is restricted to policies and approaches advocated by environmentalists in three areas: the "global water crisis", opposition to large dams, and sustainable development.

"Global water crisis"

Malin Falkenmark was the first to make the "global water crisis" viewpoint prominent. In the early 1970s she asserted that a crisis exists (or looms in the near future) because the "stock" of fresh water resources is inadequate to meet current and future needs locally in many countries and regions (and even globally).[300] Although this theme is neither new nor unique to water resources,[301] it has gained increasing international currency and a plethora of books on the "global water crisis" has been published.[302]

[300] See Falkenmark and Lindh (1975).

[301] See, for example, Meadows *et al* (1972) and Brown (1995).

[302] See, for example, Clarke (1991), Gleick (1993) and Postel (1992, 1999).

Falkenmark and Lindh (1975) focused on hydrology and the need to remedy the crisis by "extensive interference with the natural hydrological cycle" to "transfer water from the places where it is available to the places where it forms a necessary ingredient of human life" by means of large projects. This required the application of hydrological skills and international co-operation to achieve "more efficient joint use of multinational water resources".[303] The limits to this supply side approach were soon recognised in the context of the cost of large projects and a ground swell of opposition to these on various grounds (see below). An approach that focuses only on supply side measures is clearly flawed.

In response to the increasing opposition to large-scale water supply projects, Clarke (1991) emphasised local approaches to water scarcity. He called for a "water security programme" comprising the following initiatives: to increase local water availability through initiatives such as water harvesting and improved management; to increase local (decentralised) storage; to include water needs in development project planning; to develop local food storage; to stabilise water prices and ensure affordability, especially for poor households, and to maintain food self-sufficiency in staples; to create a "water aid agency" to supply financial and technical aid to water crises and for pro-active water planning to avert crises; and to develop an early warning system for droughts (Clarke, 1991: 175). Obviously, local approaches can provide solutions in a limited range of contexts only. Certainly, such an approach will not solve the problems of water supply for large urban centres (and will probably be of only limited application in rural areas).

Whilst Postel (1997) also presents an "alarmist" view with respect to the *availability* of global water resources,[304] the policies and strategies she advocates to avert this "impending crisis" are more holistic and balanced than the "supply side" and "local sources" solutions presented above. Recognising that supply side options cannot be ignored and that local sources should be responsibly exploited, she recommends reducing demand through conservation, improved efficiency and better management. She embraces the importance and necessity of providing economic incentives to help achieve these objectives: "setting prices closer to the real cost of supplying water is a key component of both urban and industrial conservation" (1997: 166). However, Postel argues that economic incentives *on their own* are insufficient, and may result in perverse outcomes, and calls for the establishment of a "water ethic" which has, at its base, a "deep appreciation of water's fundamental role as the basis of life" (1997: x):

[303] This statement, which is the only one in the book with any economic content, is not amplified at all.

[304] Postel argues that over 50 percent of accessible water resources was being used in 1990 (35 percent for irrigation, industry and domestic needs and 19 percent for in-stream flow requirements); that water demand trebled between 1950 and 1990 and is expected to double again within the next 35 years; and that water resources will be over-reached by 2025 (Postel, 1997).

> *Without [this ethic], we will keep whittling away [water's] life sustaining ecological functions. Drip irrigation, low-flush toilets, and other efficiency measures are critically important because they enable us to do more with less. But if we use the water saved through efficiency measures merely to fill more swimming pools, to irrigate more golf courses, and to support millions more meat-rich diets, we will get no closer to a sustainable world; we will simply allow unsustainable levels of consumption and population growth to persist a bit longer. (Postel, 1997: x)*

This "ethical approach" recognises that the inequality in resource allocation and excessive luxurious resource use are primary contributors to resource constraints (particularly those affecting the poor). In this context, Postel criticises the trend towards the commodification of water as follows:

> *In principle, there is nothing wrong with properly valuing water's role as a commodity. ... The risk, however, is that water's economic functions will be elevated over its life support functions, and that the three pillars of sustainability – efficiency, equity and ecosystem protection – will not be given equal weight. (Postel, 1997: xxviii)*

In Postel's view, the pressure for the commodification of water has arisen out of the need to finance rising capital and operating and maintenance costs of water supply but she cautions that privatisation is inherently risky to both the poor and the environment.

Many economists would point out that, as the scarcity of a resource increases, price adjustments will automatically result in demand being balanced with available supplies.[305] Further, environmental economists would argue that the proper valuation of the environment would remove price distortions and create the right balance between development and conservation (see below). In response, Postel argues that, at least as far as the environment and water are concerned, price responses are both too little and too late,[306] and furthermore, "getting the prices right" is not enough because a mere correction of prices does not address equity concerns in any real way, and without this sustainable development will be unachievable.

Whilst Postel's approach implies a political-economic analysis, her proposed solution (the development of a "environmental ethic") is utopian and lacks substance: it fails to address important concerns such as who will develop it, how it will be developed, and in whose interests it will be developed. The solutions proposed are of limited value because they are not grounded in political-economic realities.

[305] Higher prices can potentially serve the dual function of reducing demand *and* increasing supplies.

[306] See the Aral Sea and the Colorado River Delta examples cited later in this chapter.

Opposition to large dams

Large dams play an important role in supplying water to cities in both the developed and the developing worlds. Opposition to large dam projects has begun to exert an important influence on the development and status of these projects. The voices against large dam development are numerous and a comprehensive review is not presented here.[307] Key arguments against the development of large dams are outlined below.

Pearce (1992) argues that "everywhere large projects are both the consequence of and the justification for authoritarian government" and comments that it is "no surprise" that the US Corps of Engineers is the prominent builder of large dams in the United States and that "Stalin's secret police supervised the construction of [the Soviet Union's] dams and canals" (Pearce, 1992: 345).

Ward (1997) argues that large dams lend themselves to political influence and that this has served to promote some large dams, citing as an example the High Aswan Dam. Ward contends that political influence (to achieve various political goals and/or private financial gain) is "more likely than not" to affect large dam construction decisions and gives the example of British finance for the Malaysian Pergau dam being (illegally) contingent on Malaysia's purchase of British military hardware and resulting in the go-ahead of an unsound dam project.[308]

Large dams often involve large-scale community displacements with consequent social and economic costs.[309] In some instances unique community lifestyles are lost forever as occurred, for example, during the construction of the Kariba Dam in Zimbabwe. Large dams may also adversely affect health. For example, Lake Nasser, formed behind the Aswan High Dam, has been blamed for a "dramatic increase" in waterborne diseases (Postel, 1997: 57).

Large dams almost inevitably give rise to significant environmental damage. The kinds of damage include increased salinity in soils and water bodies, loss of natural exploitable resources (for example, fish stocks) and loss of species. The environmental (and economic)

[307] See, for example, Ribeiro (1994), Ryder (1990), Lavergne (1984), Goldsmith and Hilyard (1984), Pearce (1992), Ward (1997), and Topping (1995).

[308] The aid amount was £234 million. The value of the armaments deal which included jet fighters and submarines was £1.3 billion. An all-British consortium also won a £400 million construction contract for the dam. The ODA (the conduit of the British aid money) had advised the Foreign Secretary that "the dam was not a sound development project" ("High court rules money for dam project was unlawful" *The Guardian*, 11 November 1994, quoted in Ward, 1997: 57).

[309] The Three Gorges Dam will require the resettlement of many hundreds of thousands of people (Ward, 1997).

damage caused to the Aral Sea is considered to be largely irreversible (Postel, 1997).[310] The damming and over-exploitation of the Colorado River in the United States has resulted in irreversible damage to the Colorado River delta in Mexico taking away the economic base and livelihood of whole communities dependent on the delta (Postel, 1997). There appears to be a trend towards the decommissioning of (mostly small) dams in the United States in an effort to restore natural environments.[311]

Ribeiro (1994) argues that very large projects primarily serve to further capitalist interests and while some people assert that large dams, *per se*, are anti-developmental and undemocratic and should not be constructed under any circumstances (Pearce, 1992).[312] Others argue that large dam construction should only go ahead where the benefits exceed the cost provided that the costs accurately reflect the true costs, including the environmental, social and other damages and all opportunity costs. The latter group contend that cost benefit analyses need to be more thorough than in the past. In this context, the World Commission on Dams was established in 1998 with the brief of "bringing a more responsible approach to investments in large dam projects by conducting the first-ever independent global review of their costs and benefits" and "to establish standards for large dams and assess alternatives".[313]

Large dam projects in developing countries invariably require international finance. Consequently, multinational finance agencies such as the World Bank have considerable influence.[314] Large dam projects clearly are a "site of contest". The outcomes of this contest, and the relevance of these outcomes for particular countries, will be determined by specific political-economic forces. Developing countries are particularly vulnerable to international capitalist interests mediated through multilateral finance agencies.[315]

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[310] The Aral Sea, which has shrunk to such an extent that some of the Sea's ports are now more than 30km away from the water, used to yield over 25 000 tons of fish per annum but now the harvest is zero (Ward, 1997: 51).

[311] See Gleick (2000).

[312] See also Singh (1997).

[313] "By working closely with both advocates and opponents of large dams, the Commission's 12 members will seek to overcome the deadlock which has polarised the international debate on large dams" (Press statement on the creation of the Commission on 18 February 1998). The meeting, at which the decision to establishment the Commission was taken, was hosted by the World Bank and IUCN-The World Conservation Union and included a broad array of stakeholders.

[314] In South Africa, for example, the construction of further phases of the Lesotho Highlands Water project could be contingent on international financial support.

[315] Ribeiro (1994) gives an excellent account of the political economy of large dam construction.

Pricing and sustainable development

David Pearce's writings are used as the basis for the discussion on pricing and sustainable development presented below.[316] The implications of sustainability for a critical-realist approach to urban water pricing are evaluated in the following section.

Defining sustainable development. Pearce *et al* (1990a) take as their starting point the following definition of sustainable development: "to ensure that development meets the needs of the present without compromising the ability of future generations to meet their own needs".[317] Pearce *et al* (1990a) argue that there are three core implications of an understanding of sustainable development for economic analysis: the natural environment has a value over and above its pure "resource utility value" because the state of the environment affects both directly and indirectly a wider concept of "wealth" which includes the quality of life; the time horizon of economic analysis should be extended to include future generations;[318] and intra-generational equity concerns must be addressed because inequalities give rise to environmental degradation. Pearce *et al* (1990a) argue that maintaining a constant stock of wealth (capital and money assets) is a necessary but not a sufficient condition for sustainable development. They assert that the value of the stock of natural assets must also be maintained, or at the very minimum the sum of the stock of capital and natural assets must be maintained. Toman (1994: 409) notes that sustainability is "intimately wrapped up with human values and institutions" hence implicitly recognising the political-economic underpinning of the meanings attributed to sustainability and its practical manifestations. In this light, he argues for the imposition of "safe minimum [environmental] standards determined through political discourse and other complex social processes" (1994: 409).

A focus on environmental sustainability thus extends neo-classical economics in three ways: it highlights the rights of future generations; it recognises that inequalities give rise to environmental degradation; and it requires the measurement of the stock of environmental resources as part of welfare accounting.

[316] See Pearce (1989), Pearce *et al* (1990ab), Pearce and Turner (1989) and Pearce and Warford (1993). David Pearce is a prolific writer on the subject of environmental economics and sustainable development. He has consulted extensively for international organisations including the OECD and World Bank and his influence is significant.

[317] This is taken from the Brundtland Commission's report "Our common future" (WCED, 1987) which established the concept of sustainable development as the basis for an integrated approach to economic policy (Pearce *et al*, 1990a). See Pearce *et al* (1990a) for a discussion of alternative definitions of sustainable development.

[318] Applied welfare economics typically is highly "presentist" (occupied with the current generation). *Any* positive inter-generational discount rate has the effect that the welfare of individuals living one generation in the future is scarcely relevant to current decision making (Toman, 1994: 400).

Valuing the natural environment. Pearce *et al* (1990a) argue that natural environmental assets are not valued because of market failure (arising from the absence, or poor functioning, of markets). They disagree with the argument that markets don't exist because the resource is not scarce and that markets will develop spontaneously as scarcity increases.[319] Various techniques are advocated for placing values on the environment.[320] Although Pearce *et al* recognise that these techniques are not without problems, they allege that an answer that is "approximately right" is better than an answer that is "precisely wrong".[321] Pearce fails to point out that the values attributed to the natural environment are inherently subjective and inevitably socially contested, and therefore profoundly influenced by the political-economic context.

Pro-active versus reactive policies. Pearce *et al* (1990a) argue for a pro-active approach to environmental degradation notwithstanding the general "time preference of consumers" (who would prefer to delay ameliorative expenditure) and the potential for delay to generate additional information that may reduce future costs. Three important factors counter these preferences for delay: risk aversion in the presence of uncertainty; the irreversibility of some environmental degradation; and the cost escalation often associated with increased degradation. They argue that these push the balance in favour of anticipatory rather than reactive environmental policies. On the other hand, political-economic factors are likely to act in the opposite direction, that is, to push costs onto future generations. Pearce does not make this latter point explicit.

Cost-benefit analysis. Pearce *et al* (1990a) argue for greater efforts to be made to integrate environmental costs and benefits into project appraisal and for the inclusion of a sustainability constraint within any programme of investments. The latter may be accomplished through the inclusion of a project with positive environmental benefits that negates any negative outcomes caused by the other projects such that environmental assets in the aggregate are maintained. The general argument underlying this is that higher costs (and hence prices) will reduce environmental damage but this is not necessarily the case (see below).

Pricing and sustainability. Pearce and Warford summarise their argument for using price incentives to promote environmental sustainability as follows:

[319] Their argument against this is based on the fact that many processes of environmental damage are irreversible and that markets in environmental resources often develop too late to prevent this damage or do not develop at all (where property rights are difficult or impossible to assign).

[320] See Pearce *et al* (1990a) and Dixon and Hufschmidt (1986).

[321] Toman (1994), for example, notes that environmental impacts may be uncertain, large and irreversible, posing particular problems for the meaningful valuation of environmental assets.

> *Prices are powerful incentives. If prices are set too low, excessive use is made of the resource. The extreme example is zero-priced resources. ... To secure an efficient use of resources, outputs should be priced at their marginal social cost, which comprises the marginal costs of production and the external costs of the resource degradation caused by producing the good. (Pearce and Warford, 1993: 32)*

The marginal cost of production referred to is the long-run marginal cost although the definition and calculation of this are assumed to be unproblematic and are not discussed at all. This argument is, of course, the standard neo-classical one, but with a greater emphasis on externalities. Environmental economists (such as Pearce) stress market failures, in particular those which cause private costs to diverge from social costs. This failure is attributed to inadequately defined property rights. They assert that this failure can be fixed through two routes: full privatisation (in which private property rights over the resource are established) or public regulation. They recognise that the former may not be feasible in all circumstances though they have no problems with that option in principle. For the latter they recommend using market-based incentives.

Whilst recognising that market failure provides a rationale for government intervention in markets, Pearce strongly cautions that public intervention in resource pricing frequently results in prices being set below even the private cost of production or supply (even in developed countries) with consequent "excessive" or wasteful use of resources and "considerable environmental degradation" (Pearce and Warford, 1993: 32, 174).[322] Of course, the Pareto-optimality claim in this context suffers from the same defects present in the standard neo-classical approach. Interestingly, Pearce and Warford recognise the divergence between the theory and practice, and the political-economic ramifications of this. For this reason they point out the contradictions in the policy advocacy of international agencies: "Although international agencies advise the developing world that interventions distort market signals and contribute to environmental degradation, they should also recognise that rich countries engage in similar policies" (1993: 174).[323]

Implications for a critical-realist approach

Economic value. A key tenet of the environmentalist approach is that water in and of itself (the drop of water in the stream or in the ground) should be assigned an "economic value". It

[322] For example, they note that electricity prices in the United States are set, on average, at a level 23 percent below the long-run marginal cost price and that the adoption of marginal-cost pricing could save $60 billion worth of energy (Pearce and Warford, 1993: 181).

[323] This is a case of "do as I say and not as I do". It can be argued that such approaches are to the advantage of capitalist interests in developed countries who continue to benefit from subsidies and "price distortions" whilst advocating their elimination in developing countries.

is argued that the under-pricing of resources is a key causal factor in the "overuse" of natural resources and the consequent environmental damage. The use of markets and other economic tools are advocated to determine the "true economic" value of water (see "Methodology for valuing water" below). The subjective nature of the determination, together with the contingency of the valuation on the prevailing income distribution, is seldom made explicit. Postel (1992) provides a rare criticism of the dangers of over-reliance on pricing, pointing out the perverse social consequences of, say, shifting "low value" water for agriculture to "high value" water for watering golf courses. Clearly, pricing is only a part of a much larger social picture that cannot be ignored. Over-reliance on a "get the prices right" argument is clearly dangerous and likely to be politically untenable.

Maintaining the stock of water sources. A *strong definition* of sustainable development implies that the physical stock of water resources available (measured in both quantity and quality) should be maintained for future generations. A *weak definition* of sustainable development implies that the sum of the value of the stock of the water resources and the value of the capital (money wealth) stock should be maintained over time.

In the case of groundwater, the strong definition would imply that the rate of extraction should not exceed the rate of replenishment. This could be achieved either through regulation or through pricing (with the price set such that demand equals the natural rate of replenishment). A weak definition would imply that the groundwater resource could be over-exploited or degraded provided that the wealth created by this action more than compensates for the value of the water and the environment that is lost or degraded. This raises the problem of how to value the environment (see below).

In the case of surface water, a strict application of the strong definition is probably untenable because it would mean that no consumptive use of the water could take place. A *non-strict* application of the strong definition could assert that the extraction of water from a river or stream is permissible as long as "no" (or minimal) harm is done to the natural environment. Minimum stream flow requirements could fit into this definition of sustainable development. It is likely to be easier to regulate this directly rather than by using price.[324] In this case, that portion of the water resource required to maintain the proper functioning of the environment is not subject to pricing or competing uses at all and is, in the true sense of the word, "priceless".

[324] Minimum stream flow requirements have been legislated in some countries (for example, the United States and South Africa).

The weak definition of sustainability would mean that the value added from using the water resource must be able to more than compensate for the damage. From an environmental point of view it is obvious that this definition is not very satisfactory as there is no guarantee that the value added will indeed be used to maintain the stock of natural assets.

An important point to note is that different approaches to the achievement of sustainability *typically* will have very different distributional consequences. A review of environmental legislation in the United States shows that the policies on water resources have moved from a weak to strong definition of sustainability over time and that this move has been contingent on political-economic developments.[325]

Methodology for valuing water. Pearce asserts that the privatisation of property rights would result in the proper valuation of the resource and hence in sustainability. This assertion is dubious. In the case of exclusive and sole private ownership of an aquifer, for example, there is no guarantee that this aquifer will be managed sustainably.[326] Given that the water resource is fugitive, water rights are particularly difficult and complex to define, giving rise to high transaction costs. One of the more intractable problems with the privatisation of the resource itself is the issue of equity.[327] Valuing water by means of a market is likely to be applicable in only a limited number of circumstances and other means of valuing water are necessary. Methodologies for the valuation of water are discussed in Gibbons (1986). The emphasis of these methods is on the utilitarian use of water in the environment, for example, the value of water for its pollution assimilation capacity or for recreation. Establishing values for the water resource itself remains problematic.

Pearce *et al* (1990a) argue that measurement difficulties should not cause valuation to be abandoned and that it is better to err on the side of higher rather than lower values, which is in accordance with the general sustainability preference for proactive policies. These arguments rest on the assumption that the "proper" valuation of the resource (assuming such an evaluation is achievable) will have the desirable consequences in terms of environmental sustainability. But this is by no means guaranteed. Attributing an economic value to water is clearly a subjective exercise that will be socially determined and dependent on the underlying political-economic context.

An alternative approach is to adopt "third best pricing" (Rogers, 1995: personal communication). This simply means paying particular attention to the outcomes of any price

[325] See Frederick (1994).

[326] See Porter (1996).

[327] See, for example, Bauer (1997).

change. This "method" emphases that water is part of a wider system, that numerous "feedback loops" exist and that it is not so much the absolute level of the price that matters but the effect that price has on a desired set of socially determined objectives.

Pricing and future investments – cost benefit analysis. The role of cost-benefit analysis in the selection of water supply projects has always been somewhat problematic because of the difficulty of measuring benefits.[328] In practice, the cost of the project is typically reduced to an average "price" per unit of water and it is presumed that, as long as there are consumers who are willing to purchase the water at that price, then the benefits will exceed the costs.[329] A "sustainable development" approach to cost-benefit analysis emphasises the need to include a resource cost and all environmental costs in the cost calculation. Not only is the determination of these costs subjective, the cost of future projects is also dependent on the subjective choice of discount rate.

Pricing and choice of discount rate. Pearce *et al* (1990a) argue that the discount rate should be set equal to "the" market rate for capital (without recognising that capital markets are fragmented and imperfect) and argue that risk and intergenerational equity issues should be addressed separately. They assert that the arguments for using a lower *social* discount rate are not persuasive because there is no objective basis for determining this rate. This argument is inconsistent because they do not use the same logic when advocating the valuation of natural resources that similarly has no objective basis of measurement. The *inherent subjectivity* involved in the choice of discount rate was shown in Chapter 3. The implication of this subjectivity is that economic analysis cannot be divorced from political-economic considerations.

Marginal-cost pricing. The sustainable development agenda of environmental economists generally supports the basic contention of neo-classical economics that resources should be priced at their marginal cost. The argument for this is based on the simple premise that if a resource is priced at below its marginal social cost, "too much" of the resource will be used, resulting in environmental damage. This is not so much an allocative-efficiency argument as a "resource damage" argument. The inherent subjectivity in the determination of marginal social costs and the distributional effects of marginal-cost pricing have been discussed in previous chapters.

Water ethic. The sustainability arguments of the "water crisis" advocates (for example, Postel, 1997) largely coincide with those of the environmental economists, who believe that

[328] See, for example, Schur (1993).

[329] The World Bank has used this approach, historically.

sustainability can be achieved through the appropriate valuation of the environment and that this can be largely achieved using market-based or market friendly techniques. The environmental economists' advocacy of marginal-cost pricing is compatible with neo-classical marginal-cost pricing. However they emphasise market failures and recommend ways to value environmental costs and benefits in the absence of markets. The need for political intervention to implement these recommendations is implicit in their discussion. However, important equity issues and the political economy implications of public intervention (or non-intervention) are not explored. Postel (1997) questions the efficacy of a purely economic approach suggesting that, in the absence of an appropriate "water ethic", it is inevitable that water resources will be degraded. The political economy underlying both the absence and formation of such an ethic remains unexplored.

Legislation. Legislation is likely to remain an essential component of regulating environmental use to promote sustainability. Pricing on its own it distinctly limited. Legislative developments are clearly contingent on the underlying political-economic context, a fact demonstrated in the history of the development of environmental legislation in the United States.[330]

3. Understanding water demand

Much of the empirical literature on water demand is concerned with the measurement of the response of water demand to changes in price. The rationale for this is obvious: if it is asserted that marginal-cost pricing will result in the Pareto-efficient allocation of resources then it must be shown that water demand does respond to price, and preferably that this response is elastic. The empirical literature on water demand that seeks to prove the above assertion should be based on the neo-classical theory of consumer demand.

The theory of household water demand

The conceptual poverty of the neo-classical theory of demand has been eloquently stated by Fine *et al* (1996):

[330] See Frederick (1994).

> *[The theory is distinguished by] its debasement of human rationale to the level of individualist and calculated hedonism; significantly, production and consumption share common analytic principles, with the latter equivalent to a self-employed firm manufacturing "utils" at minimum input cost. ... The theory is the same irrespective of the nature of the goods or activities concerned. ... [Goods are not understood as] distinct, vertically organised structures of provision subject to a wide range of socio-economic and cultural forces which have complex and contradictory outcomes.*

Notwithstanding this, the neo-classical theory of household water demand is often taken as a given in the water demand literature and then totally ignored in practice. The implications of the general theory for the empirical analysis of demand in general, and for water demand in particular, are set out below.[331]

Neo-classical theory starts with the primacy of the preferences of individual consumers (in this case, households).[332] If consumer choices are assumed to be "rational", then it follows that there exists a "preference representation function", which is called an ordinal utility function, of the form:[333]

$$u = f(q) = f(q_1, q_2, \ldots, q_N) \qquad (14)$$

where q_i is the amount of the ith commodity consumed and where there are N commodities.

The consumer's choice problem then is reduced to the constrained maximisation of utility.[334] That is,

$$\max u(q_1, q_2, \ldots, q_N) \text{ subject to the household budget constraint} \qquad (15)$$

The household budget constraint is usually (though not necessarily) assumed to be linear and is represented by:

$$\sum p_i q_i = w \qquad (16)$$

where w is defined as the total outlay (total household expenditure).

In principle, the solution to equations (15) and (16) is the system of ordinary or Marshallian demand functions:

$$q_i = g_i (p, w) \qquad (17)$$

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[331] The discussion follows Deaton and Muellbauer (1980) and Hanemann (1997).

