HELMHOLTZ
ZENTRUM FÜR
UMWELTFORSCHUNG
UFZ

# UFZ Discussion Papers

Department of Economics

10/2011

# Making Water Affordable to All – A Typology and Evaluation of Options for Urban Water Pricing

*Paul Lehmann*

November 2011

Publisher:
Helmholtz-Zentrum für Umweltforschung GmbH - UFZ
Permoserstr. 15
04318 Leipzig

ISSN 1436-140X

# Making Water Affordable to All – A Typology and Evaluation of Options for Urban Water Pricing

Paul Lehmann

November 2011

Contact:

Paul Lehmann
Helmholtz-Centre for Environmental Research - UFZ
Department of Economics
Permoserstr. 15
D-04318 Leipzig, Germany
Tel. ++49-341-235 1076
paul.lehmann@ufz.de

# Making Water Affordable to All – A Typology and Evaluation of Options for Urban Water Pricing

**Abstract:**

An important criterion for the design of urban water prices is the affordability of water supply for poor customers. This paper presents a typology of water pricing options which policy-makers have at their disposal in order to address affordability. A review of theoretical insights and empirical experiences reveals, however, how the real-world performance of these options depends on the characteristics of their technological and socio-economic environment. Moreover, possible trade-offs between affordability and other criteria, including efficiency, financial sustainability and administrative simplicity, are pointed out. Thereby, the paper is meant to assist policy-makers in identifying water pricing options which are appropriate for their context.

**Keywords:**

Administrative simplicity, affordability, efficiency, financial sustainability, typology, water pricing

## 1 Introduction

The fourth principle of the 1992 Dublin Statement on Water and Sustainable Development sets out that "water has an economic value in all its competing uses and should be recognized as an economic good" (WMO, 1992). This principle is commonly interpreted as an appeal for implementing a price for water which reflects its economic value appropriately. At the same time, the Dublin Statement also emphasizes that "within this principle, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price". Ever since then, this latter requirement has been renewed repeatedly. In 2000, the United Nations (UN) agreed on the Millennium Development Goal "to halve, by the year 2015, […] the proportion of people who are unable to reach or afford safe drinking water" (UN, 2000). Two years later, the UN's Economic and Social Council again promoted the human right to water which "entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" (UN, 2002). These statements pose a formidable challenge for policy-making: On the one hand, a price is needed as an instrument to manage the use of the scarce resource water. On the other hand, all water users should be able to satisfy their basic water needs. Consequently, water price systems have to incorporate some kind of (implicit) subsidy, which makes water affordable to the poor. This insight raises two questions: Which water pricing options can effectively address affordability concerns? And what are possible conflicts with other relevant (economic) criteria and goals, which also guide the implementation of water prices?

There is an extensive body of literature which examines options to improve the affordability of water prices. It includes contributions from academics, representatives of international organizations engaged in development cooperation and other authors with very diverse backgrounds. As a consequence, this strand of research is characterized by large heterogeneity. The water pricing approaches under consideration exhibit very different designs. Differences may be related, for example, to the questions of which consumer groups receive a price discount and how it is funded. Moreover, the studies range from merely theoretical analyses which neglect real-world framework conditions to applied case studies which refer to water supply in a specific country or even city. Given this heterogeneity, it appears to be difficult to compare the results derived for different water pricing approaches. This paper aims at overcoming this restriction. It provides an overview and a discussion water pricing options to address affordability. It is based on a review of theoretical and empirical findings made in this respect. This review will help to identify and understand overarching guidelines for designing water prices. These guidelines may assist policy makers in choosing pricing approaches that are appropriate for their regulatory context. The paper focuses on pricing approaches for urban water supply. An underlying assumption of pricing discussions is that corresponding decisions are not left to the market but taken by some regulatory authority. Typically, price regulation is only implemented for water supply via a network, not for decentralized supply, e.g. by water vendors. Consequently, most of the pricing options analyzed in this paper can only benefit water users with access to a network.