[332] The terms consumer and household will be used synonymously in the text that follows, a practice that is hard to defend, but follows almost all the literature.

[333] It is said to be an *ordinal* utility function because the purpose of the function is to *order* preferences. The function represents a preference ordering, but is not necessarily unique.

[334] Rational consumers, by definition, wish to maximise their utility.

That is, each choice of the optimal quantity of good i to consume (q_i) is a function of the vector of prices (p) and the total household outlay (w).

It should be noted that the linear budget constraint imposes two restrictions on the properties of demand functions, namely, that they add up and are homogenous of degree zero. The first restriction is represented as follows:

$$\sum p_k g_k(p, w) = w \qquad (18)$$

The second restriction refers to the absence of "money illusion" and may be expressed as follows:

$$g_i(Kp, Kw) = g_i(p, w) \qquad (19)$$

where K is some scalar multiplier.

It is important to note that the budget constraint for a household facing a multipart water tariff will not be linear. The implications of this will be discussed later.

A general analysis in which the Marshallian demand (equation 17) is directly derived from the consumer maximisation problem (equation 15) is extremely difficult. The mathematical derivation of demand requires that preferences be strictly convex and that a consumer buy some of every good, and further that the utility function be smooth enough to differentiate twice. *Nothing in the specified consumer axioms guarantees this nor can additional axioms be introduced to ensure this without making unrealistic assumptions* (Deaton and Muellbauer, 1980:36).

Historically, many econometricians interested in the empirical analysis of demand have tended to accept these severe restrictions. Two forms of the utility function that have been used frequently in the past are the Cobb-Douglas and Stone-Geary utility functions:

$$u = Aq_1\alpha^1 q_2\alpha^2 \dots q_N\alpha^N \qquad (20)$$

$$u = A(q_1 - \gamma_1)\alpha^1 (q_2 - \gamma_2)\alpha^2 \dots (q_N - \gamma_N)\alpha^N \qquad (21)$$

The restrictions on the Cobb-Douglas function are that $A > 0$ and $\sum \alpha_i = 1$. In the Stone-Geary utility function (equation 21), the γs are interpreted as minimum levels of consumption (utility is derived only above a threshold consumption γ_i).

For the Cobb-Douglas utility function, the ordinary demand function takes the form:

$$q\,i = \frac{(\alpha_i\, w)}{p_i} \qquad i = 1 \dots N \qquad (22)$$

For the Stone-Geary utility function, the demand function takes the form:

$$q_i = \gamma_i + \frac{\alpha_i}{p_i} (w - \sum p_i \gamma_i) \quad i = 1 \ldots N \tag{23}$$

Price-elasticities can be calculated from the derivatives of these demand functions. Thus the own price-elasticity of demand is:

$$\eta_i^i \equiv \frac{p_i}{q_i} \frac{\delta g^i (p_1 \ldots p_N, w)}{\delta p_i} \tag{24}$$

For the Cobb-Douglas utility function this is always equal to -1 because of the restrictions placed on the form of the utility function.

Consumer demand theory predicts that the own-price-elasticity of demand will be negative, however, there is nothing in the theory that suggests that it should equate to -1. *The Cobb-Douglas utility function therefore places too many restrictions on the analysis of water demand.* Similarly, the Stone-Geary utility function also places unnecessary restrictions on demand that are unlikely to hold in practice, although these restrictions are somewhat less than those imposed by the Cobb-Douglas utility function.

Because of the theoretical and practical problems inherent in the "consumer maximisation of utility" approach to consumer demand analysis, alternative approaches have been developed. One such approach is the *cost minimisation* approach, which is analogous to the production problem. Hence the equivalent of utility maximisation is to:

$$\text{minimise } w = \sum p_i q_i \quad \text{subject to } u(q) \tag{25}$$

This has also been called the dual problem and the theory surrounding it *duality theory*.[335] The basic steps used in this approach is to start with a cost function, differentiate this to get the compensated (or Hicksian) demand, invert the cost function to get the indirect utility function, and substitute the indirect utility function into the Hicksian demand function to get the Marshallian demand.

The process starts with the definition of a cost function as a function of prices and utility:

$$c(p, u) = w \tag{26}$$

The cost function is differentiated to get the Hicksian demand function:

$$q_i = h_i (p, u) = \frac{\delta c(p,u)}{\delta p_i} \tag{27}$$

[335] See Chapter 3.

The cost function is also inverted to get the indirect utility function:

$$u = \nu (p, w) = c (p, \nu (p, w)) \quad (28)$$

The indirect utility function is substituted into the Hicksian demand to get the Marshallian demand:

$$g (p, w) = h(p, u) = h(p, \nu (p, w)) \quad (29)$$

Hence the form of the Marshallian demand curves can be directly derived from the cost function.

From duality theory it can be shown that the four general basic properties of demand arising from the axioms of rational choice are that they add up, are homogenous of degree zero in prices and total expenditure, and their compensated price responses are symmetric and form a negative semidefinite matrix (Deaton and Muellbauer, 1980: 44).

The rationality of consumer choice in practice can be proven (or disproven) by measuring the so-called Slutsky equation, which is derived from differentiating the middle identity in equation (27):

$$s_{ij} = \frac{\delta h_i}{\delta p_j} = \frac{\delta g_i}{\delta w} q_j + \frac{\delta g_i}{\delta p_j} \quad (30)$$

Hence s_{ij} can be calculated directly from an empirically derived set of measurable Marshallian demands. Duality theory asserts that if consumer choice is rational, then s_{ij} must be symmetrical and negative. Further the theory states that if s_{ij} is symmetrical and negative then consumer choice (in that particular measurement context) is rational.

Thus, in principle, it is possible to test the theory of demand, that is, to see whether or not actual consumer demand response to total outlay and prices behaves in a manner that is consistent with that predicted by the axioms of rational choice.

A number of models have been developed to test the theory of consumer demand empirically.[336] The results of these models show that, in general, "the restrictions of the theory [required to confirm rational demand] do not hold, at least on aggregate data" and that "demand functions fitted to aggregate time-series data are not homogenous and probably not symmetric" (Deaton and Muellbauer, 1980: 74, 78). Despite this negative conclusion, Deaton and Muellbauer are of the opinion that it is not necessary "at this stage" to "abandon"

[336] These models include the modelling of individual commodities, a logarithmic demand function, a linear expenditure system, a translog model, the Rotterdam model, and the "almost ideal demand system" (AIDS), and are reported in Deaton and Muellbauer (1980: 60f).

the axioms of choice and that the misspecifications inherent in the current models should be corrected first. They stress the importance of intellectual honesty:

> *It is our view that a careful transition from theory to application is a fundamental prerequisite of sound econometric work, and we find much current empirical work profoundly unsatisfying [sic] because of the lack of such a basis. We believe that many of the problems encountered so far can be resolved by careful theoretical analysis and that better models have higher explanatory power. But it is much more than a question of models that fit well. The real challenge is one of intellectual honesty; we must construct models that are fundamentally credible as representations of the behaviour and phenomena we are trying to understand. (Deaton and Muellbauer, 1980: 80)*

On the basis of their experience they make the following pertinent points and recommendations concerning the modelling of consumer demand. Here these are interpreted in the context of urban water demand.

In nearly all of the empirical work they reviewed, they found that (consumer) demand theory is used in a "*highly cavalier*" fashion in which "relatively little attention is paid to moving from theoretical abstraction to empirical reality" (Deaton and Muellbauer, 1980:80). This statement is certainly applicable to the water demand literature. For example, Hanemann (1997: 60) concedes that *almost all of the empirical demand specifications found in the literature are formally inconsistent with neo-classical demand theory.*

Aggregation over commodities poses non-trivial problems for the correct application of the theory (Deaton and Muellbauer, 1980: 80). Strictly speaking water is not a single commodity – for example, water for drinking, washing and irrigation by the same household will each have different demand functions. Therefore, the treatment of water as a single commodity (which is almost universally the case in the empirical literature) is not theoretically justified and may lead to erroneous results and conclusions.

Most studies treat aggregate data (aggregation across consumers) as if they represented the demand of a single consumer on the basis of a common (though usually unstated) argument that the problem of aggregation is unimportant. However, there is no reason to suppose that this is valid, and this *is particularly the case where social choice and inequality are important* (Deaton and Muellbauer, 1980: 81). There is clearly the case in the urban water sector, particularly in developing countries.

Durable goods represent a special category in consumer demand because they are indivisible, they may have a high unit cost and they last through more than one unit time-period. Nevertheless, in empirical studies, durable goods are seldom treated in a manner that is consistent with these characteristics. This is relevant to water demand in two respects, first, in the "purchase" of a water connection, and second, in the investment in a range of durable

goods that profoundly influence household water demand including property (land), landscaping, the house (the building), plumbing fixtures and water using appliances.

Empirical analysis of demand typically treats prices as an exogenous variable. However implicit or explicit rationing may occur which fundamentally affects consumer demand. In the case of water supply, the type of water connection (and, in some cases, the availability of a water connection at all) may place physical limits on water demand in many instances that are an important form of non-price rationing. Even the price of water itself may not be truly endogenous. In the case of municipal water supplies managed by a democratic local authority, consumers (or some groups of consumers) may exert a significant influence on the price of water. (The water pricing experiences in Los Angeles described in Chapter 4 support this contention.) Also, in the case of rising block rates, the water price is itself a function of the quantity consumed. This poses particular challenges for empirical analysis that have not been satisfactorily resolved in the literature.[337]

Uncertainty about future prices will affect investments in water using (or saving) durable goods. Uncertainty also affects short-term demand decisions, for example, there may be considerable uncertainty regarding the *quality* of the water supply.

A satisfactory theoretical and empirical treatment of water demand would have to take all of these considerations into account, yet *it is almost universally the case that many of these important factors are ignored in the empirical literature on urban water demand.*

Hanemann (1997) applies the neo-classical theory of demand to the analysis of household water demand. In this analysis he treats the household as if it were a single individual consumer rather than a collection of individuals each with different preferences.[338] He also treats water as a single commodity. This latter restriction is problematic, especially when it comes to the empirical modelling of water demand.

Hanemann's exposition of the theory of consumer demand as applied to water is a simplified version of the general theory of demand given above. He deals with only two of the possible forms of the utility function, namely, the Cobb-Douglas and Stone-Geary utility functions. Although Hanemann notes that the application of duality theory makes it possible to use less restrictive functional forms (such as a translog utility function) he states that these flexible

[337] These problems are not unique to the water sector. Fine *et al* (1996) show the limitations of the application of neo-classical demand theory to food consumption.

[338] This simplification makes the exposition more straightforward. Hanemann (1997: 56) asserts that the treatment can be readily extended to a collection of individuals making up a household with no added restrictions in the theory. However, there is some doubt as to whether this claim is justified.

forms "have not yet been used much in modelling the residential demand for water" and does not take the exposition any further (1997: 60).

For example, an indirect utility function could be specified as the following translog function (Deaton and Muellbauer, 1980: 74):

$$u = v(p, w) = \alpha_0 + \sum \alpha_k \log\left(\frac{p_k}{w}\right) + \frac{1}{2} \sum\sum \beta_{kj} \log\left(\frac{p_k}{w}\right) \log\left(\frac{p_i}{w}\right) \qquad (31)$$

The Marshallian demand function can be derived from this using Roy's Theorem and actual data tested against these demand functions (see Christensen *et al*, 1975). It has been argued that because equation (31) can be regarded as a second-order Taylor expansion of any arbitrary utility function, if the data fit the Marshallian functional form reasonably well then the theory can be assumed to hold. However this reasoning is false because the model can only be guaranteed to be accurate in the exact locality of the particular price-income ratios and thus a poor fit does not mean that the theory necessarily has to be rejected. Despite this limitation, it is true that translog functions such as the one above offer an improvement over the more severe and less acceptable restrictions imposed by other functional forms.

The above discussion is largely of academic interest. In practice, much of the literature has tended to take a more ad hoc approach, estimating a single demand equation for water using a simple functional form such as a linear demand equation in which the residential demand for water is regressed on the price of water and consumer income (Hanemann, 1997: 60). For example:

$$q_l = \alpha - \beta p_l + \gamma y \qquad (32)$$

where q_l is the demand for water, p_l is the price of water and y is the household income.

Log-log and semilog (on either quantity or price) alternatives to the above equation have also been used:

$$\ln q_l = \alpha - \beta \ln p_l + \gamma \ln y \qquad (33)$$

$$\ln q_l = \alpha - \beta p_l + \gamma y \qquad (34)$$

$$q_l = \alpha - \beta \ln p_l + \gamma \ln y \qquad (35)$$

The own-price and income-elasticities associated with these demand equations are given in Table 5 below (Hanemann, 1997).

Table 5: Own-price and income elasticities

demand equation type	Own price η	income η
linear	$-\beta p_1 / q_1$	$\gamma y / q_1$
log-log	$-\beta$	γ
semilog on quantity (equation 34)	$-\beta p_1$	γy
semilog on price and income	$-\beta / q_1$	γ / q_1

Note that in the case of linear demand, the estimated own-price-elasticity is a function of both price and quantity, in the case of the semilog demand (on quantity) own price-elasticity is a function of price only, and in the case of semilog demand (on price and income) own price-elasticity is a function of quantity. The relevant prices and quantities quoted are usually the median or mean prices. However, for significant ranges of either price or quantity, estimated elasticities that are a function of these are theoretically dubious because *actual elasticities will vary across the range*. Note also that the log-log demand function postulates an isoelastic demand curve (a constant elasticity independent of price and quantity). There is no *a priori* reason to believe that demand curves exhibit this property.

The above equations may be modified to include other explanatory variables such as the prices of other goods (particular important complements and substitutes, for example, energy prices and water efficiency appliances), climate variables (rainfall, evapotranspiration, temperature) and household and property characteristics.

Significantly, Hanemann notes that all of the above demand equations are *formally inconsistent with the theory of demand* because they cannot be derived from the maximisation of a utility function without relaxing the restrictions necessary to ensure rational choice (1997: 60). These equations can only be made consistent with economic theory *if all other commodities are lumped into a single aggregate* and consumers are conceived as having preferences for just *two* goods, water and the non-water aggregate of all other consumer "goods". Equally important, empirical analysis bears out the fact that the choice of the form of the demand equation significantly influences the results (Hanemann, 1997: 61).

Much of the empirical literature on water demand uses some form of aggregate data. This involves "something of a leap from a theory that applies to individual agents [to the analysis of] data that are more aggregate than the theory contemplates" (Hanemann, 1997: 66). In most cases, the problem of aggregation *is* important and the theory applicable to an individual consumer cannot to applied to aggregate consumption.

One of the limitations of empirical analysis is that it relies exclusively on the historical record and is not useful for predictive purposes where price changes are outside of the historic range or where there have been fundamental shifts in policies or institutional structures.[339]

The discussion now turns to the empirical analysis of water demand. First, methodological issues are highlighted and discussed and, second, empirical findings and their implications are presented.

Measuring water demand – methodological considerations

Much of the empirical literature is focused on residential water demand in developed countries, particularly the United States.[340] Relatively little work has been undertaken on water demand in developing countries.

The purpose of water demand analysis

The end to which demand analysis is undertaken will influence the methodology employed. The analysis of water demand is often undertaken for the purpose of water demand forecasting and less frequently for the purpose of welfare analysis. If the purpose of water demand analysis is solely for the purpose of providing improved water demand forecasting, then empirical analysis is used to calculate own-price-elasticities of demand. In this context, theoretical considerations such as the consistency of the demand equation form with utility maximisation and rational choice assumptions are not of prime importance. On the other hand, the analysis of consumer welfare requires a more rigorous approach to the application of theory in order for appropriate conclusions to be drawn.

Model structure for consumer demand

Most water economists have used a partial equilibrium framework for analysis of the urban water demand (Renwick, 1996).[341] The validity of partial equilibrium analysis in the context of urban water has been discussed in Chapter 3.

Equation form and theory

The importance of the form of the demand equation for theoretical consistency has been noted. Three other considerations may be important: assumptions about how price-elasticities vary with price and quantity, goodness of fit, and ease of estimation.

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[339] This is called the Lucas Critique after Lucas (1976).

[340] The literature on industrial water demand is not extensive and is not considered here.

[341] Hansen (1996), who provides an analysis of the relationship between electricity prices and water demand in Copenhagen, is one of the few economists to take the price of at least one other commodity (in this case a complement) into account. Interestingly, he found that water demand was more responsive to changes in the price of electricity than the price of water itself.

The choice of the functional form depends on the purpose of the empirical modelling. Strict conformity with neo-classical demand theory may not be important. If the estimated price-elasticities are to be used to forecast future water demand based on known future price increments, the validity and accuracy of the prediction will depend on the extent to which future prices remain close to the range used in calculating the price-elasticity estimates. The linear, semilog and log-log estimates are likely to give different future water demand estimates because they make different assumptions about how price-elasticities vary with price and quantity.

The choices of linear, semilog and log-log demand equation forms may yield statistically-significant different results. Because there is no *a priori* reason for choosing any particular equation form, the uncertainty attached to any particular price-elasticity estimate is increased.

Stone and Whittington assert that "since there is little *a priori* reason for selecting one production function over another, there is no preferred functional form of the single equation water demand model" (1984: 55). They note that "the choice of functional form is usually determined on the basis of two (sometimes conflicting) criteria: best fit, and ease of estimation" and conclude that a search for the functional form that yields the best fit can "quickly become an exercise with little theoretical content" (1984: 55).

Hanemann (1997) and Espey *et al* (1996) undertook surveys of the water demand literature and reported on the forms of the demand equations used in empirical studies (see Table 6).

Table 6: Demand equation forms used in practice

Study	Demand equation form (no. of estimates)				
	Linear	Log-Log	Semilog	Other	Total
Hanemann, 1997 : Review of 54 studies: 1951-1991	41	45	10	0	96
Espey *et al*, 1996: Meta-analysis of 24 studies	38	86		0	124

Neither study observed the use of more sophisticated functional forms, such as the translog, which are more consistent with neo-classical consumer theory. Dandy *et al* (1997) used a *piece-wise linear* form of the demand equation arguing that the influence of various factors (such as household size and income) on water demand may change over the price and quantity range in a step-wise fashion.

Choosing the independent variables

Consumer demand theory is primarily concerned with the effect of price and income on consumer demand. However, other factors also have a significant influence on demand. In the case of urban water supply, the following independent variables have been used in the modelling of domestic water demand: water supply characteristics, climate, household characteristics, and outdoor and indoor housing characteristics.

Where there are no supply side restrictions, there is strong evidence that demand is influenced significantly by household income, the price of water and climate (Espey *et al*, 1996; Griffin and Chang, 1991). Proper consideration of additional parameters, namely, the demographic characteristics of households and housing (both indoor and outside) characteristics may enhance the understanding of water demand (Espey *et al*, 1996). In developing countries, the modelling of supply-side constraints may be important (Mu *et al*, 1990).

Theoretical and practical constraints influence the selection and choice of independent variables. The theoretical constraints arise because of simultaneity. For example, water consumption is undoubtedly a function of both income and wealth but income and wealth are typically highly correlated. This poses problems for the accuracy of the estimates derived from a multivariate regression that includes both parameters as independent variables. Practical constraints arise because of the lack of availability of relevant data. For example, indoor water demand may be influenced by the type and number of plumbing fixtures installed in a house, however, data on this may not be available or may be time consuming and/or costly to obtain. Issues related to the specification of variables are discussed below.

Quantity. Typically some kind of average water demand is measured. This is because consumer metering typically occurs with a periodicity of between one and three months. This periodicity allows seasonal fluctuations in water demand (but not variations in daily peak demand) to be measured.

Income. Where actual household or per capita income data are not available, some researchers have used house or property value as a proxy (Howe and Linaweaver, 1967). Because general rates and taxes are usually levied in some proportion of assessed property value by local governments, some information on property values is usually available, even in developing countries. However, this data may be inaccurate. Lyman (1992) used both household income *and* property value and asserted that his results showed that both were important and merited individual attention. In this case there is an obvious problem of multicollinearity if an ordinary least squares (OLS) regression is used.

Indoor parameters include household and housing characteristics. Household size and age distribution may affect water demand. Hanke and de Mare (1982) differentiated between adults and children and assert that they increased the explanatory power of their model by doing so. Lyman (1992) used average age together with the numbers of children, teenagers and adults in the household and showed these to be important explanatory variables. Housing characteristics include house size and age, and plumbing fixture data. Reliable information on these parameters is unlikely to be available in developing countries.

Weather specification. It has long been recognised that weather is an important explanatory variable in the analysis of residential water demand (Howe and Linaweaver, 1967). However, specification of the weather variable has generally been rather inaccurate, typically incorporating rainfall as a proxy (Nieswiadomy and Molina, 1989).[342] Nieswiadomy and Molina (1989) argue that an appropriate specification of the weather variable, particularly in a hot and dry climate where lawn irrigation is an important component of seasonal demand, is of the form:

$$\text{weather} = e - r \tag{36}$$

where e is the potential evapotranspiration for the dominant lawn cover in the area being studied, and r the rainfall. Further, they argue that it is important that the calculation of the weather variable matches the billing cycle (Nieswiadomy and Molina, 1989). Others argue that the rainfall variable in the above specification is inaccurate and that *effective rainfall* (er) should be used where er tries to account for the distribution of rainfall. That is:

$$\text{weather} = e - er \tag{37}$$

For example, Dandy *et al* (1997) used:

$$er = 0.6r \tag{38}$$

Notwithstanding these corrections, rainfall variability may influence water demand in a way which is not accurately captured by the weather variable.

Area. Irrigated area may be an important variable determining outdoor water use. Accurate data on irrigated area are usually unavailable but can be approximated as total plot area less house area or as some function of plot size. Plot size itself can be used as a proxy in the absence of better data. This data may not be available in developing countries.

[342] The study by Foster and Beattie (1979) is a notable exception.

Supply side constraints. Analysis of supply side parameters is rare. Renwick (1996) examined demand where supplies were restricted by drought. Water pressure was used in only one of the studies reviewed (Howe and Linaweaver, 1967).

Dynamic variables. Deaton and Muellbauer (1980: 328) assert that the inclusion of a lagged consumption variable in the demand equation can yield a considerable increase in explanatory power for a number of reasons. Liquidity constraints may delay the purchase of durable goods. Imperfect or asymmetrical markets may constrain the sale of used assets. Search costs related to determining actual consumption and marginal costs delay the achievement of equilibrium. Tastes are affected by previous consumption (1980: 374). It is difficult to determine the specific causal factors in any particular context empirically. It is tempting to dispense with the lagged dependent variable, but Deaton and Muellbauer caution against this:

> *Consumption, income, prices and assets all share largely common trends, so that correlations between them and significant regression coefficients may simply be because of the* nonsense correlation *problem. The high t-values and low Durbin-Watson statistics that are usually associated with such consumption functions should act as a warning but are frequently ignored. Given the large autoregressive element in the consumption data series, the inclusion of the lagged variable will largely protect investigators against the most obvious spurious correlations. However, the frequent exclusion of the lagged dependent variables on the grounds that their entry causes the relationship to "collapse" is a testimony both to the effectiveness of the cure and to the greater difficulty in finding a theoretically satisfactory relationship that outperforms a simple autoregression. (1980: 333)*

Carver and Boland (1980) were the first to undertake empirical analysis of the relationship between short- and long-run water demand price-elasticities using a lagged dependent quantity variable. The theory suggests that long-run price-elasticities should be greater than short-run elasticities because consumers are able to adjust their stock of water-using appliances in the long-run. Carver and Boland (1980) used a flow adjustment model in which lagged consumption is included as one of the variables:[343]

$$Q_t - Q_{t-1} = \rho (Q_t^* - Q_{t-1}) \qquad 0 < \rho < 1 \qquad (39)$$

where ρ is the proportion of the desired adjustment actually achieved, Q_t is the actual consumption at time t and Q_t^* is the desired or equilibrium consumption based on the values of the independent variables at time t. Q_t^* is assumed to be linearly related to the independent variables:

$$Q_t^* = \alpha + \beta X + \varepsilon \qquad (40)$$

where X is a vector in independent variables and α and β (a vector) the parameters to be estimated. Substituting into the previous equations gives:

$$Q_t = \alpha \rho + (1 - \rho) Q_{t-1} + \beta \rho X + \rho \varepsilon \quad (41)$$

where the short-run coefficients are given by $\beta\rho$ and the long-run coefficients by β.

Although OLS estimation of the above model specification will yield consistent estimates, these tend to be biased for small samples (Gujarati, 1995: 603). Carver and Boland (1980) made the point that this equation should not be used for a single set (one cross-sectional unit) of time-series data because the time-related trend can be confounded with the lag effect, but went ahead and used it on a small sample. Few other studies have included a lagged dependent variable.[344]

Conservation and education. Only a few studies have included non-pricing policy variables in their models (Renwick, 1996, Nieswiadomy, 1992, Agthe and Billings, 1996, Moncur, 1987).