In order to guide the discussion of urban water pricing approaches, the paper proposes an analytical framework. It specifies the components of the urban water pricing system which have to be taken into account to allow an evaluation of pricing options. Firstly, the design of the water price itself is important of course. Relevant components include the object of pricing, the assessment base, the average price level, the tariff and the implementation process. Secondly, the technological and socio-economic environment forms another decisive component of the water pricing system. Its characteristics may have an important impact on the actual performance of water prices. Thirdly, the framework specifies the policy objectives which are considered in this paper to assess the performance of different water pricing options. While the analysis puts a focus on affordability, light will also be shed on three other criteria: efficiency, financial sustainability and administrative simplicity. Thus, the choice of water pricing approaches under consideration in this paper is based on affordability concerns. However, their evaluation rests on a multi-criteria framework.

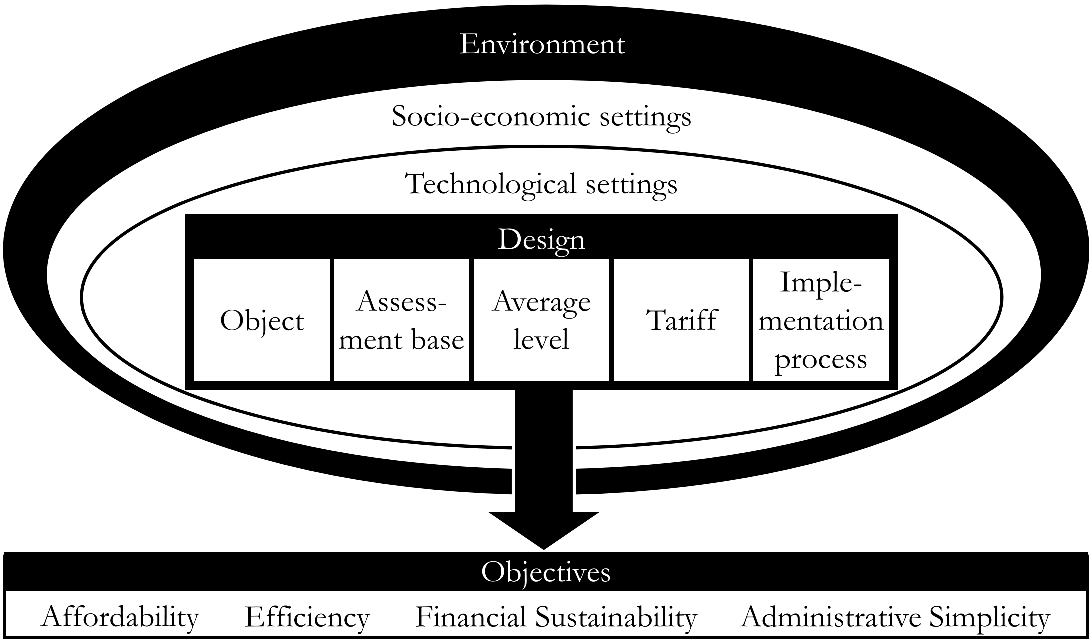
Using this framework, the paper then makes three contributions to improving the understanding of urban water prices and their performance. (1) A typology of urban water pricing options which may be employed to address affordability is developed. This typology organizes the different approaches along the major components of water price design – object, assessment base, average price level, tariff and implementation process. In this respect, the paper is distinct from existing attempts to classify water pricing and subsidy options to address affordability (see Coady et al., 2004; Komives et al., 2006; le Blanc, 2008; OECD, 2003). Basing the typology on components of water price design provides a clearer picture of the toolbox available to policy makers and the corresponding incentive structures. (2) It is identified to what extent different approaches to urban water pricing may effectively improve the affordability of water supply in the real world. For this purpose, explicit reference is made to possible constraints resulting from the technological and socio-economic environment. The analysis focuses on the question whether an approach may benefit the poor in principle under these conditions. Of course, the eventual performance will always depend on the actual extent of the price discount or subsidy. (3) The performance of urban water pricing options is also assessed with respect to efficiency, financial sustainability and administrative simplicity. This helps to identify potential trade-offs between affordability and other economic criteria.

The paper is organized as follows. Section 2 introduces the analytical framework. Section 3 presents the typology of urban water pricing options to address affordability and carries out the evaluation of these options with respect to affordability and other criteria. Section 4 summarizes and concludes.

## 2 Analytical Framework

The analytical framework developed in this section specifies the elements of the urban water pricing system which have to be considered for an appropriate examination of pricing options. Figure 1 illustrates that three elements are of particular importance: the design of the water price, the environment into which the water price is embedded, and the objectives of water pricing, the attainment of which depends on the design as well as the environment of the price. The framework is subsequently used to organize the evaluation of water pricing options.

**Figure 1: Elements of the urban water pricing system**




Source: Own figure

## 2.1 Design of the Water Price

Five components of water price design are distinguished here:

The *object* specifies the economic activity the price has to be paid for. A connection charge is paid for the installation of a new connection to the water network (usually a one-time activity). A consumption charge is levied on the supply of water through this network (usually a continuous activity) (Komives et al., 2006, p. 3-4; le Blanc, 2008, p. 15).

The *assessment base* is the physical or technological measure the price refers to. One possible assessment base may be the number of connections. It is usually implemented for connection charges but may also be used for consumption charges (with a fixed monthly or annual charge or flat rate). Alternatively, a consumption charge may be related to the actual level of water consumption (with a volumetric charge per unit of water consumed). Price systems can also be characterized by multiple assessment bases, e.g. when a fixed and a volumetric consumption charge are combined. Price systems with one or two assessment bases are usually called single-part or two-part tariffs, respectively (see, e.g., OECD, 2009, p. 78; Whittington, 2006) – although the term "tariff" would be misleading within the framework of this paper (see below).

The *average level* of a water price corresponds to the average revenue the water supplier can realize per network connection or unit of water consumption. It may refer to actual or theoretical costs of water supply, but also to some politically set level.

The *tariff* determines how the average price level is distributed to different water users and uses. Thus, a clear differentiation is made in this paper between the often synonymously used terms "water price" and "water tariff": the tariff is understood here as one component of the water price. Tariffs may be uniform or differentiated across water users and uses (for an overview of tariff structures, see, e.g., OECD, 2009, p. 78; Whittington, 2006).

The *implementation process* refers to the formal and informal rules of monitoring and enforcing the water price in practice. Is the amount of water supplied to customers billed completely? Are customers which are unable or reluctant to pay their water bills actually sanctioned by disconnection from the network? Are efforts undertaken to detect and penalize illegal water withdrawals from the network?

## 2.2 Environment of the Water Price

The environment of water prices incorporates also influences the performance of water prices. It has an effect on water users' consumption decision and their corresponding reaction to price changes. Two types of settings of the environment are important in this respect:

The *technological environment* primarily refers to the characteristics of the water supply infrastructure. Relevant properties include the proportions of water users which live in an area where a network is available, are actually connected to the network, dispose of a meter or share a connection with other households.

The *socio-economic environment* encompasses the characteristics of the water users, such as the level, distribution and timing of income streams, household size, dwelling properties and general preferences (e.g. preferences regarding service quality and risk aversion). These determine consumption levels and possible reactions to price changes. Moreover, the socio-economic environment also consists of institutions, i.e. the formal and informal rules which guide the interactions of economic actors and organizations (see, e.g., North, 1990). It refers to rules, apart from the water price, which may drive the behaviour of urban water users – but also those rules which may affect the decisions of policy-makers on water price design. Relevant rules may include inter alia the prevailing perceptions with respect to water and regulation, the legal status of water users, the lobbying power of different stakeholder groups in the water sector and, more generally, the degree of formality of an economy.

### 2.3 Objectives of the Water Price

Water prices are usually meant to pursue a variety of policy objectives. Therefore, discussing water pricing in the light of affordability concerns only is of limited use. Other possible objectives and corresponding trade-offs have to be taken into account. Consequently, the analysis in this paper provides an evaluation with respect to four objectives: affordability, efficiency, financial sustainability and administrative simplicity.

#### 2.3.1 Affordability

Affordability is defined here as the ability of water customers to pay for a subsistence level of water supply (Fankhauser and Tepic, 2007, p. 1039).[1] It is useful to distinguish between affordability of access to a water service and affordability of water consumption (Estache et al., 2002). This differentiation is important since not only consumption charges but also connection charges may be prohibitively high. Affordability considerations usually rest on the assumption that there is something like a basic human right to water which should be provided to people regardless of their ability to pay (Whittington, 2003, p. 63-64).