Specification of the price variable.

One of the key debates in the literature of water demand analysis is the specification of the price variable in the case of non-linear pricing where the unit price of water is itself a function of consumption.

Average or marginal price? Early studies used either the average price (for example, Wong, 1972, Young, 1973, and Foster and Beattie, 1979) or the marginal price (for example, Howe and Linaweaver, 1967, and Danielson, 1979). That is:

$$q = f(p_m, v) \quad (42)$$

$$q = f(p_a, v) \quad (43)$$

where p_m is the marginal price, p_a is the average price and v is a vector of other independent variables.

[343] The model was developed by Nerlove (1958) and it assumed that the actual adjustment to consumption is some fixed percentage of the total equilibrium ("desired") adjustment. This *partial adjustment* model is described in Gujarati (1995: 599).

[344] The exceptions include Dandy *et al* (1997), Lyman (1992), Nieswiadomy and Molina (1991), Moncur (1987) and Young *et al* (1983). Lyman (1992) and Moncur (1987) used the same flow adjustment model as Carver and Boland (1980). Lyman (1992) also chose to use a *lagged price specification* as this led to a regression fit of higher quality.

However, both of these price specifications are problematic because demand is a function of *both* average price *and* marginal price in cases where the intra-marginal price differs from the marginal price ($p_m \neq p_a$). That is:

$$q = f(p_a, p_m, v) \quad (44)$$

Renwick noted that "block pricing violates the standard assumption in the theory of consumer demand that consumers can purchase unlimited quantities of a good at a fixed exogenous price" (1996: 90). The problem arises because price is no longer exogenous. Thus the demand equation may be restated as follows:

$$q = f(p, v) \text{ and } p = f(q) \quad (45)$$

The controversy largely concerns the significance of the relative influence of each price dimension on demand in practice and which approach is most accurate in depicting the actual demand function.

The Taylor-Nordin specification. Taylor suggested the use of both the average and the marginal prices in the case of block pricing. Nordin (1976) demonstrated that Taylor's specification was not correct and modified it by using the marginal price and a "difference" variable (D) to take into account the infra-marginal effect. The difference variable measures the difference between the actual bill and what the bill would have been if all units were priced at the marginal price. That is:

$$q = f(p_m, D, v) \quad (46)$$

$$D = (q' \times p_a) - (q' \times p_m) \quad (47)$$

where q' is the actual amount of water consumed. The difference variable thus attempts to capture the effect of price-induced income changes on demand.[345] The difference variable is expected to be positive for increasing block schedules and negative for decreasing block schedules. This method postulates perfect information on the part of the consumer.

Although Nordin's method has been used widely in the empirical analysis of water demand,[346] opinions differ as to which price specification is better and how much this matters. Some have

[345] Taylor (1975) and Nordin (1976) describe the additional variable (that is, the intramarginal expenditure or difference variable respectively) as measuring the income effect due to intramarginal price changes. However, Renwick (1996) notes that it is uncertain whether the effect measured is a pure income effect. This is because the difference variable is constructed ex-post and its value depends on the relative strengths of income and substitution effects of rate changes (Howe, 1982). Hence Renwick (1996) notes that "it can only be an approximate way of introducing the effects of the intramarginal parts of the rate structure".

[346] See, for example, Billings and Agthe (1980), Schefter and David (1985) and Nieswiadomy and Molina (1989).

argued that, as a matter of principle, the marginal price specification is correct.[347] Others have argued that Nordin's method is a more accurate specification (Renwick, 1996). Still others have argued that average prices motivate consumer behaviour because of imperfect information (Foster and Beattie, 1981). Lastly, some have held the position that it is ultimately an empirical matter whether consumers respond to marginal price, average price or some combination of both.[348] On this last point, conflicting results have been found. For example, the estimates of Foster and Beattie (1981) under the alternative specifications for aggregate data were statistically indistinguishable whereas the meta-analysis of Espey *et al* (1996) showed that different price specifications led to statistically significant differences in elasticity estimates (pooled aggregate and disaggregate data). Schefter and David (1985) hypothesised that part of the controversy arises from the use of aggregate data rather than household level data, however, Nieswiadomy and Molina's household level study using panel data failed to resolve the controversy (1989).

Price perception model. In an attempt to escape these problems, Shin (1985) developed a model based on perceived price. Basic consumer demand theory assumes that consumers are well-informed and hence respond to the marginal price, whereas in practice consumers may be ill-informed of the marginal price and base their decisions on the average price (as perceived from the total bill). Shin (1985) developed a price perception model that can test this price perception empirically.

The price that the consumer responds to (the perception price) is formulated as a function of both marginal and average price:

$$p^* = p_m (p_a / p_m)^k \qquad (48)$$

If $k = 1$, then $p^* = p_a$ and if $k = 0$, then $p^* = p_m$. The price perception parameter k can be empirically determined using a log-log form of the demand equation:

$$\ln Q = \alpha + \beta_1 \ln p_m + k\beta_1 \ln (p_a / p_m) + \beta_2 y + \ldots \qquad (49)$$

Shin applied this equation to decreasing block pricing in the domestic electricity sector and showed (for a particular data set) that consumers respond to average price. Nieswiadomy and Molina (1991) extended Shin's analysis to increasing block pricing in the domestic water sector. They showed (for a particular data set) that consumers are likely to respond more to marginal price than average price, though their conclusions were qualified by the uncertainty

[347] Gibbs (1978) and Griffin and Martin (1981).

[348] See, for example, Shin (1985), and Nieswiadomy and Molina (1991).

inherent in the estimates. Differences between marginal and average price and the presence and significance of a fixed monthly fee are likely to affect the outcome of the analysis.

Hewitt and Hanemann (1995) noted that Shin's method (used and extended by Nieswiadomy and Molina, 1991) has a drawback because of the potential for test results regarding the more appropriate specification to be inconclusive.

Choosing the data set

Aggregation. In general, the analysis of consumption data at the level of individual consumers is preferred.[349] Most studies undertaken to date have used aggregate data for practical reasons.[350] Undertaking micro-level empirical studies requires the availability or collection of household level data. The problem is more acute in developing countries where adequate micro-level data are either costly to collect or of dubious accuracy.[351]

Cross-section analysis examines water demand relationships at a point in time. There are at least four problems associated with using cross-sectional data: First, the price-elasticity that is measured is the variation of demand in response to price *across space* at one point in time. To apply these elasticities to temporal changes in price requires the assumption that the same individuals will respond to real price changes over time *in the same way* in which different individuals have responded to difference prices across space. This is a rather "heroic" assumption (Hanke and de Mare: 1982). Second, cross-section analysis cannot distinguish between short-run and long-run price-elasticities of demand. Third, cross-section analysis of water consumption data is prone to the problem of heteroscedasticity, particularly where there are wide disparities in income between households.[352] Fourth, in contexts where there are small variations in the price variable, the analysis has limited predictive value because, at

[349] See Danielson (1979), Schefter and David (1985), Lyman (1992), Renwick (1996) and Saleth and Dinar (1997).

[350] Saleth and Dinar (1997) note that 79 percent of 124 studies published during 1967 to 1993 are related to macro and aggregate data (see also Espey, 1996).

[351] Studies that have employed household level data include Jones and Morris (1984), Chicoine and Ramamurthy (1986), Deller *et al* (1986), Nieswiadomy and Molina (1989, 1991), Lyman (1992), Hewitt and Hanemann (1995) and Renwick (1996).

[352] Gujarati notes that "in cross sectional data involving heterogeneous units, heteroscedasticity may be the rule rather than the exception" (1995: 368). In cross-sectional water demand analysis it may be expected that the disturbance term (unexplained error) may be greater amongst higher income households compared to lower income households. Thus heteroscedasticity is expected to be a particular problem in contexts where there are wide disparities in wealth. Although heteroscedasticity does not destroy the "unbiasedness" and consistency properties of OLS estimators, these estimators are no longer minimum variance or efficient and therefore t and F tests of significance may be highly misleading. Even if heteroscedasticity is expected, it may be hard to detect and it is even harder to correct the problem (Gujarati, 1995: 389).

best, prediction is only valid within the relevant price and quantity ranges present in the study. Notwithstanding the above, many studies have used cross-section analysis.[353]

Time-series analysis enables the same water consumers to be tracked over time and their response to price changes to be measured.[354] The type of analysis is of limited value in contexts where changes in the real price of water are small because it is difficult to control the analysis for other important variables (such as changes in household income). This is because time-series analysis assumes that the under-lying time-series is stationary (Gujarati, 1995: 709). On the other hand, where price changes are large, it is likely that demand will not only shift along the demand curve but also that the demand curve itself will shift. Therefore, the calculated price-elasticity is not strictly a point-elasticity but some average measure of how demand has changed in response to price. Furthermore, it may be expected that time-series data on water consumption are autocorrelated to some extent due to inertia. The presence of autocorrelation in time-series data may also arise from data manipulation and model misspecification.[355] Furthermore, time-series data are prone to spurious regressions.[356] Studies using time-series data include Young (1973), Billings and Agthe (1980) and Agthe *et al* (1986).

Pooled data analysis combines both cross-sectional and time-series data into one analysis. The principle advantage of this is that less data are required. However, the limitations of both cross-section and time-series analysis are carried through to pooled data analysis. Only a few studies have used pooled data.[357]

Data selection. The selection of the data set is likely to be constrained by practical factors such as the availability and reliability of data. Hewitt and Hanemann (1995) suggest that "the best data that a water utility can easily collect" are the appropriate data to use.

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[353] See Nieswiadomy (1992), Jones and Morris (1984), and Foster and Beattie (1979). Studies that have used micro-level data for cross-section analysis include Howe and Linaweaver (1967), Danielson (1979), Hanke and de Mare (1982), Deller *et al* (1986), Chicoine *et al* (1986), Jones and Morris (1984), Agthe and Billings (1987), Nieswiadomy and Molina (1989), Schneider and Whitlach (1991), Hewitt and Hanemann (1995), and Renwick (1996).

[354] See Mills (1990) and Harvey (1991) for a discussion of econometric analysis using time-series data.

[355] Autocorrelation can be tested for using the Durbin-Watson *d* Test provided the model does not include a lagged dependent variable (Gujarati, 1995: 421). However it should be noted that the *d* Test may be an indication of specification bias rather than pure autocorrelation (1995: 439).

[356] Granger and Newbold (1974) suggest that an $R^2 > d$ is a good rule of thumb to suspect that the estimated regression suffers from spurious regression.

[357] These include Lyman (1992), Nieswiadomy and Molina (1989), Moncur (1987) and Hanke and de Mare (1982).

Estimation technique

Regressing price and the problem of simultaneity. It is generally recognised that the use of ordinary least squares (OLS) where the tariff structure is of the increasing block form will yield biased estimates. In empirical work it is difficult to escape the problem of simultaneity bias in either demand specification (p_m or p_a) because price remains a function of quantity in both specifications and hence the price variable (either p_m or p_a) will be correlated with the random error term.[358] If Nordin's approach is followed (using p_m and D), then in the case of an increasing block structure the coefficient on the marginal price will be biased towards zero and the coefficient on the difference variable away from zero (Nieswiadomy and Molina, 1989). Saleth and Dinar (1997) argue that the difference variable solves the problem of simultaneity on the p_m variable because it captures the price-quantity adjustment potential even though they note that the difference variable may itself be subject to simultaneity problems. However, their claim is highly questionable in the light of the failure of empirical studies to verify the properties expected of the difference variable (see, for example, Nieswiadomy and Molina, 1989).

In an attempt to overcome these simultaneity problems (particularly prevalent when ordinary least square regression is used), other estimating approaches have been used, including instrumental variables[359] and two- or three-stage least squares.[360] However, Saleth and Dinar note that these corrections for simultaneity could themselves lead to other equally serious econometric problems, for example, multicollinearity in two- and three-stage estimation techniques (1997: 19).

There is no regression technique that solves the simultaneity problem satisfactorily. There appears to be a general preference for Nordin's method with the use of instrumental variable and two-stage least squares techniques in the literature, despite the limitations and potential bias of these techniques (see, for example, Nieswiadomy and Molina, 1989).

The bias of **ordinary least squares** (OLS) regression when using Nordin's marginal price and difference specification in the presence of decreasing and increasing block tariffs is demonstrated by Nieswiadomy and Molina (1989). Their results confirm that OLS regression results in this context generally should be assumed to be unreliable.

Saleth and Dinar (1997) contend that if incomplete consumer information is postulated (and demonstrated), then an average price specification may be both valid and able to be estimated

[358] See, for example, Terza (1986).

[359] See Deller *et al* (1986), Agthe *et al* (1986), and Jones and Morris (1984).

[360] See Nieswiadomy and Molina (1989), and Renwick (1996).

accurately using OLS even if the actual price structure is non-linear. The grounds for this claim are weak.

Alternatively, OLS estimates will be reliable if the price variable can be shown to be exogenous, even in the context of a non-linear price structure. A test for endogeneity is presented below. Interestingly, Saleth and Dinar also contend that the difference variable fully captures the "adjustment potential"[361] and that there is no need for any "explicit correction for simultaneity through econometric means" and hence recommend the use of the OLS estimation technique even though they do not explicitly test for endogeneity (1997: 22). The validity of this approach is questionable.

Testing for endogeneity. The endogeneity of prices in a non-linear pricing structure (which leads to the problem of simultaneity) can be tested using a method proposed by Hausman (1978) which asserts that the OLS estimator will be consistent and asymptotically efficient under the null hypothesis that prices are exogenous, but will be inconsistent under the alternative hypothesis.

An application of this test in the case of an increasing block water tariff structure is presented by Agthe *et al* (1986). They show that OLS estimates *were biased* in the case of their data set (time-series data for Tucson with an increasing block tariff structure).

Instrumental variables. Because of the problems of simultaneity inherent in OLS regression in the context of non-linear pricing, many studies have used the instrumental variable (IV) technique as a means of trying to overcome this.[362]

"The strategy of instrumental estimation is to identify a new variable or variables correlated with price but orthogonal to the disturbance term of the regression" (Jones and Morris: 1984). In their analysis a *marginal price instrument* (and associated infra-marginal rate variable) was developed from average water use by the "rate class" (that is, block 1 or 2), and an *average price instrument* was developed by regressing the observed average price on the exact tariff information. However, they found that the instrumental variable estimation was not fundamentally different from simpler OLS approaches for their data set.[363] The reason for this appears to be the disproportionately large effect of the infra-marginal rate and fixed charges on demand. Thus, although they claim their finding is encouraging in the sense that the

[361] By this they mean the simultaneous adjustment between price and quantity.

[362] Jones and Morris (1984), Deller, Chicoine and Ramamurthy (1986), Agthe *et al* (1986) and Nieswiadomy and Molina (1989).

[363] Cross-section of 100-200 households in Denver, Colorado, using annual water use in 1976 with household information from a questionnaire and billing records from the water utility.

simpler OLS estimation techniques can be used as effectively as more complex techniques, such a claim is tenuous.

Agthe *et al* (1986) acknowledged that a potential problem with the instrumental variable technique is that the choice of an appropriate instrumental variable depends on the judgement of the researcher.

Nieswiadomy and Molina (1989) used the IV technique developed by Terza (1986). In the first stage, water demand was regressed on *actual* marginal prices that the household would face at different levels of demand. In the second stage the actual rate schedule and predicted quantity demanded were used to obtain predicted marginal prices. The difference variable was calculated using the predicted marginal prices. Terza (1986) asserted that both of these adjustments are likely to improve the reliability of the estimates though they note that the method may overcompensate for OLS bias as a result of linearisation of the rate schedule.

The findings of Hewitt and Hanemann (1995) confirm the assertion of Agthe *et al* (1986), namely that specification matters in the case of the IV technique and that the choice of specification is a matter of subjective judgement.

Two-stage least squares. An alternative though similar method to instrumental variable estimation is the two-stage least squares estimation technique (2SLS). Nieswiadomy and Molina (1989) used this in their analysis of household data for Denton, Texas and obtained estimates that compare favourable with the IV technique used on the same data. They regressed *observed* marginal price and difference against the other independent variables and the actual block prices, and then used the predicted price and difference in the second stage as regressors.

Three-stage least squares. Renzetti (1992) used an iterative three-stage least squares procedure. In the first regression, he regressed observed average cost against the features of the pricing schedule so as to obtain an instrumental variable proxy for the price of water. This method follows Jones and Morris (1984).[364]

Simultaneous equations. Agthe *et al* (1986) used the following three-equation system:

$$Q = f(p_m, D, X_1, B_1) \quad (50)$$

$$p_m = g(Q, X_2, B_2) \quad (51)$$

[364] Renzetti (1992) includes in a footnote the fact that Terza (1986) argued that the instrumental variable approach may artificially linearise the price schedule and thus produce a spurious negative correlation between quantity and price, but leaves the discussion there. Renzetti (1992) also notes in another footnote that he had corrected for heteroscedastic errors. Further details of the three-stage least squares procedure are not given.

$$D = h(Q, X_3, B_3) \quad (52)$$

where the first equation is the demand function for water and the other two equations capture the effect of the changes in the supply side of the market resulting from shifts and other changes in the rate structure. X_1 is the vector of independent variables (income, weather etc.). X_2 and X_3 are vectors of dummy variables indicating shifts in the entire rate structure (X_2) and shifts in the rate structure and/or fixed charges (X_3). B_1, B_2 and B_3 are vectors of the parameters to be estimated and which were estimated using a three-stage least squares technique with all three equations specified as linear systems.[365] Using the same data set as Billings and Agthe (1980) they obtained a different price-elasticity estimate (-0.59 versus -0.49).

Hewitt and Hanemann (1995) claim that simultaneous equations do not solve the endogeneity problem because there is no single measure of the marginal price or difference given that planned consumption differs from observed consumption by the unobservable perception error.

A discrete-continuous choice model. All of the above models explicitly regress quantity against price. This approach is clearly of limited value in the case of increasing block rates because price is itself codetermined by quantity. Hence the consumer choice problem is really reduced to choosing *both* the consumption *and* the price (which is represented by the consumption block). This point is taken up by Hewitt and Hanemann (1995) who note that the labour supply literature is of relevance here because the piece-wise linear budget constraint is common to the analysis of demand in both the labour market and for water under an increasing block rate. This literature has developed a discrete-continuous model to overcome the problem of correct model specification that arises because of the phenomena of codetermination and the non-linear budget constraint.[366]

The model preserves the codetermination of the quantity consumed and the marginal price and (income) difference pertinent to that quantity without having to resort to simultaneous equations through the discrete choice that is included in the single likelihood function. However, the specification assumptions required to construct a two-error discrete-continuous choice model are restrictive and furthermore, the model is considerably more complex than the simpler OLS, IV and 2SLS models. The model has been applied to one set of data only and the robustness and consistency of the model are yet to be proved.

[365] OLS estimates in this context are systematically biased (Kindler and Russell, 1980, Gujarati, 1995).

[366] The relevant labour supply literature is summarised in Moffitt (1986) and the discrete-continuous model as applied to water demand presented in Hewitt and Hanemann (1995).

Discrete choice within a developing country context. Mu *et al* (1990) assert that the application of conventional water demand analysis techniques in many developing country contexts is inappropriate. They point out that while in developed countries consumers have no choice in their supply, this is often not the case in developing countries. For example, in many rural villages (in Africa, say) households have a choice of water supply (for example, vendor, well or kiosk). In such cases modelling the *choice* of water supply source may help to inform project planning. Mu *et al* (1990) present a discrete choice approach to this problem using a multinomial logit model noting that this is commonly used in the modelling of household discrete choices (Amemiya, 1981). The model has the form:

$$P_h(j) = \exp (\beta X_{jh} + \alpha_j Z_h) / \sum_i \exp (\beta X_{ih} + \alpha_i Z_h) \qquad (53)$$

where P_h (j) is the probability of household h choosing source j, X is a vector of source characteristics and Z a vector of household characteristics and α and β are the parameters to be estimated. This assumes that the utility function is additive ($v_{ih} = \beta X_{ih} + \alpha_i Z_h$) and a Gumbel distribution of the error term ($U_{ih} = v_{ih} + \varepsilon_{ih}$) with ε having a mean of zero and a scale parameter of 1. Different assumptions concerning the distribution of ε will lead to different choice models (Mu *et al*, 1990).

Large price changes and arc-elasticities

Where large price changes are effected, the calculation of point-elasticities (the price-elasticity of demand at a single point on the demand curve) is inappropriate and it may be better to calculate an arc-elasticity, that is an average price-elasticity over the relevant price and quantity range (Hogarty and Mackay, 1975). The arc-elasticity is defined as:

$$\eta_{arc} = (\Delta q_i / q_i) \times (\Delta p / p)^{-1} \qquad (54)$$

where q_i is the average quantity for each consumer over the range, that is, $(q_0 + q_1)/2$ and p is the average price, that is, $(p_0 + p_1)/2$.

This method is appropriate for use with time-series data and a large price change (increase or decrease). For robust results, the data should be controlled for exogenous variable such as income changes and weather.

Hogarty and Mackay (1975) used an adjacent community as their control and adjusted the percentage change for each individual in the modelled community (which experience price changes) by subtracting the percentage change in consumption experienced in the control community (which experienced no price changes). That is:

$$\eta_{arc} = [(\Delta q_i / q_i) - (\Delta Q / Q)] \times (\Delta p / p)^{-1} \qquad (55)$$

where q_i is for the modelled community and Q is the consumption for all consumers in the control community.

Katzman (1977) employed a variant of this method in a developing country context. He regressed time-series data using consumption for stratified groups of consumers (by income, neighbourhood and rate category) as the dependent variable and trend (1 ... n), rainfall and price (a dummy variable indicating pre- or post-price increase) as the independent variables. The linear model used was:

$$q_{it} = \alpha + \beta_1 X + \beta_2 R_t + \beta_3 X R_t + \beta_4 t$$

where q_{it} is the consumption in month t for group i, X is the dummy variable equal to 0 pre-price increase and 1 post-price increase, R_t is the rainfall in month t, t is the trend variable (1... n months) and α and β are the parameters to be estimated.

The arc-elasticities for each group were calculated by inserting the mean values and 0 and 1 for the price dummy into the fitted equations.

Summary and conclusions

Linear and log forms of the demand equation are most commonly used in the literature even though these are formally *inconsistent* with consumer demand theory.

The choice of independent variables may be constrained for practical reasons. The most essential variables that should be included are household income (or some proxy thereof), weather and price. The modelling of supply side constraints may be important.

Where non-linear pricing schedules are used, the marginal price is not equal to the average price and a decision has to be made concerning the specification of the price variable. Any specification of the price variable in this context results in estimating problems because of the violation of key assumptions necessary for the main tenets of the theory to hold.

In general, micro-level data sets are to be preferred to aggregate data sets. However micro-level data may not be available or may be of dubious accuracy. The use of cross-section analysis to estimate demand curves relies on the "heroic" assumption that price-elasticities derived from inter-consumer comparisons of demand can be applied to inter-temporal variations in price for the same consumers. It is also prone to the problem of heteroscedasticity. Time-series analysis also has limitations. Where price changes are small this method is likely to be inaccurate because it assumes a stationary underlying trend. Where price changes are large the resulting measure is not a true point-elasticity because the demand curve would have shifted at the same time. Pooled data analysis has the advantage of requiring

less data but the limitations of both time-series and cross-section analysis pertain. No wholly satisfactory data set exists in practice and compromises must be made.

The choice of estimation technique may be important, particularly where price is itself a function of consumption. In general, the assumptions necessary for the ordinary least squares (OLS) technique to give valid estimates do not hold when the pricing structure is non-linear. Other estimating techniques, namely instrumental variables and two- or three-stage least squares have been used in an attempt to overcome the problem of simultaneity. However these techniques may give rise to other equally serious econometric problems and the results are sensitive to the choice of model specification. Regression analysis in the presence of a non-linear price function is inherently problematic and great caution needs to be exercised when interpreting results. Unfortunately, non-linear pricing is commonly found in practice.

Hewitt and Hanemann (1995) used a discrete-continuous choice model in an attempt to overcome the problems of simultaneity present in other regression models. The method gives very different results compared to other estimating methods for the same data set. The robustness of the results obtained has not been tested.

Where price increases are significant, the calculation of point-elasticities is likely to be inappropriate. Arc-elasticities provide a measure of the average response of demand to price over the relevant price and quantity range. This "rough and ready" method has been used infrequently in practice even though, in certain contexts, it can provide a measure of demand response to price that is not fraught with the theoretical and practical problems associated with the other more complex methods discussed here. Such a method may be particularly applicable in developing country contexts.

Assumptions concerning the form of the demand curve are frequently made without justification. Where price reform moves the price outside the range of historic experience, the application of statistical regression techniques to historical data is generally not helpful to predict the demand response to these changes. Although income is universally included as an independent variable, few studies report price-elasticities as a function of income, an important omission. Lucas (1976) made the important point that the parameters estimated from an econometric model are dependent on the policy prevailing at the time and will change if there is a policy change. Therefore significant changes in the price structure and/or price level will render the price-elasticity estimates obtained under different conditions invalid.

Measuring water demand: the empirical evidence

Overview

Summary results of the review of empirical price-elasticity estimates are presented in the Appendix 3. Key points arising from this review are presented below.

Distribution of results. Hanemann (1997) surveyed the literature on price-elasticities of demand undertaken in the United States since 1950. A graphic depiction of the estimates arising is given below.

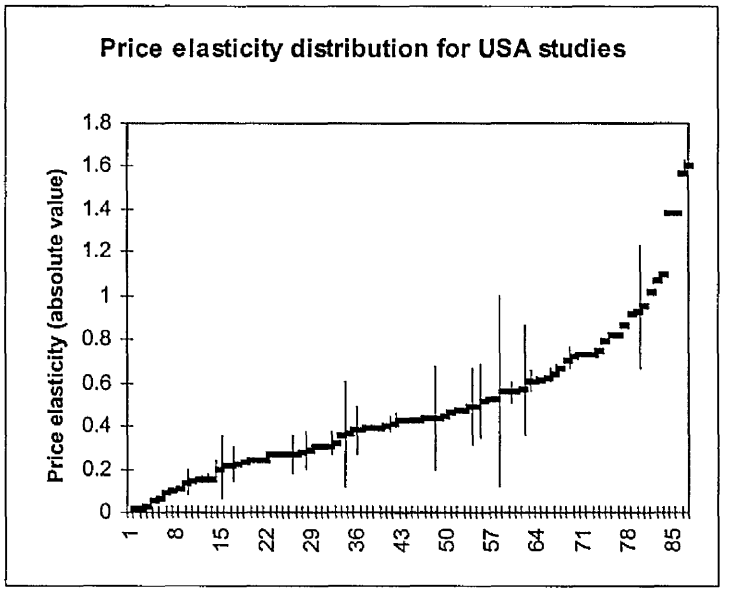

Figure 7: Distribution of price-elasticity estimates for the USA

Approximately one third of estimates are in the range 0 - 0.3, a further third in the range 0.3 to 0.6 and the remaining third larger than 0.6. Less than one tenth of estimates show that demand is elastic. Mann (1989) undertook a review of the available price-elasticity estimates and concluded that, "in brief, the most reliable empirical results clearly indicate that urban water demand is highly price-inelastic, with the possible exception of seasonal (sprinkling) demand".

Comparability. Carver and Boland (1980) make the important point that comparisons between dissimilar studies are fraught with difficulties and should be avoided. In particular, distinctions should be made between studies using aggregate versus micro data, cross-section versus time-series or pooled data, the type of water demand, areas with different climates, and communities with different income characteristics (level and distribution). The influence of methodology employed should also be noted (see below). An examination of sub-groups within the set of estimates for water demand in the USA reveals that *in all the sub-groups*

(grouped by type of use, time of use, location and type of data), *a wide range of estimates exists*.

The influence of methodology on results. That methodology matters and profoundly affects the results of the analysis of water demand is ably illustrated by comparing the Nieswiadomy and Molina (1989) and Hewitt and Hanemann (1995) studies. Both studies used the same micro data set yet reported significantly different results, even for similar estimation techniques.[367] Hewitt and Hanemann (1995) and Hanemann (1997) concluded that specification matters but they were unable to shed light on which specification is more correct.[368] Saleth and Dinar (1997) used OLS to analyse demand in the context of a steep increasing block structure; on finding a positive and significant price-elasticity for an average price specification, they concluded: "this means that price has a dominant positive effect on water consumption among economically well-to-do households" and they did not question possible bias in their estimation technique.[369]

Data reliability. The quality and nature of the data profoundly influence the results. Yet there is little discussion in the literature on data reliability, a particular problem in developing countries. On the consumption side, meters may be inaccurate, there may be transposition errors in manually entered meter readings, meter readings may be missing, estimated or guessed, consumption may be wrongly attributed and bills may be wrongly calculated. Wide variations in water usage between consumers and over time (for the same consumer) make errors difficult to detect. Households may have incentives to misreport income, household size, and so on, in surveys. The accuracy of social, economic and demographic data in poor neighbourhoods is particularly doubtful.

Confidence intervals. Any estimate of the price-elasticity of demand has a confidence interval attached to it. It is remarkable how little attention is given to this in the literature. The question of confidence intervals becomes even more important when considerations of data uncertainty and the influence of methodology on results are also included in the interpretation of confidence intervals. In fact, the uncertainties attached to many estimates may be so large so as to render the estimates meaningless for all practical purposes.

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[367] For example, the slightly altered instrumental variable and two-stage least square specifications used by Hewitt and Hanemann (1995) yield positive but insignificant price parameters whereas Nieswiadomy and Molina report significant negative price parameters for essentially the same data set.

[368] A discrete-continuous choice model developed by Hewitt and Hanemann (1995) calculated elastic price-elasticity estimates (-1.6) compared to inelastic estimates (-0.55 to -0.86) calculated by Nieswiadomy and Molina (1989) using IV and 2SLS estimations for the same data set.

[369] This is notwithstanding the fact that Nieswiadomy and Molina (1989) have shown OLS estimates to be biased in this context. Neither do they draw any specific attention to a price-elasticity of -5.3 calculated

Threshold consumption. The water demand study by Cairncross and Kinnear (1992), one of the few undertaken in developing countries, confirms the fact that there is a minimum threshold consumption which consumers value very highly. They found an effective zero price-elasticity of demand even in the context where households pay an average of 55 percent of their income for between 25 and 30 lcd of water from vendors. This result is confirmed by studies that have examined the relationship between consumption and water carrying distance in rural areas (see, for example, White *et al*, 1972).

Multiple households. Where multiple households share a common meter and are responsible for the water bill in proportion to their share of the total consumption, the price incentive is muted and it may be expected that elasticities are smaller. This is borne out by the Hansen (1996) study in Denmark in which the price-elasticity was found to be less than -0.1 in the context where a large proportion of households in a city shared meters.

Outdoor water demand. Peak seasonal demand (usually occurring in the summer and related to garden irrigation) is likely to be more elastic than that for indoor usage, *ceteris paribus*. This is borne out particularly by the seminal study by Howe and Linaweaver (1967) that undertook separate metering for indoor and outdoor water usage. Other studies also support this supposition (for example, Lyman, 1992).

Peak demand and costs. The Howe and Linaweaver (1967) study demonstrated the influence of garden irrigation (sprinkling) on peak demand and hence on system capacity costs.

Price-elasticity as a function of income. It is remarkable that only a few of the studies reviewed calculate and quote price-elasticity as a function of household income. Agthe and Billings (1987) showed that, in the case of a mildly increasing block pricing structure in Tucson, price-elasticities decreased as income increased. A similar (though more striking) pattern was found by Renwick (1996). She calculated price-elasticities of -0.53 for low-income, -0.21 for middle income and -0.11 for high-income groups. Martin and Wilder (1992) quoted sample means (consumption, income and delinquency rate) by income category for the three categories chosen but did not calculate separate price and income-elasticities for each group. Katzman (1977) grouped his data by consumer type (rich urban, poor urban and poor rural). He does not quote separate price-elasticities although he did not calculate arc income-elasticities by income group (0.24 to 0.3 for the poor to middle range and 0.32 to 0.39 for the middle to rich range). Saleth and Dinar (1997) reported price-elasticities by housing category, but the results obtained were inconclusive.

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for consumers consuming more than 15 kl per month using a marginal price specification and OLS estimation, a degree of elasticity never before found and reported in the literature.

Price-elasticity and equity. Very few of the water demand studies reported in the literature discuss equity issues. Agthe and Billings (1987) argued for a steeper inclining block structure in Tucson on the basis of the assertion of combined equity and efficiency improvements. Martin and Wilder (1992) modelled delinquency rates as a function of price and household income. They found a strong inverse relationship between income and delinquency rates and noted that "low income households find it more difficult to remain current in paying water bills and are consequently more likely to face cutoff ", and further that "the burden of increased rates includes the loss of service by some households" (Martin and Wilder, 1992: 99). Renwick (1996) found in her study area that price policy may shift the conservation burden to lower income households. Cairncross and Kinnear (1992) found that pricing can discriminate against the poor because at low (subsistence) levels of consumption the price-elasticity of demand may be zero. Equity issues were discussed more fully in Chapter 5.

Price-elasticity and rate structure. Nieswiadomy and Cobb (1993) analysed the influence of rate structure on price-elasticity. Whilst acknowledging that their analysis suffered from incompletely corrected selectivity bias, they noted that price-elasticities under increasing blocks were higher than those under decreasing blocks suggesting that increasing block structures were "conservation orientated". However, they also concluded that consumers are more likely to respond to average prices than marginal prices. A more obvious point is made by Saleth and Dinar (1997): the steeper the blocks and the higher the marginal prices, the more likely it is that consumers will respond to marginal price rather than average price and the greater the price-elasticity of demand (with respect to marginal price).

Technology adoption. Renwick (1996) modelled the adoption of water saving technologies. She found that price policy, non-price policy and technology change may all reduce household water demand. Households with higher incomes are more likely to adopt water efficient irrigation technologies when subsidies are provided for water saving appliances. If lower income households adopt water efficient irrigation technologies, they are more likely to be particularly labour intensive technologies such as grey-water use and hand irrigation.[370] Poor (and elderly) households are likely to apply very much higher implicit discount rates in their decisions to purchase water saving devices because they are more risk averse and the opportunity cost of the money used to purchase the goods is much higher than for higher income households (Pearce *et al*:1990a). This further supports the findings of Renwick (1996) and may have important policy implications. For example, Woodwell (1992) argues that supply-side investments in consumer level water saving technologies may be more efficient

[370] "The adoption of water efficient technologies reduces demand most among higher income households because wealthier households tend to have more bathrooms and other water using capital within the home and maintain larger lots with more landscaping" (Renwick, 1996: 82).

than using marginal-cost pricing and relying on households and industries to invest in water saving technologies.[371]

Composition of the aggregate. Few studies disaggregate the data in accordance with the different demand characteristics of different groups of households. Renwick (1996) found that the composition of the aggregate matters. She found that policy responsiveness and thus the distribution of the conservation burden differ depending on the policy instrument and the characteristics of the household classes. Saleth and Dinar (1997) analysed their sample grouped by housing type and consumption and found significant differences between groups. Only one of the studies in the USA surveyed by Hanemann (1997) quoted different price-elasticities for different income groups. In the context of developing countries, income inequalities may be extreme and thus there may be wide disparities in income even within income-stratified groups of consumers. This should be borne in mind when drawing policy conclusions from empirical results.

Water restrictions. Renwick (1996) found that water allocations, landscape irrigation restrictions and improvements in landscape irrigation technology shift the "conservation burden" to households with larger landscaped areas.[372]

Policy sequencing. Renwick (1996) found that policy sequencing (for example, pricing versus restrictions) may influence the reduction in demand attributable to a particular policy instrument when more than one policy is implemented.

Metering. There is strong evidence that water demand is affected by metering and a non-zero marginal price for consumption. Howe and Linaweaver (1967) demonstrated the differences in water use between households in metered and unmetered areas which otherwise had similar characteristics.[373] Hanke (1970) undertook a time-series analysis of water demand in Boulder (Colorado) and demonstrated that both indoor and outdoor water use decreased in the short-run in response to metering and that this decrease was maintained over time.[374]

[371] "Data specific to Denver show that the potential gains in aggregate consumer surplus attributable to supplier-financed investments in improved water-use efficiency are many times larger that potential gains from reformed [marginal cost] pricing. An expanded efficient pricing rule which incorporates these supplier-financed investments, promises substantial improvements in economic efficiency" (Woodwell, 1992).

[372] See also Dandy (1992).

[373] The ratio of summer sprinkling to summer potential evaporation was 0.6 for metered areas compared with 1.8 for unmetered areas.

[374] The ratio of actual to "ideal" sprinkling changed from more than 150 percent before metering to about 80 percent after metering.

Large price increases. Hogarty and Mackay (1975) used arc-elasticities and time-series data to calculate demand responses to large changes in the marginal price.[375] They obtained mean elasticities of between -0.56 and -0.86 (though these were not statistically significantly different from one another)[376] for the price increase and close to zero for the price decrease. Hogarty and Mackay concluded that: "residential water consumption, even for domestic use, is highly sensitive to large increases in (marginal) rates; response to rate increases is as great in the short-run (3 months) as in the long-run (12 months); and, residential water consumption is relatively insensitive to decreases in (marginal) rates following large increases" (1975: 793). They attribute the elasticity of the price responsiveness to a combination of income and substitution effects. The income effect arises because higher water tariffs may reduce discretionary income by a much higher proportion than total income in the short-term because a large proportion of total income may be pre-committed to monthly fixed payments. The substitution effect arises from the adoption of new practices (for example, fixed leaks and shorter showers). The asymmetry in demand response to price changes may arise from the tendency for some of the substitution effects to be less reversible.

Implications of empirical results for methodology

Different methodologies (equation form and estimation technique) yield significantly different results for the same data, particularly in the context of non-linear pricing schedules. There is therefore considerable methodologically induced "noise" in all water demand estimates. This uncertainty is further exacerbated because of data unreliability that is particularly prevalent in developing countries.

Lack of homogeneity amongst consumers as a whole means that aggregate estimates of price-elasticities gloss over differences between consumers, a problem which is exacerbated in developing countries where disparities in income are typically stark.

Results of different demand studies are seldom comparable because of differences in methodology and the estimation context. The results of a demand analysis in one study cannot be transferred to another area with any confidence.

[375] The area studied was a newly developed area comprising largely young professionals living in townhouses in Blacksburg, Virginia, USA. The price changes were +24 percent and -55 percent respectively. Subtracting the percentage change in quantity from an adjacent control community controlled exogenous influences on demand.

[376] This is a rare explicit acknowledgement of the uncertainty implicit within statistical estimates.

The calculation of point-elasticity estimates in a developing country context typically will be inappropriate.[377] There are no *a priori* grounds for assuming the demand curve to be of any particular functional form. Point-elasticities are only accurate at the respective mean values of the estimating equation. Lack of homogeneity amongst consumers means that the estimate of the price-elasticity at the mean value is not useful (particularly for the purposes of welfare analysis). When moving away from the mean value, different assumptions concerning the form of the demand curve will influence the estimated price-elasticities. Arc-elasticity estimates therefore may be more appropriate.

Implications for a critical-realist approach

Estimating the price-responsiveness of water demand typically appears to have been done for one or more of the following purposes: to "prove" demand theory; to display the researcher's skills in econometric techniques; to show that pricing is an effective tool to enhance "efficiency"; and/or, to assist in making water demand forecasts.

The review of the theory of water demand and the methodology applied in the analysis of water demand has shown that if the primary purpose of empirical estimates is to *prove* demand theory, then this effort has been futile because empirical methodology (as used in practice) is formally inconsistent with the theory of demand.

The results of empirical studies show that demand for water is price-inelastic. The logical conclusion to be drawn from this is that relying on price alone to improve water-use "efficiency" is ill-conceived because the welfare effects of changing prices will be much larger than the "efficiency" effects and hence an analysis of price reform which does not examine the welfare effects of price reform is both selective and biased. This is not to say that prices do not affect demand; rather, policies which seek to enhance efficiency only through pricing are ill-conceived. This is all the more apparent in the light of the criticism of the Pareto-efficiency claim of marginal-cost pricing presented in Chapter 3. Clearly a more satisfactory definition of efficiency is needed. This topic is addressed in the next section.

The usefulness of price-elasticity estimates is restricted to assisting in demand forecasts. Unfortunately, the efficacy of price-elasticity estimates to improve water demand forecasts is limited due to four key factors: the dominant influence that the stochastic climate variable has on water demand, the uncertainty in the price-elasticity estimates arising from methodological and data induced "noise"; the Lucas critique combined with the inadmissibility of applying

[377] Reddy (1996), for example, applies a calculated point-elasticity estimate (-0.4) to a 100 percent increase in the urban water price in order to estimate demand. This is clearly inappropriate and likely to result in erroneous water demand forecasts.

statistical estimates beyond the range in which they were estimated; and, the inability to transfer estimates from one context to another.

4. Understanding water-use efficiency

Water-use efficiency is defined in the neo-classical economics literature purely in terms of allocative-efficiency that, in turn, is based on consumer demand preferences. Within this framework, water use *is only efficient* when the marginal price of water is equated to its marginal cost. The theoretical difficulties with this definition have been discussed in Chapter 3. Moreover, the review of pricing practice presented in Chapter 1 showed that water is *hardly ever* priced at its marginal cost (however defined). Arguments as to *why* this is the case were advanced in Chapter 4. In this chapter, the *empirical difficulties* of determining the price-elasticity of demand for water have been demonstrated. Even if these limitations are accepted as being unproblematic, the "efficient" allocation and use of water are premised on the existing income distribution and hence are neither objective nor value neutral. Finally, the implementation of marginal-cost pricing (with the objective of achieving allocative-efficiency) may cause a significant and regressive change in income distribution (see Chapter 5).

In the light of the above, the neo-classical allocative-efficiency definition of water-use efficiency clearly is not very satisfactory. Alternative and more operational definitions of efficiency are technical or *x-efficiency* and *optimal beneficial use*. These concepts are defined and discussed below. It is argued that they are likely to be more useful in analysing the efficiency effects of price reform, especially in a developing country context.

X-efficiency

A process may be said to be X-efficient if it is accomplished with the minimum expenditure of total resources. In the case of water use, say in a production process, technical efficiency is achieved when the value of the sum of water use and other inputs is minimised, that is:

$$\text{output} = \min \sum \text{value(water use, other inputs)}$$

In terms of this definition, an initiative to conserve water is not technically efficiency if the reduction in water use (as measured by its value) is less than the value of the additional inputs required to achieve the same output (with future flows discounted to the present). If the same output is achieved by using less water *and* no additional inputs, then X-efficiency is unambiguously improved and it is not necessary to place a value on any of the inputs. However, X-efficiency improvements are typically achieved through employing a new

combination of inputs with some inputs decreased and others increased. The measurement of technical efficiency improvements thus typically is dependant on how resources are valued.

At the risk of making a rather obvious point, a zero marginal price for water (for example, a fixed monthly charge which is independent of the amount of water used) will not encourage X-efficiency in water use because no additional cost is imposed on the user for additional use of water. Similarly the higher the marginal cost of water to the user, the greater the incentive for X-efficiency use because the higher the cost of marginal consumption.

Although, at face value, X-efficiency does not appear to be very different to static-allocative-efficiency defined within neo-classical economic theory, there *is* an important difference. X-efficiency does not make an overall welfare maximisation claim (Pareto-optimality) and therefore is not subject to the objections to the Pareto-optimality claim of marginal-cost pricing. Furthermore, X-efficiency may be advocated in a way that is fully cognisant of the political-economic context and outcomes of X-efficiency pricing.

It may be concluded that, as a general rule, and subject to equity and sustainability considerations, it is desirable that tariffs create incentives that promote X-efficiency in water use, water production, wastewater treatment and disposal, and institutions.

Optimal beneficial use

Optimal beneficial use may be defined as "the best possible use of a resource in the public interest", that is, o*ptimal beneficial use* achieves the desirable combination of social, economic and environmental objectives that is in the best interests of the public. The concept requires that the social, economic and environmental values of water use, as well as both intra- and inter-generation concerns, be taken explicitly into account. The definition of efficiency in terms of *optimal beneficial use* thus recognises the *social* value of water and the fact that it is inappropriate to value water solely in terms of the value placed on the resource by the "highest bidder".

Optimal beneficial use emphasises the need for social choice in the way in which water is allocated and used. Hence *optimal beneficial use* can only be understood within an historically specific context. Actions to achieve *optimal beneficial use* would need to take into account the appropriate balance between promotion and enforcement, given due consideration to research, pilot projects, education and general communication activities and are likely to work best in a supportive framework which includes *regulatory incentives and penalties*, and the provision of information on best practice and comparative performance.

Implications for a critical-realist approach

Although the general goal of "efficiency" is likely to be uncontroversial, there are very different understandings of what this actually means in practice. The review of theory presented in Chapter 3 showed that an exclusive focus on allocative-efficiency is inappropriate. Technical efficiency is a more direct measure of the efficiency of resource use and can be useful in assessing the efficiency-effects of price reform. *Optimal beneficial use* emphasises the social value of water and the need for social choice in the way in which water is allocated and used.

In this context, the following two general principles are proposed: pricing policy should recognise both the economic and social nature of water and make use of all three definitions of efficiency as appropriate to the particular context; and higher consumption-related prices will generally promote X-efficiency in water use, although the effects on equity and sustainability need to be assessed and taken into account.

The first principle rejects the neo-classical "price equals marginal cost" rule as the exclusive basis for promoting water-use efficiency. The second principle recognises that water demand is somewhat price responsive and that metering water and requiring consumers to pay in proportion to the amount of water consumed are likely to increase X-efficiency in water use but that these improvements must be weighed against the equity and sustainability outcomes. The principles thus explicitly recognise the importance of the political-economic context.

5. Summary and conclusions

Sustainability and pricing

The goal of ecological sustainability is unlikely to be achieved solely through a pricing strategy and other interventions will be necessary. These would typically include legislative interventions such as the stipulation of minimum flow requirements. Such interventions, in turn, will influence the availability and relative scarcity of water and hence may affect pricing strategies.

Higher water prices will generally promote ecological sustainability but not necessarily guarantee it. Moreover, the equity implications of higher prices must be taken into account. The political-economic context will have an overriding influence on water pricing and management practices and the outcomes these have on the environment and the achievement of ecological sustainability.

Understanding water demand

In general it is expected from the theory that water demand will be responsive to price, that is, higher water prices will result in reduced water demand, *ceteris paribus*, and that water demand will increase as income increases. Although the exposition of the theory of water demand is relatively straightforward, it is no easy matter to *apply* this theory in a general and consistent matter to the empirical analysis of water demand. Almost all empirical modelling of water demand recorded in the literature to date is formally *inconsistent* with the neo-classical theory of preferences and demand. Thus, the damning point made by Deaton and Muellbauer's (1980: 80) – demand theory is very often used in a "highly cavalier" fashion with little attention being paid to formal consistency between theory and application – is applicable to the water demand literature.

There is considerable controversy and little agreement on three key methodological considerations: the choice of the appropriate equation form, the specification of the price variable and the choice of estimation technique. All three significantly effect the empirical results.

If the lack of data availability and reliability, which is a particular problem in developing countries, is added to the methodologically induced uncertainties, then it may be expected that the results obtained from empirical studies are likely to have wide confidence intervals rendering the results to all intents and purposes meaningless. The review of the empirical results confirmed this expectation, showing unambiguously that methodology significantly influences the results and that the results, in general, have very wide confidence intervals.

The parameters estimated from an econometric model are dependent on the policy prevailing at the time and will change if there is a policy change. Significant changes in the price structure or price level outside the historical range will render the application of price-elasticity estimates obtained under different conditions invalid.

The usefulness of this kind of empirical demand analysis for welfare analysis is highly questionable. This is because welfare analysis requires the examination of the demand behaviour of individuals rather than groups of households. The use of a "representative household" to model welfare effects, a method often employed to circumvent this problem, may yield misleading results, particularly where income disparities are stark.

Results from different demand studies are generally not comparable with one another. Similarly, the results of demand studies are generally not transferable from one context to another.

There appears to be little merit in employing complex methodologies that attempt to estimate point-elasticities of demand, particularly in developing countries.

Understanding efficiency

X-efficiency and *optimal beneficial use* are more satisfactory definitions of efficiency in the light of the shortcomings of the neo-classical static-allocative-efficiency definition. The valuation of resources implicit in all three definitions is subjective, but this is explicitly recognised in the two alternative definitions whereas this is not the case for the Pareto-efficiency definition. In general, the promotion of x-efficiency is likely to be a desirable social goal and should be promoted subject to equity and sustainability considerations. The need for a balance between these considerations is captured in the concept of *optimal beneficial use* that explicitly recognises the primacy of the political-economic context.

The political economy of water and the environment

The current political orthodoxy in the OECD counties and its multinational institutions, specifically the IMF and World Bank favours privatisation, liberalisation, deregulation and market pricing, with private management of infrastructure monopolies through competitive tendering. This approach emphasises water as a tradable commodity, much like any widget. But the wise use of water is intrinsic to sustainable development and the market, on its own, is unlikely to deliver this. Hence regulation and direct public action in the public interest are needed to safeguard the environment. This requires both political will and a conducive political economic context. Hence, water resources management (when linked to the aim of promoting sustainable development) is fundamentally a political-economic product.