[1] In fact, the (subsidized) provision of a subsistence level of water supply may also be justified for efficiency reasons if it produces positive externalities in terms of improved health outcomes, reduced incidence of epidemics or reduced time spent on fetching water (Agthe and Billings, 1987, p. 275; Hajispyrou et al., 2002, p. 667).

The performance of a water pricing system with respect to affordability is commonly measured by the coverage rate. It reveals which share of water users with affordability problems actually benefit from a subsidy incorporated in the pricing system. Inversely, the so-called error of exclusion represents the share of customers with affordability constraints who do not receive any subsidy to their water bills (Coady et al., 2004, p. 10; le Blanc, 2008, p. 13-15).

How to assess which water users are actually not able to pay for water connection and consumption is a heavily debated question (Fankhauser and Tepic, 2007, p. 1039; Foster and Yepes, 2006, p. 15; Gawel and Bretschneider, 2011; OECD, 2003). This paper refers to the definition that is used by the World Health Organization and most policy makers. A water user is assumed to face an affordability constraint if the share of expenditures for a minimum of water supply (usually 20 to 100 litres per capita and day) in total income exceeds a certain threshold (usually three to five percent) (Howard and Bartram, 2003; OECD, 2003).

### 2.3.2 Efficiency

The efficiency criterion refers to the overall welfare a society obtains from water supply. It basically requires that the cost-benefit ratio of water supply be maximized. For urban water supply, the efficiency criterion allows answering two questions: (1) what is the optimal aggregate level of water consumption in an urban area, as compared to other current and future uses, and (2) what is the optimal allocation of this aggregate level to different urban water users (Bithas, 2008, p. 223)? The aggregate level of water consumption can be assumed to be efficient when the marginal cost of supplying the last unit of water equals its marginal benefits.[2] Costs should include operation, maintenance and investment costs but also opportunity and external environmental costs of water supply. Benefits should include the direct value to water users but also benefits from returned flows, indirect benefits and intrinsic values (Rogers et al., 2002). In this sense, an efficiently set water price will also induce an ecologically sustainable water use.

Economic theory suggests that an efficient aggregate level of water supply as well as an efficient allocation to different water users can be attained by setting the average price level equal to the marginal cost of water supply and imposing a uniform volumetric water tariff (Whittington, 2003,

[2] With increasing levels of water supply, marginal costs of water supply are usually increasing, while marginal benefits are decreasing.

p. 63). In this case, each water user will choose a level of water consumption where his willingness to pay for another unit of water (and his marginal benefits) equals the water price.[3]

Obviously, an efficient water price which is uniform across all water users may raise affordability concerns as it does not account for people's ability to pay. Classic economic theory would suggest that in this case affordability should be addressed by an additional lump-sum income transfer to poor customers. For a variety of reasons, however, such transfers may be ruled out politically in most developing countries (World Bank, 2000, p. 23). If affordability can only be addressed by a modification in price design, it is important to choose a pricing option with a high targeting ratio (or a low error of inclusion) which directs the incorporated subsidy primarily to those customers who are actually in need (le Blanc, 2008, p. 13-15). This reduces trade-offs in terms of efficiency. However, it is also important to consider that measures to increase the targeting ratio – e.g. granting subsidies less generously – often simultaneously bring down the coverage ratio (Coady et al., 2004, p. 10; Foster et al., 2002a).

### 2.3.3 Financial Sustainability

In this paper, financial sustainability refers to the implications of water pricing systems for (1) the budget of the water supplier and (2) the budget of the government. Both implications are closely linked for most water pricing options. Financial sustainability basically requires that water prices should allow the water supplier to recover its supply costs. According to Whittington (2003, p. 63), revenues from water pricing have to be sufficient to pay the operation and maintenance costs of the water supplier's operations, repay loans which are needed to replace and expand the capital stock, provide a return on capital at risk and maintain a cash reserve for unforeseen events. Financial sustainability thus requires that the average price level reflect the average cost per unit of water supply. If a water supplier is unable to fully recover the cost of supply, this is likely to have negative implications for the government's budget. In order to maintain and extend water supply infrastructure, it may then be necessary to compensate the supplier's deficits by government transfers funded from general tax revenues.