Chapter 7: Conclusions

An outline of a critical-realist approach to urban water pricing with specific reference to South Africa

> *Observed reality is generated by underlying structures [but] our knowledge of these is inevitably incomplete; reality can only be understood as an open system, so there is scope for a range of understandings. But each understanding can be discussed rationally in relation to our [necessarily subjective] perceptions of the underlying structures and processes. (Dow, 1997: 88)*

1. Introduction

Earlier chapters have presented the justification for developing a critical-realist methodological approach to the policy and practice of urban water pricing (Chapters 1 and 2) and critically reviewed key constituent elements of this approach (Chapters 3 to 6). It remains the task of this chapter to illustrate how these constituent elements may be assembled and hence to provide an outline for *a* critical-realist methodological approach to urban water pricing. I do this with specific reference to South Africa.

The approach developed here asserts the absolute priority of political economy (in terms of understanding the constraints on and scope for price reform), which is consistent with a critical-realist methodological framework. Within the context of South Africa, I also assert the priority of justice over other water pricing policy goals. This is consistent with Sen's argument for *equality of capability* in the context of *antecedent diversity* (as discussed in Chapter 5) and, further, is based on the proposition that a proper understanding of the political economy of South Africa will invariably lead to this conclusion (see Section 2). There is nothing inherent in the critical-realist methodology to suggest that it must be this way; the methodology only requires that the subjectivity and limitations of the choices be recognised and made explicit, and that the possibility of a range of understandings be acknowledged.

It should be noted at the outset that water policy (and hence practice) in South Africa has undergone a process of rapid and significant evolution in recent years. This process commenced in 1993 and was coincident with the drafting of the new (interim) constitution. The first policy statements to make a break with the past were contained in the Reconstruction and Development Programme (RDP) published as a key pillar of the ANC's election manifesto in late 1993. The RDP become official government policy in May 1994, though in

an eviscerated form.[378] The first white paper on water policy by the newly elected democratic government was published in November 1994.[379] This was followed by further policy documents and legislation which include a further white paper on water policy,[380] the Water Services Act (1997) and the National Water Act (1998).[381] This evolutionary process is still ongoing. At the time of writing, policies are being refined and regulations related to the actual and proposed legislation are being developed. Pricing practices are in transition as a result of these changes as well as the reform of local government.[382] The focus of the analysis presented here is on these recent changes. The analysis endeavours to understand these changes in terms of a critical-realist approach to water pricing and in relation to the broader political- economic context.

2. Towards a political economy of water in South Africa

I argued in Chapter 4 that market structure has a profound influence on water pricing practices and outcomes and, further, that the structure of the market is contingent on the underlying political-economic dynamics. In this chapter I demonstrate how an analysis of the political economy of the South African water sector might proceed and outline some of the outcomes of the specific South African political economy in terms of its macro-economic policies, the structure of the "water market" (institutions) and how these influence pricing practices. I have not endeavoured to present a comprehensive political-economic analysis of the South African water sector (space does not allow), but only to illustrate how such an analysis might proceed. Particular issues related to equity, sustainability and efficiency are elaborated in the sections that follow.

[378] The RDP White Paper was a watered down version of the original RDP (the so-called "base document") for reasons discussed in the following section. See Marais (2001).

[379] "Water Supply and Sanitation Policy: Water – an indivisible national asset" (DWAF, 1994). The White paper was drafted in the main by white liberals (the principal author was Len Abrams) and reflected World Bank thinking in many (though not all) respects.

[380] "White Paper on a National Water Policy for South Africa" (DWAF, 1997a).

[381] The water policy White Paper asserts government custodianship of water, refutes private ownership of water, delinks water *use* rights from land rights and emphasises the need to redress economic and social imbalances arising from past policies and practices. The policy and Act are stamped with the character of Kadar Asmal stamped on it, who was heavily influenced by (old) labour party policies in the UK while in exile (in reaction to Thatcherism).

[382] A new two-tier system of local government is being implemented in South Africa in terms of the Municipal Structures Amendment Act (2000) and the Municipal Systems Act (2000). These provide for the reallocation of responsibilities for water services provision to district government from municipalities.

An outline for a political economic analysis

A political economic analysis of the water sector in South Africa would need to develop a detailed understanding of a number of key historical events and processes including but not limited to the following: the development of the gold mining industry on the Witwatersrand;[383] the development of water infrastructure to supply the gold mining industry, specifically the formation of Rand Water and the nature of the private legislation governing its mandate and responsibilities; the development of towns and cities on the Witwatersrand to service the mines, the development of secondary industries and the related development of water infrastructure and institutional arrangements (for example, the changing relationship between Rand Water and these towns over time); the municipal management of water infrastructure in other cities and towns and the relationship between these and the national government; the effect of apartheid policies and legislation on the spatial development of infrastructure and the corresponding funding and pricing policies;[384] the evolution of the roles and responsibilities of national government with respect to water and, in particular, government funding and pricing practices with respect to agricultural schemes, joint agricultural and urban schemes, urban schemes and inter-basin water transfer schemes; the formation of other water boards, specifically the formation of Umgeni Water to provide bulk water to Durban and Pietermaritzburg and the evolution of its mandate over time to include the supply of water to rural communities; the development of the Lesotho Highlands Water Project and, specifically, the nature and content of the agreements between South Africa and Lesotho with respect the assignment of rights and obligations; the influence of the development of "strategic industries" such as Sasol (petroleum from coal), Eskom (electricity) and Iscor (iron and steel) on water infrastructure development; the outcomes of economic development under apartheid and its effects on the spatial and racial distribution of household income; the political-economic conditions leading to the first democratic elections in 1994 and the consequent influences on government policy (specifically, the negotiated settlement between the African National Congress (ANC) and the National Party, the constitution and workings of the "tri-partite alliance"[385] and the influence of national and international capital over government policy),[386] the core elements of government policy, including fiscal discipline, a "basic needs"

[383] See, for example, Fine and Rustomjee (1996).

[384] See, for example, the history of water development in Grahamstown (Eberhard, 1999c).

[385] The tri-partite alliance is between the African National Congress, the Congress of South African Trade Unions (COSATU) and the South African Communist Party.

[386] See Marais (2001) for a more general discussion.

orientation and privatisation, and the influence of these on the water sector;[387] the origins and outcomes of the Reconstruction and Development Programme, particularly the reasons for its early demise;[388] the "flagship" role of the Department of Water Affairs and Forestry under the leadership of Kadar Asmal and the implications of this for national water policy and urban and rural water infrastructure; the political and institutional transitions within local government, specifically the reallocation of roles and responsibilities for municipal water infrastructure; the origins and implications of the national governments "free basic water" policy initiative; and the development of so-called "Municipal Service Partnerships" for water services in Johannesburg, Nelspruit, the Dolphin Coast and other areas.[389]

Time and space do not allow a detailed examination of these issues, though some points are elaborated below. Nevertheless, it is possible to substantiate some of the "stylised facts" asserted in Chapter 4 with specific reference to the political economy of the water sector in South Africa.

There is no doubt that the allocation of property rights and distribution of resources under apartheid has profoundly influenced the development of water infrastructure in South Africa. Despite the shift to a democratic government in 1994, current outcomes still very much reflect past allocations.[390] Marais argues convincingly that the central concerns of capital were "transparent and aggressively expressed" during the transition, namely, the "need for a market economy, for social and political stability, for continuity in state institutions and for *restraint from radical redistributive programmes*" (2001: 84). Consequently, the unequal distribution of resources under apartheid continues to be perpetuated in the post-apartheid era and efforts to redress inequalities have been severely constrained (see below).

Reforms in the water sector in South Africa have arisen as a result of the much larger and all-encompassing political-economic crisis leading to a change in the polity.[391] This underlines the fact that the polity is crucial as it determines the social contract between government, capital and society. As will be shown below, the social contract has extended benefits to poor households only in a limited way and has taken place within a framework of protecting the integrity of the capitalist system. This is consistent with Marais' assertion that the historical

[387] The key documents here are the government's macro-economic policy "Growth, Employment and Redistribution" (GEAR) (DOF, 1996) and the "Reconstruction and Development Programme" (ANC, 1994).

[388] A detailed account is given in Marais (1998).

[389] The term "Municipal Services Partnerships" is used in many instances as a euphemism for private sector participation in local government.

[390] Evidence of this is presented in Section 1.3.

[391] See Marais (2001) for an analysis of this process.

privileging of the political over the economic by the ANC allowed "for the possibility of a settlement based on significant restructuring of the political sphere, [but] broad continuity in the economic sphere" (2001: 85).

For the reasons identified above, the sections that follow are largely illustrative in nature, giving emphasis to the present context at the expense of a more detailed understanding of the dynamics leading to this context.

The political economy of macroeconomic policy

At the time of the first democratic elections in 1994, there was a general consensus within the ANC-led alliance that South Africa should embark on a large-scale social and economic infrastructure investment programme seeking to redress the imbalances and deprivations of apartheid and, at the same time, to restructure the economy so as to achieve rapid and sustained economic growth. The ANC recognised (at least at the level of rhetoric) that these two objectives were intimately linked: economic growth depends on social and political stability, which in turn depends on the capacity of the government to deliver the prospect and reality of a better future to the majority of the population. These views provided both the justification for, and are reflected in, the Reconstruction and Development Programme (RDP) which formed an integral part of the ANC election manifesto.[392] The RDP played an important role in the first years of the ANC government in reorienting government expenditure towards infrastructure investment focused on meeting the basic needs of South Africans, specifically in the areas of water supply, electricity, schools and clinics.[393]

The development of a more comprehensive macroeconomic strategy called GEAR (Growth, Employment And Redistribution) coincided with (and arguably was responsible for) the demise of the RDP.[394] The rhetoric of GEAR asserted that the strategy was designed to facilitate rebuilding and restructuring the economy such that the economy would contribute to the realisation of the following long-term vision: a competitive fast-growing economy which created sufficient jobs for all work-seekers; the redistribution of income and opportunities in favour of the poor; a society in which sound health, education, and other services are

[392] Marais asserts that the RDP originated with the Reconstruction Accord developed by COSATU in 1991 and was adopted by the ANC at the last minute and became "touted as the hub of a strategic programme" (2001: 95, 133). Albie Sacks (now a Constitutional Court judge) admitted that the ANC had no analytical framework at all at the time and was reduced to policy improvisation (Marais, 2001: 98).

[393] See, for example, Marais (2001). For a more critical review of the RDP programme, see Bond (1994).

[394] The GEAR macroeconomic strategy is set out in DOF (1996). Marais argues that the eventual fate of the RDP reflects "the outcome of the struggle to determine the class bias of an ANC-managed hegemonic [transformation] project" (2001: 99).

available to all; and an environment in which homes are secure and places of work are productive (DOF, 1996).

The core elements of the strategy included the following: a renewed focus on budget reform to strengthen the redistributive thrust of expenditure; a more rapid fiscal deficit reduction programme to contain debt service obligations, counter inflation and (ostensibly) to free resources for investment; the accelerated restructuring of state assets to optimise investment resources (a euphemism for privatisation); an expansion of the infrastructure investment programme to address service deficiencies and backlogs; and a monetary and exchange rate policy which aimed for low (but positive) real interest rates, low inflation and a stable currency. With respect to revenue, the strategy asserted that "international experience confirms that it is on the expenditure side that the state budget is most effectively able to contribute to redistribution", but that "it is nonetheless important that the incidence of taxation should remain progressive, while at the same time impacting across a broad base so as to avoid excessive rates" (DOF, 1996: 9).

The strategy asserted that "the provision of basic household infrastructure, in particular, *is a relatively low cost* and effective form of public intervention in favour of the poor and consistent with the reduction of income inequalities" (DOF, 1996: 15, own emphasis). The strategy noted that "improved water and sanitation is typically the first priority of rural communities", and that commitments have been made to "some 500 projects costing R1.5 billion" (US$350 million) (DOF, 1996: 15).[395] The strategy further noted that the rural water supply programme will ultimately result in the supply of potable water to the 12 million people currently without adequate access, and that this will make a major contribution to poverty relief (1996: 15).

In practice, the GEAR policy was essentially a fiscal stabilisation policy with strong emphasis on debt reduction and inflation targeting. For example, public sector borrowing declined from 9% of GDP in 1994 to just over 2% in 2000 and government debt was stabilised at 50% of GDP from 1995 onwards after increasing from 30% to 50% in the period 1985 to 1995 (South African Reserve Bank time-series data). It can be argued that investments in infrastructure were relatively modest and based on a minimalist definition of basic needs (see Section 3). Thus the macro-economic policy imposed important restrictions on the water sector by constraining the investment resources available to the sector and limiting the funds available for subsidising the operating costs of water services. One important implication of GEAR for

[395] In this chapter, I have converted South African Rands to US dollars (for ease of reference) using the following conversions for the years 1993 to 2001 respectively: US$ = 3, 3.5, 3.6, 4.3, 4.6, 5.5, 6.5, 7 and 8.

water pricing policy is the government's emphasis on cost-recovery through user contributions.[396] The *rhetoric* of GEAR (if not its reality) indicated that a core component of the macro-economic policy *should be* the redistribution of both income and opportunities in favour of the poor. This could provide a rationale for more progressive water investment and pricing practices which have a greater effect in reducing the inequality in income distribution. However, the balance of economic forces has mitigated against a more progressive outcome. The reasons originate in the political and economic compromises inherent in the ANC-National Party political settlement. Marais (2001) ascribes the ANC's "short walk to economic orthodoxy" to a combination of factors including the influence of the IMF and World Bank,[397] the ability of capital to co-opt the ANC elite, the lack of technical capacity related to economic policy within the ANC, the debilitating international context including the collapse of Soviet-style socialism and the crises within Western European welfare systems, the growing influence of *bourgeois* and *petty bourgeois* layers within the ANC, the need of South African capital to expand beyond South Africa and the "serious complicating factor of globalisation". Marais notes that the compromise carried a "steep price":

> *Trade and financial liberation, a privatisation programme, a regressive tax system, ultra-low inflation targets (above all favouring financial capital) and a vast array of other business-friendly adjustments. The tone was patently neoliberal, albeit leavened with a rhetoric to the contrary and, more importantly, later also by commendable changes to the labour market and affirmative action policies in the workplace. (Marais, 2001: 136)*

Notwithstanding these macro-economic constraints, the government claims it has made good on more than 60% of its RDP-based election promises. For example, it claims that some 6 million people have benefited from the government's community water supply programme in the period 1994 to 2000. Based on these asserted achievements, Thabo Mbeki was emboldened to claim that "it would be difficult to find examples elsewhere in the world where a negotiated transfer of power took place, where such progress has been achieved in so short a time to redefine the nature of the new society" (1998). The statement does have some merit, though the claimed redefinition of society is clearly hyperbole.

Marais (2001) outlines elements of an alternative macro-economic strategy premised on the "art of the possible" and which include more flexibility in the fiscal deficit, a prescribed asset requirement for institutional investors to raise capital for investments in social infrastructure,

[396] "To promote the efficient use of water, the policy will be to charge users the full financial cost of providing access to water, including infrastructure development and catchment management activities. This will be done on an equitable basis and according to the realistic reasonable programme which has already begun. To promote equitable access to water for basic needs, provision will also be made for some or all of these charges to be waived" (DWAF, 1997a: 4).

[397] This notwithstanding the fact that their *direct* leverage over South Africa was limited.

increased state expenditure on social services (particularly health and education), resisting downward pressures on wages, and implementation of a universal income grant of about R100 ($16) per month. However, Marais (2001) acknowledges that the prognosis for establishing the political pre-conditions for implementing an alternative along these lines is not good.

Institutional outcomes and their influence on pricing practices

The national government sets bulk water prices in terms of a national water pricing strategy (developed in terms of the water policy White Paper and National Water Act). The water tariff is made up of three components: an infrastructure charge, a catchment management charge and an "economic" charge. The former is intended to recover the costs of infrastructure, the second to recover the costs of water resource management and the "economic" charge is meant to reflect the scarcity value of water in that particular context (that is, to provide an economic signal to encourage the "efficient" allocation of water). Infrastructure costs are based on a return on revalued assets (set at 4%) and full operating and maintenance costs in the case of water supplied to urban areas and industries. In the case of agriculture, the infrastructure charge is intended to recover the ongoing refurbishment and full operating and maintenance costs. The basis of determining the economic charge has not been decided by government. In view of the fact that the water tariffs calculated in terms of this strategy (finalised in 1999) are much higher than the tariffs historically applied, the tariffs are being phased in over five years. A special dispensation for "emerging farmers" (black South African farmers) has also been created whereby the full water tariffs are introduced over a longer time span (10 years). Hence, in practice, the "economic charge" will not come into effect for a number of years.

The bulk water pricing strategy tries to balance efficiency, sustainability and equity objectives in a politically and socially acceptable manner (a key objective of the Water Policy White Paper). The pricing strategy was developed through a consultative process and appears to have received support (or at least acceptance) by affected constituencies. It is too early to evaluate the outcomes of the policy. The pricing strategy has been criticised by the World Bank for not basing prices on marginal costs and for not using markets to determine the "economic" charge.[398] In fact, the South African government has gone much further than most governments in charging full costs for irrigation water and has been criticised for not taking into account the social implications of this policy in terms of the loss of farm worker jobs as the area irrigated in South Africa declines (Versveld, 2001: personal communication).

Local government has the constitutional responsibility for the provision of water services which are accessible, adequate, affordable and sustainable. Local governments receive some funding from national government (mainly in the form of an "equitable share" of national revenue and conditional capital grants) but are heavily reliant on property taxes and user charges to sustain service delivery.[399] Retail water tariffs are set by local government but must comply with national policies. In general, the national pricing policies are not prescriptive. Local governments are strongly encouraged to provide the first six kilolitres of water for domestic use free of charge in terms of the Free Basic Water Policy (see below). Thus water pricing policy goals may be negotiated and reconciled largely at a local level within a national policy and legislative framework.

There is an ambivalence within government concerning institutional arrangements for water supply, specifically as they relate to the involvement of the private sector in management and service provision.[400] This ambivalence reflects the contradictions within the ANC-COSATU-SACP alliance.

It is government policy to promote municipal service *partnerships*, a euphemism for greater private sector participation.[401] (International development agencies, including the World Bank and the IFC, also actively encourage privatisation in South Africa.)[402] However, in the Municipal Systems Act (2000), there is a general presumption in favour of service delivery by the municipality itself. This reflects a negotiated position between the ANC government and COSATU.[403] The ostensible drivers pushing greater private sector participation are increased technical efficiency (lower costs of provision) and greater access to capital (in an environment where public funds are constrained – although this latter point may be contested). It has been

[398] The World Bank was involved, together with the author, in the early stages of the pricing strategy development. The government has not ruled out the use of water markets, but has stated that an active pro-market strategy is inappropriate at this time (Muller, 2001: personal communication).

[399] The equitable share is not nearly sufficient to cover local government's constitutional responsibilities for service provision. In terms of the 2001/2 national budget, local government is due to receive just R6 billion from national government through the equitable share which is less than 3% of national revenue.

[400] There are many possible definitions of privatisation. The definition employed here refers to various forms of private *participation* in the provision and management of water services (that is, some form of public-private "partnership") and not necessarily to outright private ownership of assets. Necessary elements for an activity to be defined as a public-private partnership include genuine participation by both public and private sectors, at least one common objective, non-fleeting contract duration and an appropriate allocation of risks (Stacey, 1997: 14).

[401] It would appear that the use of the word *partnership* is an attempt to characterise the relationship between the private and public sectors as being an *equal* and *mutually beneficial* one. This is, of course, not necessarily (nor typically) the case (see Chapter 4). Government's privatisation policies are evident *inter alia* in the White Paper on Municipal Service Partnerships (DPLG, 2000).

[402] See, for example, Bond (1998).

[403] The political-economic dynamics between the ANC and COSATU are analysed in Marais (2001). He shows how the ANC has managed to suppress the socialist agenda of COSATU and explains the political-economic forces leading to the ANC's "accommodation" of capital.

estimated that only between 100 and 150 municipalities (out of the then 800 or so) are able to secure loans from private banks and lending institutions (Jackson and Hlahla, 1999: 556). The latest restructuring of local government is likely to make matters worse. Constrained public resources for water resources reflect broader political choices. For example, the government has been willing to commit itself to spending more than R45 billion ($5.6 billion) on armaments over the next few years. Key fears that have been voiced by unions, local government politicians and others include the potential loss of jobs, "reducing costs for the wealthy at the expense of the poor", and higher costs of service provision (as a result of high transaction costs, high profits and/or poor efficiencies).[404] Other key risks relate to universal basic services provision being compromised, the deterioration of service quality, environmental externalities not being adequately catered for, alienation of communities, corruption of elected representatives and municipal officials, and undermining local council accountability (Fourie, 2000: 159). These risks are typically exacerbated where there is a poor regulatory framework, insufficient regulatory capacity and the danger of regulatory capture. All of these conditions are present in South Africa.

In addition to the presumption of municipal service delivery in the Municipal Systems Act, the power to cap tariffs resides with the national Minister of Provincial and Local Government. This latter provision is viewed as a key constraint to greater private sector interest and involvement in municipal services provision in South Africa (Schur, 2001: personal communication). Notwithstanding this, the interests of capital (both internal and international) may be seen as an important driver towards increased privatisation in the water sector in South Africa.[405]

Experiences with private sector participation in the operation and management of water services in South Africa have been fairly limited to date. Some examples are as follows: two concessions (Nelspruit and Dolphin Coast), a large management contract (Johannesburg), a Build-Own-Operate-Transfer (BOOT) contract for a wastewater reclamation plant (Durban)

[404] For example, "Councillor Mower (ANC) indicated that the corporatisation process was aiming at cutting costs to the wealthy at the expense of the poor. He also pointed out that the process had not been negotiated with the unions and that the ANC could not support the proposal (for corporatisation of water, electricity and solid waste services in Cape Town)" (Council of the City of Cape Town minutes, 28 March 2001). The South African Municipal Workers Union has argued that public-private partnerships cater to the needs of capitalist operators and not the needs of local communities: privatisation jeopardises the jobs of municipal workers and will result in a model of urban governance which limits the space for democratic engagement, and disadvantages the poor (Ronnie, 1996; SAMWU, 1999, Urban Futures, 2000).

[405] The then Lyonnaise des Eaux (now Suez), for example, set up an office in South Africa as early as 1993 for the specific purpose of securing privatisation contracts in the water sector in South Africa (Ambert, 1993: personal communication). This represents just the tip of the iceberg – municipal water managers in South Africa frequently receive uninvited visits from private sector international water companies (Macleod, 2000: personal communication).

and a pilot programme looking at innovations to better serve poor communities (Durban). I discuss these briefly below.

Despite a signed 1998 "framework agreement" between two prominent South African unions and the South Africa Local Government Association (SALGA) which specifies that involvement of the private sector in service delivery should only be a last resort (that is, if there is no public sector provider willing or able to provide the service), long-term concession contracts were signed for Nelspruit in April 1999 and Dolphin Coast in January 1999 amidst protests by the unions.[406] It is significant that both concessions were signed before the implementation of the Municipal Systems Act which, in effect, put into law the framework agreement. Details of the concession contracts are not publicly available for scrutiny and it is too early to reach any definitive conclusions on both the nature and performance of the contracts. Nevertheless, in both cases the (initial) water price (together with the basis for escalation) was determined as part of the bidding and negotiation process. Any price adjustments outside of the standard escalation clause must be negotiated on a case-by-case basis. The relative bargaining strengths of the municipality vis-à-vis the private company will determine the outcome of these future tariff adjustments. In view of the discussion given in Chapter 4 together with the review of the political context presented above, the scope for surplus extraction as a result of power asymmetries is likely to be large in the South African due largely to local inexperience in these contracts, the weak regulatory framework and the relative strength of the international companies vis-à-vis municipalities.[407]

Coincidentally, the contract between Siza and KwaDukuza (the Dolphin Coast municipality) has been renegotiated recently (June 2001). Siza requested and secured a 40% reduction in the investment requirement as well as a 15% increase in the water tariff above that provided in the contract. The reasons given were an oversupply of infrastructure and a serious shortfall in revenue. In the words of the General Manager: "The pipes are in place but the customers aren't there" (*Business Day*, 6 June 2001). Siza threatened to walk away from the contract unless their demands were met. KwaDukuza, the contracting municipality, could have called in the performance bond but chose not to. KwaDukuza has some 60 000 inhabitants, two-thirds of whom earn less than R800 ($100) per month, and an annual budget of less than $30 million. In contrast to this, the multinational company SAUR has 23 000 staff and an annual turnover of about $2 300 million. In a context of an inadequate national regulatory framework and little government support to KwaDukuza it is inconceivable that the negotiations were not

[406] Biwater has the majority share in the consortium which won the bid for Nelspruit. In the case of Dolphin Coast, the concessionaire is Siza whose main shareholder is SAUR.

[407] The South African government has implicitly admitted as much by publishing a request for proposals to assist the government in strengthening the regulatory framework.

affected by the existing severe power and information asymmetries. It is no surprise that the national business paper recorded that "the KwaDukuza municipality is reported to have renegotiated the contract on a basis favourable to the company" (*Business Day*, 14 June 2001).