Financial sustainability and affordability are not necessarily conflicting objectives for water pricing. If a water price system is meant to satisfy both criteria simultaneously, the tariff has to be designed to incorporate a cross-subsidy. The implicit subsidy granted to some (poor) customers by imposing a price below average cost on them has to be compensated by a price above average

[3] In fact, price differentiation may be efficient when water customers are characterized by different price elasticities of water demand (Boiteux, 1956; Ramsey, 1927).

costs paid by other water users. In this respect, it may again be decisive how well different pricing approaches target the subsidy to those water customers with actual affordability problems. The lower the targeting ratio, the smaller the share of water users which actually pay a higher price and the more difficult cost-recovery will be. Moreover, a low targeting ratio also reduces the amount of subsidies which is available to the really poor given that the overall budget of the water supplier or government is fixed (Coady et al., 2004, p. 5).

### 2.3.4 Administrative Simplicity

The criterion of administrative simplicity reflects the ease (or difficulty) of implementing a water price appropriately in reality. In economic terms, it depends on the transaction costs which have to be incurred by the regulator, the water supplier and the water users. A useful distinction for transaction costs is between decision-making costs and monitoring and enforcement costs (Birner and Wittmer, 2004).[4]

Decision-making costs arise before water is actually supplied to a water user. In order to design an efficient and financially sustainable water price, the regulator has to assess the benefits and costs related to water supply. If affordability concerns are to be taken into account, he also has to find out about the ability-to-pay of water users. These assessments require information which typically is costly to obtain. Decision-making costs may also be faced by water users, for example, if they are required to apply to an agency and provide credible information on their economic status to qualify for price discounts (le Blanc, 2008, p. 19-20).

In contrast, monitoring and enforcement costs occur once water is actually supplied. They are mainly incurred by the water supplier. The supplier has to maintain and read water meters and bill the corresponding amounts of water consumed. Moreover, it has to keep the water network under surveillance in order to prevent illegal withdrawals. If water users refuse to pay water bills, the water supplier has to impose sanctions to enforce the water price.

These definitions reveal that in many instances, there will be trade-offs between administrative simplicity and the accuracy needed to address affordability (and efficiency and financial sustainability) properly.

---

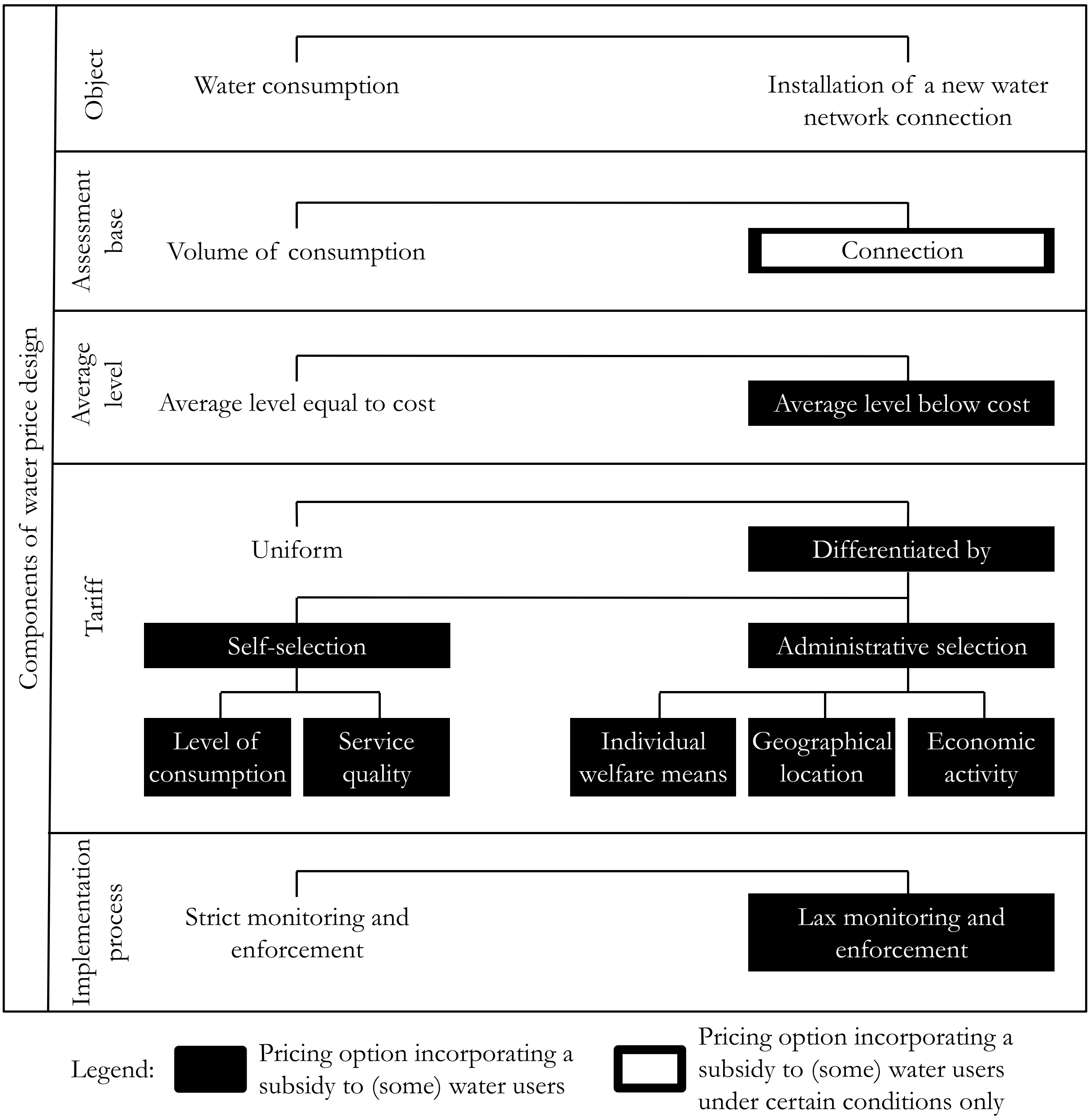
[4] For an overview of other possible definitions and typologies of transaction costs, see Allen (1991) or McCann et al. (2005).