In Johannesburg, a five year management contract was signed in February 2001 between the city's newly formed public water company (Johannesburg Water) and Johannesburg Water Management Company (a joint venture between Northumbrian Water Group (51%), Suez Lyonnaise des Eaux (20%) and Water Services South Africa (29%), a local subsidiary of Suez Lyonnaise des Eaux. The contract covers both water and wastewater services in the metropolitan area. The catalyst for the process was the financial crisis faced by the city in 1997. The ostensible justifications for the contract were to improve the city's financial position by securing a dividend from the water utility and reducing the city's need to raise capital. Neither of these objectives are likely to be achieved in the short term – a significant dividend is not likely to be realised by the city for many years and the management contract will not affect the utility's ability to raise private capital finance in a discernible way. Nevertheless, consultants involved in the process believe the city got a "good deal" – good management at a relatively low cost with payments tied to credible performance targets – even though the key initial objectives are unlikely to be realised.[408] It is probable that both the city and the private contractor view the management contract as a first step towards greater private sector participation. The private company may have been willing to offer its services as a "loss-leader" in the hope of positioning itself as the preferred bidder for what ultimately might be a much more lucrative concession. Given the two primary needs – better management and access to low-cost capital – it is not clear that the net benefits of bringing in a foreign based company to South Africa will outweigh the alternative option of making use of local managerial talent (Still, 2001: personal communication). A key risk to South Africa more generally is the potential expropriation and export of a profit (or cash flow) stream which would otherwise have remained in South Africa.

In 1998 Durban Metro Water Services (the water department of the city of Durban) designed and negotiated a 20 year BOOT contract for a water recycling plant with Durban Water Recycling, a purpose-built company whose principle shareholder is a subsidiary of Vivendi. This appears to be a well-balanced contract which serves the interests and needs of both industries and the city: industries benefit by receiving water suitable to their needs at a much lower cost than available alternatives and the city benefits by having reduced capital needs

[408] Contractors were asked to bid for a share of savings through reducing non-revenue water. Interestingly, all bidders opted for a very low share, preferring the major share of management fees to be fixed (Pickering, 2001: personal communication).

(and hence lower costs and prices for its other consumers). According to Macleod, head of Durban Metro Water Services, the example serves to illustrate that private participation *per se* need not be problematic; the important questions to consider are how the private sector is engaged and how public and private interests are balanced (Macleod, 2000: personal communication).

Durban Metro Water Services also initiated a pilot programme with Vivendi, Mvula Trust and the Water Research Commission to "demonstrate how a partnership of NGO, public and private sectors can address the issues of providing adequate and sustainable water and sanitation services to poor communities" (World Bank, 2001b).[409] More specifically, the objectives of the project are to provide acceptable and affordable water and sanitation services, to manage water in a responsible way, to create community awareness of health, hygiene and conservation issues, to adapt and refine appropriate management systems, and to involve community-based enterprises (2001b). According to Macleod, the partnerships "are helping to prepare the utility, Council, labour and other stakeholders for the future, a future where there will be much more involvement of the private sector. Through these partnerships, local government is learning how the private sector works and thinks, and how to structure a contract and act as regulator. The private sector firms are learning about poverty in South African cities, and are also learning to relate to and respect local government" (World Bank, 2001b). Macleod argues that these projects can be beneficial if you "run small programmes first, work in specific local communities, emphasise collaborative doing and learning, involve those who might otherwise be opposed (for example, unions), and structure arrangements so that there are no residual obligations" (2001b).

There are two possible responses to this pilot project. It could be argued that this type of project is the "thin edge of the wedge" (practically admitted by Macleod above) and that these projects are really a means to a much greater end for private companies (full or significant control of water services in Durban and other large cities in South Africa). Alternatively, it could be argued that the private sector can be engaged on mutually beneficial terms provided the right balances are struck between private and public interests. Advocates of the former point of view will argue that the interests of the private sector (shareholder profits) are fundamentally opposed to broader public interest and hence it is naïve to believe that the alternative view point has any validity. A rejoinder to this is that, given the political-economic context in South Africa, it could be argued that it *is* inevitable that capitalist interests will prevail and hence the only alternative is to try to engage with these on terms that are as

[409] Mvula Trust is an NGO providing assistance to rural communities with the provision of water and sanitation services. The Water Research Commission is a national public agency which funds water research from a levy on water sales.

favourable to the public interest as possible. If this last point is correct, then perhaps the approach adopted by Macleod is the only pragmatic one.

Some have gone so far as to pose the question: has the state deliberately set up *public-public* partnerships to fail in order to strengthen the argument for private sector participation? (Pape, 2001).[410] In support of the argument, Pape quotes a DWAF official: "I suspect we will be moving to a private sector model but it's taking too much time ... do you keep paying subsidies and get nothing in return?" (2001: 24). Pape's argument is akin to conspiracy theory, implying a coherence of purpose (and the power to achieve this purpose) within the state that is simply not there.

Alternatively, it could be argued that local governments have no choice but to seek greater private sector participation. For example, Gotz and Harrison (2000) support this argument in the following manner:

> *The cap on borrowing by municipalities (as determined by the Department of Finance) coupled with their increased responsibilities has put them into a position whereby they are realistically unable to deliver services without looking for financial assistance beyond the public sector. The increased expectations on municipalities through the Municipal Infrastructure Investment Framework and concepts such as developmental local government have meant that municipalities are in the position of increased responsibilities, increased jurisdictions and insufficient finance.*

Elaborating on this theme, the justification of municipal service partnerships is articulated as follows in an official government publication:

> *Today many municipalities are unable to provide municipal services to all their citizens. There are many reasons for this. In some instances, it may be that the municipality does not have adequate funds. In other cases, it may be because the municipality is unable to manage the service properly – that is, to provide good services at an affordable cost to itself, its communities and other users. (Citizens Guide to Municipal Service Partnerships, 1999)*

This argument touches on a point rarely raised by those opposed to private sector involvement in water services, namely, the record of public sector delivery, in many instances, is very poor. In South Africa, the "white" local authorities generally did a reasonably good job in delivering services to the then "white" areas. Services were reliable and reasonably cost-effective (PDG, 1994). However, the democratisation of local government in South Africa has provided great challenges: not only are local authorities more thinly stretched in terms of skills and resources (a result of the rationalisation of resources across wider boundaries to include the previously heavily under-resourced black local authority areas), but the stable and

[410] Pape (2001) evaluated the first public-public partnership in South Africa, between Rand Water and Odi, a local authority. Public-public partnerships are proposed as a viable alternative to public-private partnerships by the South African Municipal Workers Union (SAMWU).

cohesive social compact which existed between the consumers and the local authority (in the case of many of the old white areas, but not in the case of the then black local authority areas) is fundamentally threatened. Without the development of a new broader and more inclusive social compact, *and* the provision of greater resources, it is questionable whether the old model of municipal service delivery in South Africa can meet the new challenges of universal provision of basic services and financial sustainability. In this context, an approach which is agnostic about ideology but is focussed on (and willing to experiment and be innovative in) developing approaches for providing better services for more people and at a lower cost would seem to be most appropriate. Cutting out private sector options on the grounds of ideology alone is clearly short-sighted. This is not to say that the potential pitfalls of private sector involvement should not be taken seriously.

Sylvy Jaglin makes the important point that institutional frameworks cannot be imposed successfully from the outside, rather it is the existing system of social relations which will determine how well any system will work, not the institutional structure itself (2001: personal communication). This would suggest the importance of placing a very significant emphasis on process and on building social compacts. This is a lengthy and time-consuming process which cannot be undertaken in a matter of weeks or months. It is perhaps for this very reason that speedy privatisation processes have so often come aground on the rocks of conflict.

The role of the Municipal Infrastructure Investment Unit (MIIU) in South Africa illustrates the problems associated with ignoring this line of thinking. The MIIU was set up specifically to promote greater private sector involvement in municipal service delivery (with the performance of staff evaluated in terms of the number of deals signed). The standard terms of reference for a feasibility study of service delivery options for water and sanitation services requires consultants to investigate the services status quo, evaluate service delivery options (including a full range of private sector participation arrangements), consult and make a recommendation to the council within 100 days. It is impossible to undertake any meaningful consultation within such a short period, particularly in a context where both labour and the governing legislation is antipathetic to the cause of privatisation so boldly advanced by the MIIU and where local authorities are newly created institutions with cultural divisions and lack of trust between politicians and officials. Hence it is not surprising that of the more than 100 feasibility studies commission by the MIIU, only a handful has resulted in contracts being signed – the MIIU appears to have been hoisted by its own petard.

This discussion has served to illustrate, albeit briefly, that a critical-realist approach to pricing must not only take into account the effect of the current institutional arrangements, but also the prospects for institutional transformation and the underlying political-economic forces

governing these changes. Furthermore, the discussion shows that a range of understandings are likely to co-exist at any one time and that these understandings are based on necessarily subjective perceptions. Institutional outcomes and pricing practices will flow from the balance of political and economic power underlying these perceptions.

3. Taking justice and inequality seriously

The political and economic imperative of addressing the injustices of the past and reducing inequality is likely to be a key outcome of any detailed examination of the political economy of South Africa. The same examination will also identify both the constraints to addressing injustices and the scope for reducing inequalities.

In the context of urban water pricing, and within a critical-realist framework, the following kinds of questions would need to be addressed: How should equitable access to water services be defined and to what extent should this be a priority in terms of resource allocation? What are the relationships between income inequality, affordability and cost-based water pricing and what are the implications of this for water pricing policy? What role should (or could) subsidies play in the pricing of water? and, What scope is there for water pricing policy to contribute to the reduction in inequality?

There is not one stable set of answers to the above questions. The questions themselves will continue to be rephrased and the answers refined or amended as time passes and conditions change. Moreover, the methodology used to address these questions may be contested and is likely to change over time. Some of the questions may never be answered in a definitive way. All of this is consistent with a critical-realist methodology. Nevertheless, it is possible to outline some ways in which these questions have been or could be answered in the South African context.

Equitable access

Because historic investments in infrastructure have favoured certain groups at the expense of others, "neutral" forward looking policies which ignore past investments will serve only to entrench existing inequalities. It is therefore not surprising that the newly elected democratic government in South Africa sought to develop policies and legislation which were intended actively to address the issue of inequality in access to water supply.

The following constitutional rights are of fundamental importance to the water sector in general and water pricing in particular: the right to equality, the right to dignity and life, the right to an environment that is not harmful to health or well-being, the protection of property

rights from expropriation without compensation, and the right of access to adequate nutrition and primary health care services. The last right is interpreted in the 1997 White Paper as follows: "Every child has a right to, amongst other things, basic nutrition and health services. Access to *sufficient affordable clean water for hygiene purposes* should be seen as part of the primary health care service" (DWAF, 1997).[411]

The 1994 White Paper on Community Water Supply and Sanitation defined a basic water supply as the consumption of a minimum of 25 litres per person per day, with access to the water supply within 200m of each household, a minimum flow at the source of 10 litres per minute, availability on a regular daily basis, 98% assurance of supply, effective operation and maintenance of the system, and safe to drink (DWAF, 1994: 15), a definition which draws heavily on the World Health Organisation guidelines.

In terms of this definition, about 3 million households in South Africa did not have an adequate water service in 1997. About 80% of households without access to adequate water services reside in rural areas (DCD, 1998). The capital cost of making up this backlog (up to a basic supply as defined above) is approximately R6 billion (or 0.7% of GDP).[412] The National Infrastructure Investment Framework (NIIF) estimated a total five-year investment requirement for water services of R23-33 billion. Thus the costs of upgrading currently inadequate services to a basic standard are not large in relation to the total investment requirements. Nevertheless, pricing policy may profoundly influence the total investment requirements in at least three ways. First, pricing policy will affect the demand for new connections and, in particular, the distribution of service levels. Second, pricing policy will affect water demand and change the timing of investments in new capacity. Third, pricing policy will affect the distribution of the cost and benefits in accordance with how it allocates revenue responsibility.

South Africa has adopted a "basic needs" framework for addressing the question of equitable access to services. This approach appears to be consistent with Harberger's neo-classical "basic needs pricing" approach – that is, the altruism of the consumer and tax-payer does not extend beyond providing for universal access to a (minimalist definition of) a basic service which is adequate to maintain health. Although the approach could be thought of as being consistent with either of two alternative approaches, namely Rawls' "equal holding of primary

[411] It should be noted that this right is what is known as a "second generation right"; government would be required to prove in court, should it be challenged, that it is taking reasonable steps to meet this right.

[412] Capital costs are dependent *inter alia* on service level, consumption, settlement characteristics, topography, existing infrastructure, labour costs, material costs, distance to the water source, technical efficiency and economies of scale. See DCD (1997) and PDG (1994). South African GDP in 2000 was R873 billion (US$124 billion).

goods" or Sen's "equality of functioning", this would require very moderate assumptions concerning the definition of primary goods (in the case of Rawls) and the definition of basic functioning (in the case of Sen). Bolder and more progressive interpretations of primary goods and/or basic functionings could arguably lead to the definition of a higher standard of service as the basic guaranteed service for each household.[413] Clearly an important constraining factor has been the government's macro-economic policy (defining the government's willingness to commit resources to investments in water supply) and, in turn, the political-economic dynamics that gave rise to this policy in the first instance (as previously discussed). Although it is not possible to get trends in capital expenditure in the water sector, this trend is likely to mirror total local government expenditure which is shown in Figure 8 below (sourced from South African Reserve Bank time-series data).

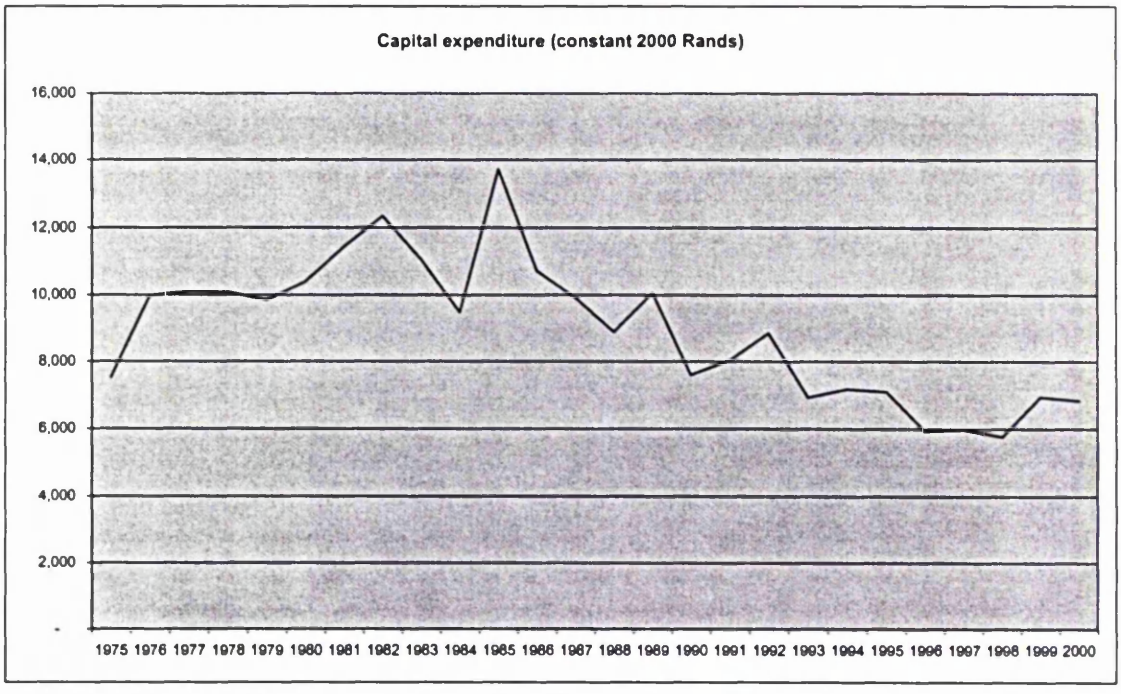

Figure 8: Trend in local government capital expenditure in South Africa (R million)

The data shows very clearly that capital expenditure by local government has been on a significant declining trend since 1985, halving in real terms from a peak of R14 billion per annum in 1985 to about R7 billion per annum in 2000.

The question "equality of what?" in the context of access to water supply is thus socially determined. I have shown how the contest over meanings and interpretations of equality has played out and further, how it is contingent on the underlying political economy of South Africa, particularly as reflected in its macro-economic policies.

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[413] Such an argument has been put forward by Patrick Bond (2001).

Income inequality, affordability and pricing

The level and distribution of household income, and the degree of inequality are of considerable importance in the consideration of the pricing of domestic water consumption because they will have an important influence on the pattern of water demand and the affordability of water services. More than 3 million households live below the poverty line of R353 per month ($1.50 per day) (Marais, 2001: 194). Average household expenditure in South Africa was estimated to be R1 090 ($300) per month in 1993 (Deaton, 1997). However, household incomes were very unevenly distributed between race groups. For example, average household expenditure per month amongst white households was R4 615 ($1 500). When converted to an individual per capita expenditure (PCE) equivalent, the mean individual PCE is almost seven times larger for white people than it is for black people in South Africa (Deaton, 1997). Income distribution is also very unevenly distributed between households both across and within race groups.[414] The cumulative distribution of income (PCE expressed as Rands per month per person) for the white and black population in South Africa is shown in Figure 9 (Deaton, 1997: 166). The gap between black and white South Africans is stark. The poorest 40% of South Africans are overwhelmingly African, female and rural (Marais, 2001: 194). South Africa was the third most unequal society in the World as measured by the Gini coefficient (World Bank, 1996b).

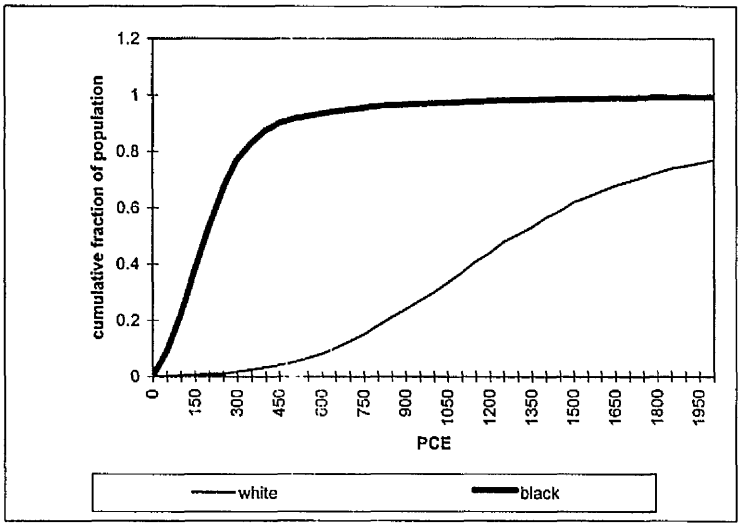

Figure 9: Cumulative distribution of Per Capita Expenditure (PCE) in South Africa

Both income levels and service costs will vary by locality. Nevertheless it is possible to provide an indication of likely levels of affordability for water services in South Africa as a

[414] In 1993, the poorest 20% of South Africans spent only 3% of all PCE and the poorest 20% of black people spent only 5% of all PCE spent by black people. The poorest 50% of South Africans spent only 13% of all PCE (Deaton, 1997: 160).

whole using the income data from Deaton (1997) and the following assumptions related to costs and affordability. The full monthly costs per household (inclusive of all capital costs) are R30, R60, R90 and R150 respectively for communal standpipes, yard tanks and house connections ("normal" and "high" use);[415] and a household can afford a water service if the cost of the service is less than or equal to 5% of household income or expenditure.[416]

The above assumptions were combined with black household income distribution data to show the overall levels of affordability of water services amongst black households in South Africa. Less than 5% of black households in South Africa can afford the full cost of an in-house water connection with consumption of 40 kl per month, and only some 15% of black households can afford the full cost of an in-house water connection with consumption of 20 kl per month. However, some 40% of black households can afford the operating and maintenance costs of an in-house connection using 40 kl per month and about 60% can afford the operating and maintenance cost of an in-house connection using 20 kl per month. More than 80% of black households can afford the operating and maintenance costs for a communal standpipe water supply, and about 70% of households can afford the operating and maintenance costs of a yard tank supply. The reality of water cuts confirms the picture of lack of affordability painted here.[417]

In the context of a high degree of income inequality, water pricing which is directly related to the cost of service provision is likely to have a regressive effect on income distribution. The likely influence of cost-based water pricing on income inequality in South Africa is illustrated in Figure 10.[418]

[415] Operating and maintenance costs are affected by the level of service, the level of consumption, economies of scale, the age of the infrastructure and operating (technical) efficiency. These costs are based on the following assumptions: fixed costs of R5 for communal standpipes and R10 for yard tanks and house connections; a variable operating cost of R1/kl; consumption of 5, 10, 20 and 40 kl per household per month for communal standpipes, yard tanks and house connections ("normal" and "high" use) respectively; costs are purely a function of service level, each of which has an assumed fixed consumption.

[416] This rule of thumb (the so-called "5% rule") is commonly used and has some empirical support in the South African context. See Bahl and Linn (1992) and Goldblatt (1997). Macleod has suggested that the 5% rule may be too high and proposes a 2% rule instead (Macleod, 1997, personal communication).

[417] "Thousands of water connections are cut off each month because users cannot afford the service fees"(Marais, 2001: 190).

[418] The following assumptions were used: in-house water supply, a fixed cost of R10 per month, a variable cost of R3/kl, a base consumption of 66 lcd for a family of five with a household income of R500, a constant family size across the income range, an income elasticity of demand of 0.5 for the income range R500 to R5000 per month, 0.4 for the range R5000 to R10 000 per month and 0.3 for the range R10 000 to R15 000 per month.

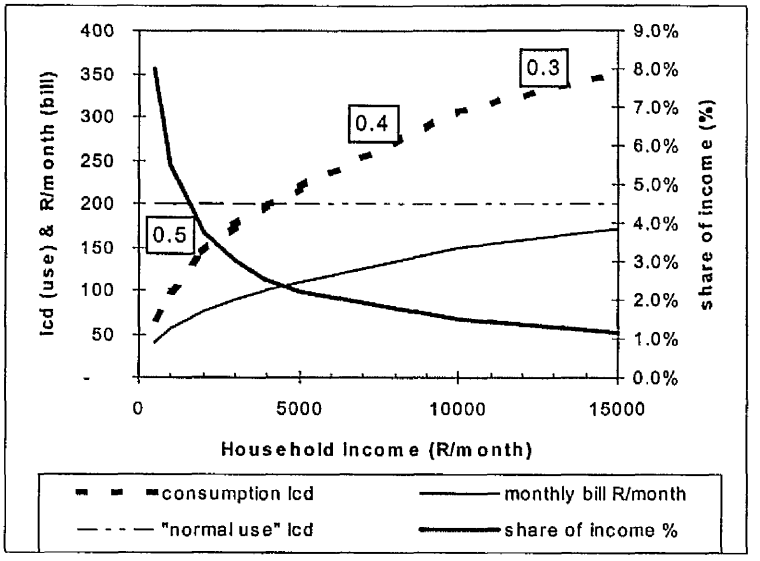

Figure 10: The influence of cost related water pricing on inequality

Figure 10[419] shows that a poor household with an income of R500 ($62) per month and consuming just 66 litres per capita per day would have to spend 8% of its income to cover the cost of service provision whereas a household with an income of R15 000 ($1875) per month would have to pay only 1% of its income to cover the cost of the water service even though its per capita consumption is 350 litres per capita per day. The overall effect of cost-based water pricing on income distribution in South Africa is clearly regressive.

In summary, income distribution in South Africa is highly skewed. Pricing policy that exacerbates this inequality is likely to be undesirable. Cost-based pricing typically will exacerbate income inequality because the income elasticity of water demand is low (much less than 1). Notwithstanding the fact that the above considerations are likely to be balanced with the incentive effects of pricing in terms of promoting efficient use and financial and ecological sustainability, it is not surprising that South Africa has not opted for a full cost-recovery approach to domestic water pricing and has implemented subsidies for water services as discussed below. Notwithstanding this, it also must be recognised that the extent to which water pricing is able to address the profound income inequalities found in South Africa is severely circumscribed.

[419] Water use (in litres per capita per day – lcd) is plotted as a function of household income. The monthly water bill (in Rands per month) is derived from the consumption (and is also plotted against household income). The monthly bill as a *percentage* of household income ("% share of income" on right-hand y-axis) is calculated and plotted against household income.

Subsidies – rhetoric versus reality

Subsidies in water sector in South Africa take the following forms: capital subsidies to assist with the development of bulk infrastructure; capital subsidies to assist with household access to water and sanitation services; operating subsidies arising from the "equitable share" policy.[420] It is impossible to quantify these flows because some of the grants are made available for a composite set of services and it is not possible to determine what portion of these grants have been allocated specifically to water supply. Notwithstanding this uncertainty, there is little doubt that the capital costs of ensuring universal access to *basic* water supplies *could be* fully covered by capital subsidies, and the operating costs of supplying a "basic needs amount" of water to poor households *could be* fully covered by operating subsidy, with both sources of subsidy coming from national government. A five year programme to eliminate the backlog would require expenditure of R1.2 billion ($150 million) per year, less than 0.2% of GDP. The amount to be made available through the "equitable share" policy for the subsidisation of operating costs for basic services has been estimated to be R86 ($16) per month per household earning less than a R1100 ($140) per month (DOF, 1998).