# 3 Evaluation of Water Pricing Options to Address Affordability

This section is devoted to reviewing the theoretical insights and empirical experiences which have been gained for different water pricing options to address affordability. The discussion is organized along the different components of water price design. The resulting typology of water pricing options is illustrated in Figure 2. Grey-shaded options necessarily constitute a price discount or subsidy to some water users or uses and may therefore be considered as a means to improve the affordability of water services. These options will be explained in further detail in the subsequent subsections. For each option, light will be shed on the performance with respect to affordability. In this context, particular attention will be paid to effects of the characteristics of the environment, including technologies, actors and institutions. In addition, the performance of the pricing options regarding the other criteria efficiency, financial sustainability and administrative simplicity will be assessed to highlight possible trade-offs with affordability.

Obviously, the different design options to address affordability in water pricing are not exclusive. Most options can be combined vertically as well as horizontally. As a result, policy-makers can create a complex pricing strategy with multiple subsidy components – as it is usually done in practice. Of course, the overall performance of the water price system depends on the interplay of the different design components. Nevertheless, the evaluation of water price design first of all requires a proper understanding of each component in isolation. That is why the different options to address affordability will be analyzed separately for each component in this paper.

**Figure 2: Typology of water pricing options to address affordability**




Source: Own Figure

3.1 Options Related to the Object of Pricing

As has been pointed out earlier, two basic approaches can be distinguished regarding the object of pricing: a consumption charge and a connection charge. Neither approach necessarily implies a subsidy to some water users. However, the choice between consumption and connection charges has important implications for the affordability of pricing if a subsidy is incorporated at a subsequent stage for one of the other components of price design. These implications will be discussed in this section. The attainment of the other policy objectives is irrespective of the object of pricing chosen. It depends on how well the other components are designed. Therefore efficiency, financial sustainability and administrative simplicity will not be addressed in this section.