The historical trend in grants from national to local government is shown in Figure 11 (sourced from South African Reserve Bank time-series data).

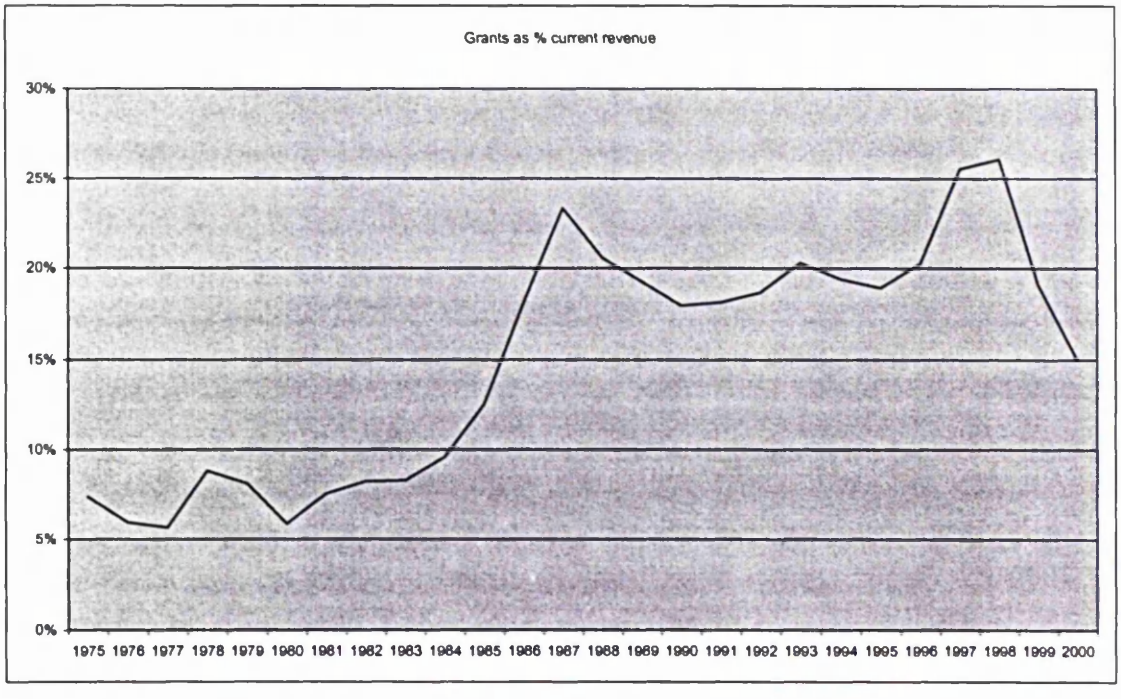

Figure 11: Trend in recurrent grants to local government in South Africa

[420] These subsidy mechanisms are described in DCD (1998b), DOF (1998), DBSA (1998) and DWAF (1997a).

There was a significant increase in grants to local government during the 1980s, however, in the last three years grants (as a share of total local government revenue) dropped to pre-1985 levels. This demonstrates that the ANC government has not been successful is shifting significant resources to the subsidisation of municipal services.

It has been government policy to provide the capital infrastructure for a basic water service (as defined above) free of charge. In practice many households are still without a basic supply of water even though this policy has been in place for more than six years. The ANC government's initial policy on operating subsidies was that households should pay the full operating and maintenance costs, subject to affordability.[421] In practice this policy has not been extensively applied. Water charges are not applied effectively in many rural and urban areas. Average payment levels on government water schemes serving about 6 million rural people are between 1% and 2% of the costs of supply (Muller, 2001: personal communication). The president announced a new policy on charges for basic water supply during the local government elections at the end of 2000. Election posters read "Free water and electricity for all". The policy intention is that government will provide six thousand litres of water each month to poor households at no charge.[422] Importantly, the government has made no additional monetary provisions for this policy in its national budget and it appears to be the intention that the funds for this policy are to come either from consumer cross-subsidies at the local level or from local government's equitable share of national revenue.

The constraints imposed by the government's macro-economic policies are evident in its water subsidy policies which are consistent with a basic needs framework employing a minimalist definition of a guaranteed minimum service package. It could be argued that, given South Africa's fiscal resources, the definition of basic services could (or should) be expanded to include a higher level of service and ensure a greater average consumption of water by households. The Department of Water Affairs has taken a (small) step in that direction with its promotion of the Free Basic Water Policy. However, its willingness to implement more progressive subsidies and its ability to influence the Ministry of Finance to provide greater resources for subsidies remain in doubt.[423]

[421] "The basic policy of Government is that [water] services should be self-financing at a local and regional level. The only exception to this is that, where poor communities are not able to afford basic services, Government may subsidise the cost of construction of basic minimum services but not operating and maintenance or replacement costs" (DWAF, 1994: 19).

[422] This equates to 25 lcd for a household of eight.

[423] Marais argues that government departments' "persuasive weight is limited by the powerful super-ministry status of the finance ministry and by the fact that the president's office wields a formidable hand in policy making"(2001: 208).

Redressing past inequalities

During the apartheid years, South Africa's cities, towns and rural areas were divided into vastly unequal confines – one well-endowed with municipal services, management capacity and the economic development necessary to pay for the services; the other under-resourced, poorly located and suffering from deliberate restraints on economic development. This inequality has, in many cases, led to basic needs not being met (as outlined above), created extensive hardships for those living in deprived areas, and often resulted in health problems.[424] The inefficiencies of the apartheid spatial form have also slowed economic development. At the level of the household, this is because being forced to live in poorly serviced areas has stifled productivity and reduced business opportunities. At a national level, the inefficiencies created by the apartheid spatial form have, *inter alia*, added to the cost of installing services, intensified the need for service subsidies and increased the cost of producing goods and services.

These inequalities are also reflected in domestic water consumption patterns in South Africa. Although *average* domestic water consumption is not unduly low in the major urban areas of South Africa, water consumption *within* the urban areas of South Africa is highly unevenly distributed. In particular, the distribution of water consumption between previously defined and designated "white" and "black" areas is highly skewed. For the purposes of illustration, the distribution of water consumption between the previously defined "black" (solid line) and "white" (dotted line) areas in Grahamstown is shown in Figure 12 (the data comes from Eberhard, 1999c).

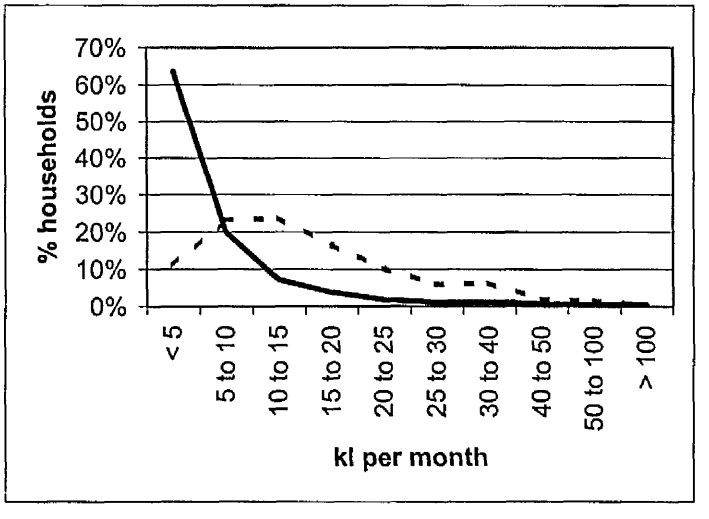

Figure 12: Consumption distribution in "black" and "white" Grahamstown

[424] The cholera epidemic in the rural areas of KwaZulu-Natal in 2000 is a case in point.

Supply-side factors provide an important constraint on consumption in "black" Grahamstown – many households in "black" Grahamstown do not have on-site water connections, for example. Nevertheless, affordability is also an important constraining factor (Eberhard, 1999c). It has been argued in Chapter 5 that it is highly desirable that households consume at least 50 litres per person per day. Hence a water tariff policy which encourages greater consumption water amongst poorer households, and reduced consumption where this is high (typically for relatively wealthy households), could play an important role in reducing inequality.

South Africa's domestic water pricing policy seeks to do this:

> *The policy of sliding tariff scales is endorsed. The basic approach identifies three separate tariffs:* A life-line or social tariff *to cover basic human needs. The quantity shall not exceed 25 lcd. The tariff shall be set [to zero].* Normal tariff. *This is for normal use. The quantity shall not exceed 250 lcd and shall be provided at cost (operating, maintenance and capital) including the losses incurred though the life-line tariff.* Marginal tariff. *Water consumption exceeding 250 lcd will be charged for at the marginal cost defined as the present day cost of the latest or next augmentation scheme. (DWAF, 1994: 24, modified to reflect the new "free water" policy)*

Comparative analysis of international experience suggests that domestic consumption of between 100 and 200 litres per person per day is sufficient to maintain a high standard of living (Eberhard, 1999b). Such an *average* level of consumption is already attained in South Africa's major urban areas. However, as shown above, domestic consumption in South Africa is highly skewed with a minority consuming large quantities of water (often in excess of 300 litres per person per day) and a majority of households consuming much less than 50 litres per person per day. This suggests that it may be appropriate for pricing policy to seek to achieve the dual goals of encouraging consumption where this is less than 50 litres per person per day (rather than the 25 litres per person per day which is currently the policy) and discouraging consumption where this is in excess of 200 litres per person per day. Alternatively, instead of subsidising water directly, government could provide a universal basic income grant sufficient for households to afford basic amenities (see above).

This discussion has sought to illustrate how the political-economic context governs both the rhetoric and reality of water pricing policies and practices as they relate to inequality. The fundamental tension between a popularly expressed desire for universal free basic services and the conservative neo-classical macro-economic policy is again evident. The outcomes will be determined to a large extent by the process of institutional transformation within local government as previously discussed.

4. Ensuring environmental sustainability

South Africa's water resources

South Africa is a water scarce country, its limited water resources are spread unevenly across the country and it suffers from hydrological extremes.[425] Areas of mineral wealth and economic development are not coincident with run-off and groundwater is not abundant. In several river catchments the current water requirements far exceed the natural availability of water and it has been predicted that, overall, the available water resources will be insufficient to meet projected demands within the next 30 years or so.[426] Future resource development costs are expected to be significantly higher than past investments in water supply capacity in many areas in South Africa. The most striking example is the costs associated with the Lesotho Highlands Water Project – the long-run marginal cost of supply of raw water into the Vaal River system was estimated to be R1.50 /kl (41 US c/kl) compared to the average historic cost of R0.30 /kl (Roome, 1995: personal communication). These cost increases are significant because of the dominance of Gauteng both in terms of economic activity and in terms of urban and industrial water use.

International experience indicates that countries with renewable freshwater resources below 1 000 m^3 per capita per year are "*likely to experience chronic water scarcity on a scale sufficient to impede development and harm human health*" (WRI, 1996). South Africa's total per capita availability of annual renewable fresh water is estimated at 1 220 m^3 based on a population of 41 million people (CSS, 1998). Current estimates of population growth imply that the country's per capita water resources will dip below the 1 000 m^3 benchmark within the next 10 years.

Defining sustainable development

In this context, the South African government has attempted to develop answers to the following question: How can sustainable development and the sustainable use of water resources be assured? In order to answer this question, government has had to define the meaning of environmental sustainability and work out the role that pricing could and should play to promote sustainability.

[425] Both severe and prolonged droughts as well as floods occur periodically.

[426] "Now looming is the full utilisation of the overall conventional water resources of the country in about 30 years should the efficiencies of water utilisation by the different users not be dramatically improved and should the current growth trends ... continue to apply" (DWAF, 1997b: 65).

I have argued that a *strong definition* of sustainable development implies that the physical stock of water resources available (measured in terms of both quantity and quality) should be maintained for future generations, and that the adoption of this definition of sustainable development was much more likely to secure environment sustainability compared to a *weak definition* (see Chapter 6). Furthermore, I have argued that the actual definition of sustainability development adopted in any particular context will be socially determined and contingent on underlying political-economic factors. Contrary to the views of many neo-classical economists, I argued that pricing could play only a limited role in ensuring environmental sustainability and that legislative interventions to protect the environment would be of critical importance.

South Africa's approach to ensuring environmental sustainability affirms these arguments. South Africa's definition of sustainable development has changed over time, reflecting economic and political priorities and environmental conditions. As pressure on the water environment has grown, South Africa has moved from a weak to a stronger definition of sustainable development. The change in the polity provided an opportunity for South Africa's water law to be rewritten from scratch. A strong definition of environmental sustainability lies at the heart of the new legislation. Key elements of this approach are outlined below.

Ensuring ecological sustainability

The Water Act provides for the determination of an "environmental reserve" which is not subject to pricing. The environmental reserve defines the minimum flow requirements for a particular river (or stretch of river). In terms of the Act, the river must then be managed in such a way so as to ensure that these minimum flow requirements are met. Given the minimum flow requirements, hydrological models are used to determine the "surplus water" which is available water for extraction and allocation to users. The minimum flow requirements are determined on the basis of the water needs for the proper ecological functioning of the river. Only surplus water (as defined above) may be allocated to users and priced. Where existing allocations exceed the availability of surplus water, these allocations will need to be reduced. In the past, the quantity and quality of return flows into the river system were controlled by a permit system. The cost of the permit was based on an administrative fee. In terms of the new Water Act, the quantity and quality of return flows into the river system will be controlled through a combination of legal, administrative and pricing mechanisms. The new Water Act is still in the process of being fully implemented and hence it is too early to judge its efficacy. Notwithstanding this, the legislation is held in high esteem internationally (Mike Muller, 2001: personal communication).

5. Improving efficiency

I have argued that X-efficiency provides a more satisfactory definition of efficiency in the light of the shortcomings of the neo-classical static-allocative-efficiency definition, and have argued that the promotion of X-efficiency is likely to be a desirable social goal and should be promoted subject to equity and sustainability considerations (see Chapter 6). The practical implications of this approach are explored in a cursory manner below with reference to water use in South Africa.

Understanding water use patterns in South Africa

A pricing policy which seeks to improve water-use efficiency must start with an understanding of the existing pattern of use and demand. Some key questions need to be answered: How is water allocated between users? For what purposes is water being used and how efficient is the water use in achieving these purposes? What role can water pricing play in influencing water use and water-use efficiency?

Estimates of overall water use in South Africa are summarised in Table 7.

Table 7: Water use estimates for South Africa

(million kl per annum)	1980	1990	1996	2000	2010	2030
Urban and domestic	1 500	2 280	**2 170**	3 220	4 480	**6 940**
Mining and industrial	1 780	2 400	**1 600**	3 400	4 510	**3 380**
Irrigation and forestry	10 100	11 410	**12 340**	12 860	13 940	**15 870**
Environmental	2 950	2 950	**3 930**	2 950	2 960	**4 230**
Total	**16 300**	**19 050**	**20 050**	**22 440**	**25 890**	**30 420**

Sources: Columns 1, 2, 4 and 5: DWAF(1986); Columns 3 and 6: DWAF (1997b) which includes estimates for Lesotho and Swaziland.

The implied growth rates are given in Table 8.

Table 8: Water use growth rates for South Africa

(% per annum)	80-90	90-00	00-10	97-30
Urban and domestic	4.2	3.5	3.4	**3.6**
Industrial (including mining)	3.1	3.5	2.9	**2.3**
Irrigation and forestry	1.3	1.2	0.8	**0.8**
Environmental	0.0	0.0	0.0	**0.2**
Total	**1.6**	**1.7**	**1.4**	**1.3**

Sources: First three columns: DWAF (1986); Last column: DWAF (1997b).

Urban and industrial growth were significantly over-estimated in DWAF (1986). Nevertheless, high annual growth rates (3.6%) continue to be used for future forecasts. Most of the new demand for water is expected to originate from the municipal (urban and domestic)

and industrial (including mining and power) sectors. Environmental water resource requirements are in the process of being revised and hence are uncertain at this stage. The reasoning behind the water use projections is not well documented. The potential influence of price changes and improvements in water use efficiency have not been taken into account hence the projections represent a "business as usual" scenario.

Power generation is a significant water using sector in South Africa. The choice of technology in power generation ("wet" versus "dry" cooling) plays an important role in water use. Eskom has managed to reduced water consumption per unit of electricity generated (by coal fired power stations) by more than 41% in the 10 years from 1987 to 1996. The decline in both the total water use and specific water use is shown in Figure 13.

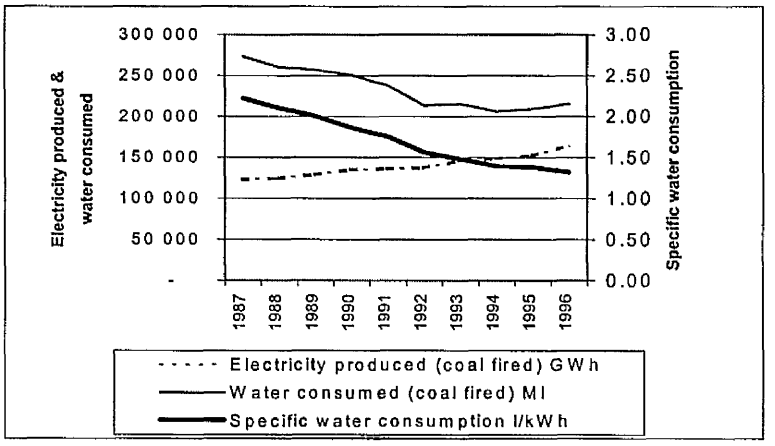

Figure 13: Water use for electricity generation in South Africa

Improving technical water-use efficiency

The electricity generating sector provides a dramatic example of the potential role of investments and innovation in water-wise technologies to improve technical efficiency and reduce water use. Higher water prices are likely to promote such investments and innovation. However, on their own, prices may be an inadequate or insufficient incentive.

Scope for improvements in technical water-use efficiency is not restricted to the energy sector, but also includes the agricultural, manufacturing and domestic water use sectors. Manufacturing as a whole contributes approximately 22% of the total GDP while consuming approximately 5 to 8% of the total annual renewable water resource. The petroleum, chemicals and pulp and paper sectors use a major share of the water consumed within the manufacturing sector, therefore focusing specifically on incentives to promote improvements in technical water-use efficiency in these sectors would be sensible in a context of increasing water scarcity.

In a survey of water use in urban areas in South Africa, 35% of municipalities reported an unaccounted-for water rate of more than 15% (PDG, 1994). This indicates that there is considerable scope to reduce water losses and unaccounted-for water through improved water management.

Agriculture is a large user of water, yet the value added to the economy per unit of water consumed is significantly lower than industrial water use. There is considerable scope for the improvement of water-use efficiencies within agriculture. There is also scope for the reallocation of water from low value crops to high value crops. This will increase the overall benefit derived per unit of water consumed in the agricultural sector. The reallocation of water from the agricultural sector to the industrial sector could potentially increase the overall benefit derived per unit of water consumed in South Africa. However the forward and backward linkages between agriculture and industry need to be factored into the calculation of the net benefit of such a transfer. The pricing of irrigation water is likely to lead to increased irrigation efficiencies, especially if combined with research and investments in improved irrigation technologies.

6. Concluding remarks

A key stated objective of the South African government in its management of water is "to achieve optimum, long term, environmentally sustainable social and economic benefits for society" from the use of water (DWAF, 1997a: 34). The means of achieving this objective lies in the concept *optimal beneficial use* that may be defined as the best possible use in the public interest. The 1997 White Paper makes three points related to the promotion of optimal beneficial use: (1) there should be an appropriate balance between promotion and enforcement, (2) promotion through research, pilot projects, education and general communication activities will work best in a supportive framework which includes *regulatory incentives and penalties*, and (3) the provision of information on best practice and comparative performance with respect to water use will help to identify problem areas and encourage corrective action.

I have argued in this thesis that optimal beneficial use in the public interest must necessarily be subjectively determined and that the process of determination is itself contingent on the underlying political economy. Clearly water pricing has an important role to play. Nevertheless, pricing is just one element and on its own can only achieve limited objectives. Thus pricing practice must be located within a coherent understanding of the political economic context, recognising its limitations and seeking to determine the effects of pricing on equality, efficiency and sustainability when used in tandem with other mechanisms

(specifically legislation and subsidies transfers). Moreover, actual pricing practices in South Africa will be determined largely by the outcomes of the institutional transformation in local government in South Africa and the fundamental tension between public and private delivery of water services. A critical-realist approach to water pricing can only be worked out through direct engagement in the processes of politics, policy making and institutional transformation, all of which are situated directly within the governing political-economic context. In essence, this is the practical meaning of a critical-realist water pricing methodology.

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Appendix 1

Tariff structure, marginal price and consumption

No explicit charge for water. **Average price = zero, marginal price = zero**		
Where water is not charged on a volumetric basis, the marginal price of water use is zero. A number of cities do not meter domestic water and do not charge in proportion to the amount of water used. Some examples are given below.		
Country / city	**Source**	**Comment**
Scotland (Edinburgh)	Sullivan, 1996	Revenue from banded property tax.
Ireland (Dublin)	Sullivan, 1996	Revenue from general taxes.
Both of these cities have relatively abundant water resources and all houses have private water connections. The need to conserve water is not urgent and the urban water agencies do not face steep costs for expanding supplies. It would appear that equity considerations dominate in both cases because revenue is raised through a progressive wealth or income related tax. The European Commission is placing pressure on Ireland to introduce charges related to water consumption.		
Separate water charge, but not directly related to water consumption. **Average price > 0, marginal price = zero**		
Water is charged for separately based on some proxy measure used to estimate average water use.		
Netherlands (Amsterdam)	Sullivan, 1996	Charge based on house characteristics (number of toilets, number of rooms, garden size).
Sudan (Khartoum)	Adam, 1997	Water charges set on the bases of house size.
Although payments may reflect water usage better than where no proxy for water use is used, residents have no incentive to conserve water as this will not affect their water bill. Where water is relatively abundant and the need for capacity expansion is low (or at least its cost is low) this type of charging system may be appropriate.		
Direct charge related to water consumption, but subsidised **Average price < average historical cost, marginal price > 0 but < average cost** The consumer pays a non-zero and positive marginal price for water (there is a volumetric charge), but the service is subsidised from non-water related revenues.		
Italy	Destro, 1997	"The water pricing policy in Italy has been guided by a range of social and developmental considerations, rather than commercial principles." Operating costs are not recovered and all major construction has been financed by the government.
Spain	Maestu, 1997	Tariffs fully recover operating costs but only a share of capital costs. However, this share in increasing over time.
World Bank financed projects	World Bank, 1992	A review of World Bank financed (drinking) water projects showed that the effective price charged for water is only about 35% of the average cost of supplying it.
In many countries, the revenue raised from the sale of water is insufficient to cover costs. The consequence here is that both the average and marginal price of water are below actual costs and thus there may be a tendency towards the "wasteful" consumption of water and inefficient use of resources.		
Average price = average historical cost, marginal price > 0 The service is revenue neutral, that is, revenue matches costs.		
France	Montginoul, 1997	Towns are required by national law to balance their water budgets. Charges include an abstraction levy (resource cost). The principle is that users should pay for the cost of the services received.
USA	Wahl, 1997	"Nearly all water districts charge for their water on the basis of average costs. The principle derives from the legal requirement in most districts that charges must be set to recover costs, but no higher."
In many countries, urban water agencies are required to cover their costs and not generate a surplus.		

Average price > average historical cost , marginal price > 0		
Surpluses are generated from the sale of water		
Israel	Yaron, 1997	The bulk water price is set nationally hence regional cost differences are not reflected. Retail prices are set by municipalities who make large profits. For example, Tel Aviv made a profit of 44% and other towns made profits of 80%, 135% and 169% in 1989-90. "In general the wealthier the community, the greater the profit margin."
South Africa	PDG, 1994	Municipalities are allowed, by law, to make a 10% profit on their water trading account. However, in practice, and especially in the past, some cities have made significantly greater profits.
Private utilities		Private utilities are almost always required to cover their costs and allowed to make a reasonable return (profit) on their investments. In developing countries, private utilities may receive public subsidies but still make profits.
It is a relatively rare occurrence that profits are made from the sale of water from public agencies. Both South Africa and Israel are water poor countries. This policy raises the marginal price of water which supports conservation efforts.		
Marginal price = marginal cost (and average price equal average cost)		
Although marginal-cost pricing is sometimes stated as a pricing goal in country policy statements, in practice, water prices are rarely set explicitly to equal marginal costs. Some pricing practice (for example, rising block tariffs) may very roughly approximate marginal-cost pricing some of the time.		
Botswana	Thema, 1997	The marginal tariff in the upper block is set to reflect the scarcity of water and the long-run marginal cost of extending supply. The first block is subsidised and overall the revenue matches expenditure.
USA	Wahl, 1997	"Some utilities in water short areas in the USA use inclining blocks where the marginal price may reflect the marginal cost of capacity expansion. However, flat rates are more common."
Selective marginal-cost pricing in Los Angeles is discussed in Chapter 4.		