By definition, a subsidy incorporated into a *consumption charge* for network supply is only available to water users which are connected to the network (the only exception is a price reduction for public standpipes, see Section 3.4). Thus, in most cases, the maximum achievable coverage rate corresponds to the share of connected users among the poor (World Bank, 2000, p. 11). However, particularly in cities in developing countries, a significant share of water users is not connected to the network. For example, urban connection rates are far below 50% in in many cities of Sub-Saharan Africa. Moreover, unconnected water users are particularly likely to be poor (Foster et al., 2002a; 2002b, p. 2; WHO, 2010). Therefore, consumption subsidies may exclude many persons with affordability constraints. This limitation is particularly important as unit prices for water delivered through decentralized means of supply, such as water vendors, are usually far above those for network supply (see, e.g., Keener et al., 2010, p. 23).

This implies in turn that increasing the connection rate is an important measure for poverty alleviation in many developing countries (Estache et al., 2002, p. 82; Komives et al., 2005, p. 4). However, lump-sum up-front costs of getting connected to the network may be prohibitively high for some water users – a restriction which is aggravated by the fact that poor households are often unable to receive loans at reasonable interest rates. This obstacle can be overcome by incorporating a subsidy in the *connection charge* (Komives et al., 2005, p. 123; Whittington, 2003, p. 69). The coverage rate of connection subsidies is usually substantially higher than that of consumption subsidies (Foster et al., 2002a). Nevertheless, the actual effects of such subsidies are subject to restrictions. Firstly, a connection subsidy can only benefit water users in districts where a network is actually available (Komives et al., 2006, p. 18). Water suppliers usually do not offer a connection to all due to restrictions in funding. In fact, suppliers may have incentives to connect low-cost consumers with priority, particularly when private sector participation combines with weak regulation. This so-called cream-skimming is likely to affect particularly poor water users negatively as they are often more costly to supply. Reasons include higher commercial risk and billing costs, the fact that poor neighbourhoods are often located in distant and topographically difficult sites and the in many cases relatively small amounts of service are consumed by the poor, which implies that fixed costs are spread over a relatively small number of consumption units (Estache et al., 2002, p. 16). Secondly, water users may have to meet additional requirements in order to get connected. Most notably, a legal land title is often compulsory, which means that inhabitants of predominantly poor informal settlements are not eligible (Debomy et al., 2005, p. 1). Thirdly, there are costs of establishing a network connection apart from the actual connection charge. Water users also have to undertake intra-households fixtures and may be required to provide a security deposit. More generally, water users may choose not to connect because they expect overall expenditures for water consumption to increase with network supply. This fear is often associated with the timing and format of utility payments which is usually less flexible than with decentralized supply and may be incompatible with household income streams (Estache et al., 2002, p. 92; Komives et al., 2006, p. 12). Consequently, consumption as well as connection subsidies may exclude a significant share of the poor.

## 3.2 Options Related to the Assessment Base

The assessment base for a connection charge is necessarily the connection. In this case, there is no clear relationship between the performance of water pricing and the assessment base. Therefore, this section focuses on the implications of choosing the assessment base for a consumption charge. A *volumetric charge* is based on the actually metered amount of water consumption. It does not necessarily result in a subsidy, but it constrains the performance of subsidies incorporated in the design of subsequent price components. A consumption charge raised per connection, i.e. a fixed charge or *flat rate*, is based on an average level of historic or estimated consumption per connection.[5] It provides a subsidy to water users whose actual consumption is above the average level (Komives et al., 2006, p. 4). In practice, both approaches are often combined as two-part tariffs (OECD, 1999, 2010).

### 3.2.1 Affordability

By definition, subsidizing a *volumetric charge* can only benefit water customers with a metered connection (le Blanc, 2008, p. 34; Whittington, 2006, p. 20). That is, the maximum coverage rate is limited to the metering rate among the poor. However, metering rates are often low, even in many OECD countries (OECD, 1999, p. 46). Moreover, poor customers are less likely to have a meter as water suppliers often charge for their installation and maintenance (Komives et al., 2006, p. 11).

In contrast, the coverage rate of a *flat rate* is not restricted by the extent of metering. Instead, the performance of the incorporated subsidy depends on whether the poor consume above or below the average consumption level. On the one hand, water consumption is usually assumed to decrease with income (for an overview, see Worthington and Hoffman, 2008). On the other

[5] In fact, a fixed charge is usually meant to recover fixed costs of water supply while a flat rate is to recover variable costs. This distinction is not made here as it does not affect the general implications for the affordability of overall water consumption.

hand, the consumption of poor customers per connection may be relatively high as they typically have larger families and often share a connection (Bithas, 2008, p. 225; Boland and Whittington, 2000, p. 229; Foster and Yepes, 2006, p. 23; OECD, 2009, p. 91; Whittington, 2003, p. 66). Therefore, the overall effect of a flat rate in terms of affordability is ambiguous.