Appendix 2

Nonparametric density analysis: empirical results

Figure 14: Consumption versus property value (Grahamstown)

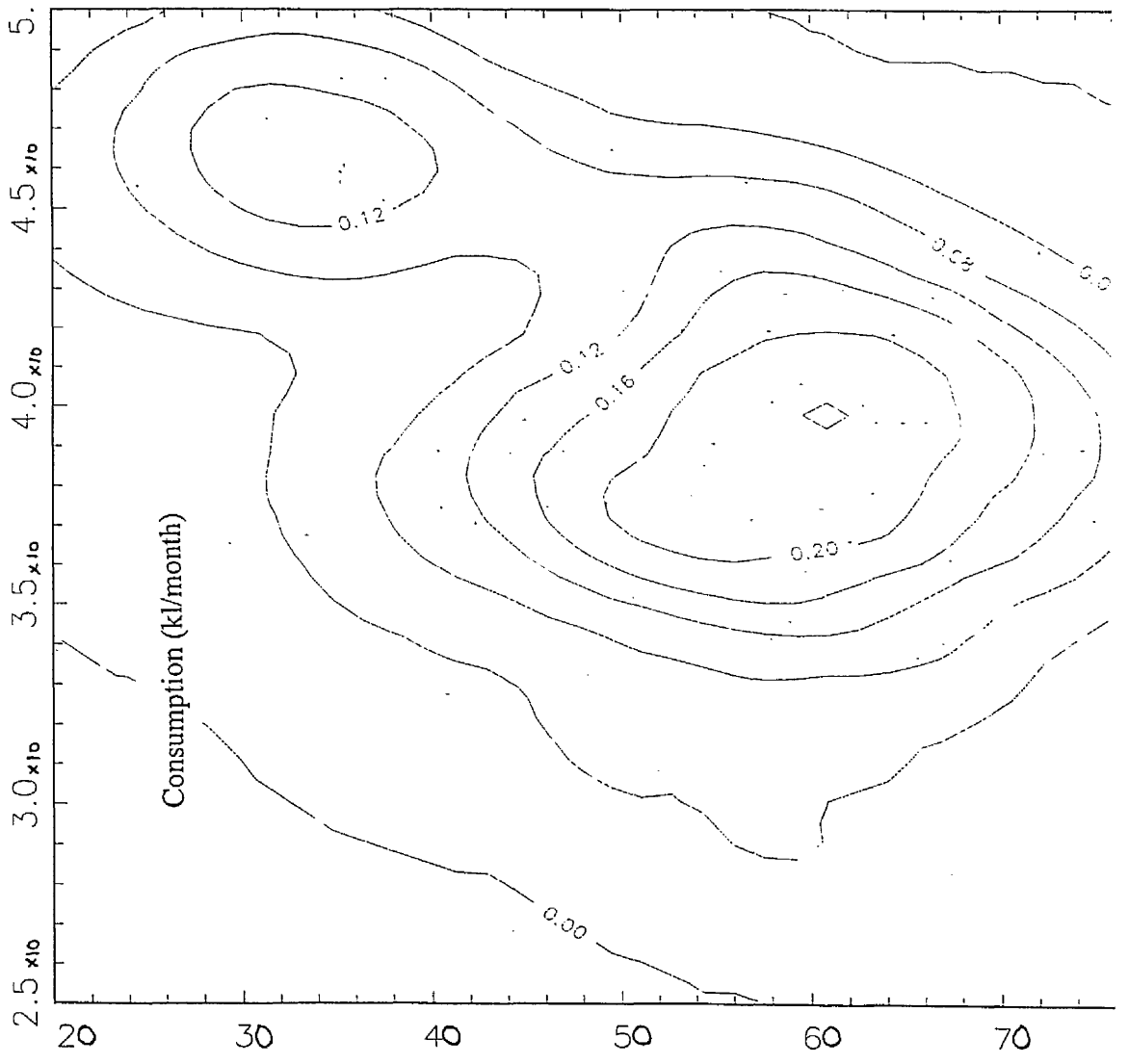
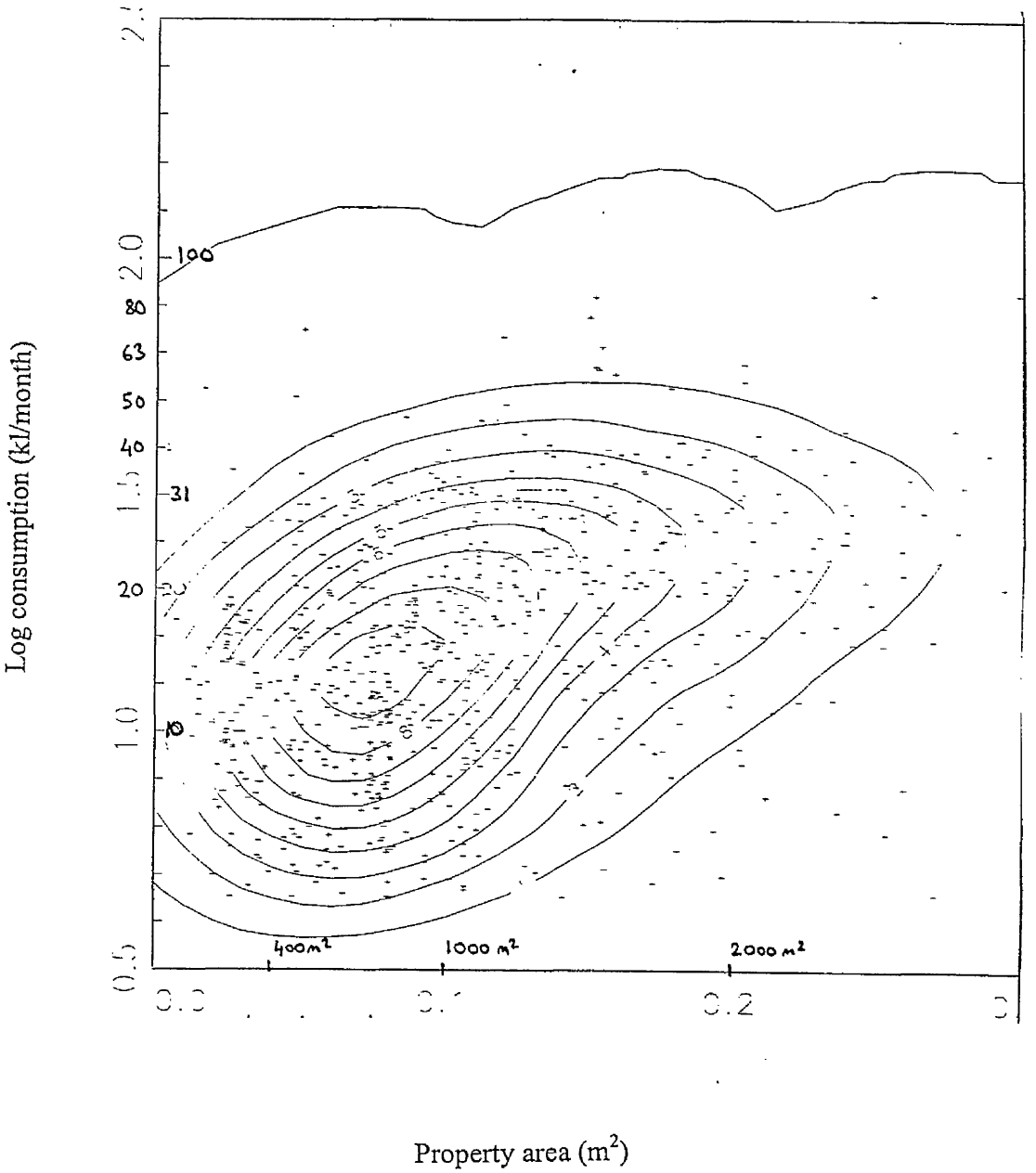


Figure 15: Consumption versus property area (Grahamstown)



Appendix 3

Price-elasticities of demand for water – selected studies

Table 9: Price-elasticities of water demand – selected studies

Source	Price-elasticity		Comment
	short-run	long-run	study area; period; rate structure; data; estimation; equations; specification sample screening; *comment*
Residential water demand			
Agthe *et al* (1986)	-.27	-.60	Tucson; 1974-77; mild increasing blocks A, T; SE; L; p_m+D single residential; average for Tucson
Agthe & Billings (1987)	-.40 to -.56		Tucson; 1974-80; mild increasing blocks M, P; SE; L; p_m+D Reported by income group
Billings & Agthe (1980)		-.27 to -.49	Tucson; 1974-77; mild increasing blocks A, T; LS; L, LL; p_m+D single residential; average for Tucson *estimates biased*
Carver & Boland (1980)	-.02	-.02 to -.7	Washington, DC; 1969-74; mixed types A, P; LS; L; p_m , Q_{t-1} Utilities (13); ave. water prod./connection
Dandy *et al* (1997)		-.63 to -.77	Adelaide; 1978-92; free allowance M, P, LS; L; p_m+D , Q_{t-1} single residential (random, 400);
Danielson (1979)		-.27	Raleigh, NC; 1969-74; ≈ 1st block M, P; LS; LL; p_m Households (random, 216); *estimates biased*
Foster & Beattie (1981)		-.29 to -.69	urban United States; 1960; mixed A, X, LS; SL; p_a cities (218); average/household for city *regional models developed*
Gibbs (1978)		-.51	Miami, 1973; mixed types M, X, LS; SL; p_m h-holds (random, 355) across 11 utilities *compared p_m to p_a*
Hanke and de Maré (1984)	-.15		Malmö, Sweden; 1971-8; constant M, P; LS; p_m single households (69)
Hogarty & Mackay (1975)		-.56 to -.86	Blacksburg, VA; 1971-73; 2 part M, T, arc; p_m h-holds (all, 120) *arc-elasticity for tariff increase*
		0	*Arc-elasticity for tariff decrease*

Hubbell (1977)		-0.5	Nairobi; M, X; LS; L Household (400), survey
Jones & Morris (1984)		-.07 to -.29	Denver; 1976; mixed M, X, IV; L, SL; p_a or p_m h-holds (representative, 889) + survey *biased*
Katzman (1977)	-.1 to -.2		Penang, Malaysia. Arc-elasticities
Martin *et al* (1984)		-.26	Tucson; 1976-1979; mild increasing M, P; IV; SL; p_m Household (2100) + census data
Martin & Wilder (1992)		-.32 to -.7	Columbia, South Carolina; 1980-1; 2 part M, P; LS, 2S; LL; p_a, p_m households (19 000) urban & suburban
Moncur (1987)	-.27 to -.52	-.35 to -.68	Honolulu; 1972-83; ≈ uniform M, P; SAS; L; p_m , Q_{t-1} single households (1281) + survey
Nieswiadomy & Molina (1992)		-.22 to -.6	US cities; 1984; mixed A, X; LS; LL; p_a k water utilities (430), AWWA, census
Nieswiadomy & Molina (1993)		-.46 to -.64	US cities; 1984; mixed A, X; Logit; LL; p_m cities (229), AWWA, census
Renwick (1996)			2 towns in California; 1990s; mixed M, P; IV; p_m+D household survey (117) *modelled technological adoption*
Saleth and Dinar (1997)		-5.3 to 3.0	Hyderabad; 1991/2; increasing block M, P; LS; p_a, p_m+D grouped by housing type (survey, 862 hh)
Young (1973)		-.41 to -.62	Tucson; 1946-71; mixed A, T; LS; L, LL; p_a average production per connection
Residential "in-house"			
Cairncross & Kinnear (1992)		0	Khartoum, Sudan; 1978; vending sales M, X, Arc; p_a household surveys (57) *comparison between communities; very low consumption (<30 lcd)*
Danielson (1979)		-.31	see above
Hansen (1996)		< -.1	Denmark; 1981-90; two-part A, P; LS; L, SL; p_a housing type (detached, row, apartment) *small ∝ sprinkling, high ∝ heated water*
Howe & Linaweaver (1967)		-.23	urban USA; 1961-66; mixed M, X, LS; L; p_m 39 study areas, separate indoor metering
Lyman (1992)	-.42	-.64	Moscow, Idaho; 1983-87; two-part M, P, LS; LL; p_m households (30); winter
Residential "outdoor use"			
Danielson (1979)		**-1.38**	see above
Hewitt & Hanemann (1995)		**-1.60**	Denton, Texas; 1981-85; incr. 2 block M, P; DC; LL; p_m single h-holds (random, 121); summer *same data set as N&M (1989) incr. blck.*

Howe & Linaweaver (1967)		-.7 to **-1.6**	urban USA; 1961-66; mixed M, X; LS; LL; p_m 39 areas, separate outdoor metering
Lyman (1992)	**-1.39** to **-1.7**	**-2.6** to **-3.2**	see above; summer
Nieswiadomy & Molina (1989)		-.55 to -.86	Denton, Texas; 1981-85; incr. 2 block M, P; 2S, IV; L; p_m single h-holds (random, 121); summer
		-.09 to -.36	Denton, Texas; 1976-80; decr. block
Williams and Suh (1986)		-.29 to -.48	USA; 1976; mixed A, X; LS; SM; p_m , p_a water utility and state census data
Commercial & institutional			
Williams and Suh (1986)		-.14 to -.36	see above

Notes: Data: A = aggregate, M = micro, X = cross-section, T= time-series, P = pooled. Estimation: LS = ordinary least squares, IV = instrumental variables, 2S = 2-stage least squares, SE = simultaneous equations, DC = discrete choice, SAS = model of Fuller and Battese (1974) programmed for SAS by Drummond and Gallant (1983). Equation: L = linear, LL = log-log, SL = semilog, TL = translog; CD = Cobb-Douglas. Specification: p_a = average price, p_m = marginal price, D = difference variable, k = price perception parameter, + = used in same equation, Q_{t-1} = lagged Q.

Price-elasticity estimates – United States

Table 10: Price-elasticity estimates for the United States

See following two pages

APPENDIX 3: Table 10
Haneman (1997) database

	year	authors	price elasticity				data						time of use			type of use					location					description						
			min	max	mean	income	L	LL	SL	XS	TS	P	annual	sum	win	m&i	SFR	MFR	AR	irrigators	all	E	W	M	S	region	sample	time period	income	short	long	estimation technique
1	1957	Seidel & Baumann	0.12	1.00	0.56		1			1			1			1					1					USA	111 areas					
2	1958	Fourt	0.39	0.39	0.39	0.28		1		1			1			1					1					USA	34 cities					
3	1963	Bain	1.10	1.10	1.10	0.58		1		1			1			1						1				California (N)						
4	1963	Gottlieb	0.67	1.23	0.95	0.28		1		1			1			1								1		Kansas						
5	1964	Gardner-Schiek	0.67	0.77	0.72		1	1		1			1			1						1				San Fransisco						
6	1965	Flack	0.12	0.61	0.37			1		1			1								1											
7	1966	Ware & North	0.61	0.67	0.64	0.38	1	1		1			1				1								1	Georgia						
8	1967	Conley	1.02	1.02	1.02					1			1						1			1				California (S)						
9	1967	Howe & Linaweaver	0.40	0.40	0.40	0.47	1			1			1				1				1					USA	21 areas					
10	1967	Howe & Linaweaver	0.23	0.23	0.23	0.32	1			1					1		1				1					USA	21 areas					
11	1967	Howe & Linaweaver	1.57	1.57	1.57	1.45	1			1				1			1					1				east USA	11 areas					
12	1967	Howe & Linaweaver	0.73	0.73	0.73	0.69	1			1				1			1						1			west USA	10 areas					
13	1969	Turnovsky	0.25	0.28	0.27		1			1			1						1			1				Massachusetts	19 towns					
14	1970	Male *et al*	0.20	0.37	0.29		1	1		1			1						1			1				northeast USA						
15	1970	Hittman Assoc.	0.44	0.44	0.44			1		1			1						1		1					USA						
17	1972	Wong	0.02	0.02	0.02	0.20		1			1		1			1								1		Chicago - city		1951-61				
18	1972	Wong	0.28	0.28	0.28	0.26		1			1		1			1								1		Chicago - suburbs		1951-61				
19	1972	Wong	0.53	0.53	0.53	1.03		1		1			1			1								1		Chicago - suburbs		1961	> 25000			
20	1972	Wong	0.82	0.82	0.82	0.84		1		1			1			1								1		Chicago - suburbs		1961	10-25000			
21	1972	Wong	0.46	0.46	0.46	0.48		1		1			1			1								1		Chicago - suburbs		1961	5-10000			
22	1972	Wong	0.27	0.27	0.27	0.58		1		1			1			1								1		Chicago - suburbs		1961	< 5000			
23	1972	Grima	0.93	0.93	0.93	0.56		1		1			1				1					1				Toronto, Ontario						
24	1972	Grima	0.75	0.75	0.75	0.41		1		1					1		1					1				Toronto, Ontario						
25	1972	Grima	1.07	1.07	1.07	0.51		1		1				1			1					1				Toronto, Ontario						
26	1973	Morgan	0.49	0.49	0.49	0.53	1					1			1		1						1			Santa Barbara country	92 residences					
16	1973	Young	0.65	0.69	0.67		1	1			1		1			1							1			Tucson, Arizona		1946-71				
27	1974	Primeaux & Hollmar	0.37	0.45	0.41	0.25	1	1		1			1				1								1	Mississippi	14 cities, 402 hh					
28	1974	Sewell & Roueche	0.39	0.46	0.43	0.23	1	1				1	1			1							1			Victoria, BC	17 areas	1954-70				
29	1975	Andrews & Gibbs	0.62	0.62	0.62	0.80			1	1			1			1									1	Miami, Florida						
30	1975	Hogarty & Mackay	0.86	0.86	0.86		1					1	1				1							1		Backsberg, Virginia	120 hh	1971-73		SR		
31	1975	Hogarty & Mackay	0.56	0.56	0.56		1					1	1				1							1		Backsberg, Virginia	120 hh	1971-73			LR	
32	1975	Pope *et al*	0.31	0.67	0.49		1					1	1				1			yes					1	South Carolina	households	1965-71				
33	1975	Pope *et al*	0.06	0.36	0.21		1					1	1				1			no					1	South Carolina	households	1965-71				
34	1975	Grunewald *et al*	0.92	0.92	0.92			1		1			1						1					1		Kentucky						
35	1976	Morgan & Smolen	0.44	0.44	0.44	0.33	1			1			1			1						1				California (S)	33 areas					
36	1976	Morgan & Smolen	0.45	0.45	0.45		1			1					1	1						1				California (S)	33 areas					
37	1976	Morgan & Smolen	0.43	0.43	0.43	0.33	1			1				1		1						1				California (S)	33 areas					
38	1977	Clarke & Goddard	0.60	0.63	0.62		1	1		1			1			1					1					USA	22 areas					
39	1977	Gallagher & Robinso	0.24	0.24	0.24			1				1			1		1															
40	1977	Gardner	0.15	0.24	0.20		1	1		1			1						1					1		Minesota						
41	1977	Danielson	0.27	0.27	0.27						1		1			1						1				Raleigh, N Carolina						
42	1977	Danielson	0.31	0.31	0.31						1				1	1						1				Raleigh, N Carolina						
43	1977	Danielson	1.38	1.38	1.38						1			1		1						1				Raleigh, N Carolina						
44	1978	Camp	0.24	0.24	0.24		1			1			1				1								1	Mississippi	10 cities, 288 hh					
45	1978	Carver	0.13	0.17	0.15		1				1			1					1					1		Fairfax, Colorado		1974-75				
46	1978	Carver	0.02	0.04	0.03		1				1				1				1					1		Fairfax, Colorado		1974-75				
47	1978	Gibbs	0.51	0.61	0.56	0.65	1					1	1				1								1	Miami, Florida	households					
48	1979	Cassuto & Ryan	0.14	0.30	0.22		1					1	1						1				1			Oakland, California?		1970-75				
49	1979	Danielson	0.27	0.27	0.27	0.33		1				1	1				1					1				Raleigh, N Carolina	261 hh	1969-74				
50	1979	Danielson	0.30	0.30	0.30	0.35		1				1			1		1					1				Raleigh, N Carolina	261 hh	1969-74				
51	1979	Danielson	1.38	1.38	1.38	0.36		1				1		1			1					1				Raleigh, N Carolina	261 hh	1969-74				
52	1979	Foster & Beattie	0.53	0.53	0.53	0.18			1	1			1			1					1					USA	218 cities	1960				
53	1979	Foster & Beattie	0.43	0.43	0.43				1	1			1			1						1				New England	218 cities	1960				
54	1979	Foster & Beattie	0.30	0.30	0.30				1	1			1			1								1		Midwest	218 cities	1960				
55	1979	Foster & Beattie	0.38	0.38	0.38				1	1			1			1									1	South	218 cities	1960				
56	1979	Foster & Beattie	0.36	0.36	0.36				1	1			1			1							1			Southwest	218 cities	1960				
57	1979	Male et al	0.20	0.68	0.44	0.40	1	1	1	1			1			1						1				Eastern USA						
58	1980	Agthe & Billings	0.18	0.36	0.27		1	1			1		1						1				1			Tucson, Arizona		1974-77				
59	1980	Ben-Zvi	0.73	0.73	0.73			1		1			1						1							Red River Basin						
60	1980	Ben-Zvi	0.79	0.79	0.79			1		1					1				1							Red River Basin						
61	1980	Ben-Zvi	0.82	0.82	0.82			1		1				1					1							Red River Basin						

62	1980 Billings & Agthe	0.27	0.49	0.38		1	1			1		1						1			1			Tucson, Arizona		1974-77			
63	1980 Carver & Boland	0.70	0.70	0.70		1					1			1	1				1					USA	13 areas			LR	
64	1980 Carver & Boland	0.05	0.05	0.05		1					1			1	1				1					USA	13 areas		SR		
65	1980 Carver & Boland	0.11	0.11	0.11		1					1		1		1				1					USA	13 areas			LR	
66	1980 Carver & Boland	0.10	0.10	0.10		1					1		1		1				1					USA	13 areas		SR		
67	1980 Morris & Jones	0.39	0.39	0.39			1		1			1				1						1		Denver, Colorado	10 utilities, 889 hh	1976			
68	1980 Morris & Jones	0.09	0.09	0.09			1		1					1		1						1		Denver, Colorado	10 utilities, 889 hh	1976			
69	1980 Morris & Jones	0.73	0.73	0.73			1		1				1			1						1		Denver, Colorado	10 utilities, 889 hh	1976			
70	1981 Foster & Beattie	0.47	0.47	0.47	0.46			1	1			1			1				1					USA	218 cities	1960		LR	
71	1981 Hansen & Narayana	0.47	0.47	0.47			1			1		1			1						1			Salt Lake City, Utah		1961-77		LR	
72	1982 Billings	0.56	0.66	0.61	2.14	1	1			1		1			1						1			Tucson, Arizona		1974-77		LR	
73	1982 Howe	0.06	0.06	0.06					1			1				1			1					USA				LR	
74	1982 Howe	0.57	0.57	0.57					1				1			1				1				USA, east				LR	
75	1982 Howe	0.43	0.43	0.43					1				1			1					1			USA, west				LR	
76	1984 Jones & Morris	0.21	0.21	0.21			1		1			1				1								Denver, Colorado	10 utilities, 200 hh	1976		LR	
77	1987 Moncur	0.27	0.38	0.32		1					1	1				1								Honolulu	1281 hh		SR		
78	1987 Moncur	0.35	0.68	0.51		1					1	1				1								Honolulu	1281 hh			LR	
86	1989 Nieswiadomy & Moli	0.36	0.86	0.61		1					1		1			1							1	Denton, Texas	101 hh	1976-1985			IV and 2SLS
79	1989 Weber	0.08	0.20	0.14		1				1	1			1				1			1			Oakland, California?	12 sub-districts				
80	1990 Boland *et al*	0.01	0.02	0.02			1				1			1		1					1			California (S)	households				
81	1990 Boland *et al*	0.13	0.18	0.16			1				1		1			1					1			California (S)	households				
82	1991 Dziegielewski & Opi	0.24	0.24	0.24			1				1			1		1					1			MWD, California					
83	1991 Dziegielewski & Opi	0.39	0.39	0.39			1				1		1			1					1			MWD, California					
84	1991 Dziegielewski & Opi	0.13	0.13	0.13			1				1			1			1				1			MWD, California					
85	1991 Dziegielewski & Opi	0.15	0.15	0.15			1				1		1				1				1			MWD, California					
87	1995 Hewitt & Hanemann	1.57	1.63	1.60	0.15		1				1		1			1							1	Denton, Texas	101 hh	1981-1985			discrete continuous
			-	-																									
count	87					39	46	8	48	13	27	53	18	16	34	35	2	15	14	15	24	17	10						