### 3.2.2 Efficiency

The implementation of an efficient pricing scheme is only possible with a *volumetric charge* as this allows facing water users with the marginal costs for each unit of water they consume. With a *flat rate*, the marginal price of water is zero, i.e. increasing consumption by one unit does not raise the water bill. Consequently, there is no incentive to save water. Individual and aggregate levels of consumption tend to be inefficiently high (OECD, 1999; Whittington, 2003, p. 66; 2006).

### 3.2.3 Financial Sustainability

At least in theory, both a volumetric charge and a flat fee can be designed to recover water supply costs if the total amount of consumption as well as its average per connection is known. If information is imperfect, however, and if either option is meant to recover fixed as well as variable costs, financial sustainability may be impaired. A *volumetric charge* will be insufficient to recover the fixed costs of supply if actual total water consumption is below the estimated level. A *flat rate* will not recover the variable costs of supply if the average consumption per connection increases about the expected value. This is particularly likely when tapped water is resold to unconnected users and per-capita consumption increases as a consequence of economic and income growth (Whittington, 2006, p. 19; Whittington et al., 1990). Nevertheless, water suppliers may prefer flat rates over variable charges as they provide relatively stable revenues when the share of fixed costs in total costs is high (O'Dea and Cooper, 2008, p. 28; OECD, 1999, p. 45). Obviously, a superior solution is a two-part tariff with a fixed charge to recover fixed costs and volumetric charge to recover variable costs (Brown and Sibley, 1986; Coase, 1946).

### 3.2.4 Administrative Simplicity

The main difference associated with the choice of the assessment base for a consumption charge is related to the implementation costs. These costs are higher for a volumetric charge than for a fixed charge as the latter does not require metering (O'Dea and Cooper, 2008, p. 28; OECD, 1999, p. 45).

### 3.3 Options Related to the Average Price Level

Reducing the average price level below actual full cost of water supply (under-pricing) is an option which can be implemented for any object and assessment base of pricing chosen. It can also be incorporated into two-part consumption charges. A commonly discussed approach in this respect is the so-called Feldstein-pricing where the fixed charge is set below cost at the expense of a higher volumetric charge (Feldstein, 1972). Another option is to offer a price menu: Water users may be allowed to choose between an option with low fixed charge and high volumetric charge and another with high fixed charge and low volumetric charge (le Blanc, 2008, p. 6; OECD, 2003, p. 94). Under-pricing is widespread throughout the developing as well as the developed world (Dinar and Subramanian, 1998, p. 246; Komives et al., 2005, p. 21; OECD, 1999, p. 118; Raghupati and Foster, 2002, p. 5). A Global Water Intelligence study finds, for example, that only 39 percent of the surveyed utilities raise prices which cover operation and maintenance costs (GWI, 2004). A reduction of the average price level may be the only feasible option when there are limitations to implementing a differentiated tariff with a cross-subsidy. This is the case when the share of poor customers in water consumption is high and there are only few water users which are actually able to pay a higher price to fund the subsidy.

#### 3.3.1 Affordability

Under-pricing brings about a universal price reduction. Consequently, it is beneficial to all poor water customers, at least in the short term. However, this approach will deteriorate affordability problems in the long run. Firstly, it hampers the extension of existing networks since water suppliers are not able to recover their cost (see below). Thus, those districts which do not yet have access to the network yet – and which are predominantly poor – are less likely to be connected in the future (OECD, 2009, p. 85). Secondly, low average price levels promote overconsumption (see below). This results in higher water scarcity and higher costs of supply in the future. Correspondingly higher water prices will then be even less affordable (Bithas, 2008, p. 225).

Particular issues for affordability arise with Feldstein pricing. It basically implies that larger water users pay a larger share of the fixed costs relative to their consumption (Feldstein, 1972). This solution improves the affordability of water supply for poor users when consumption is only a function of income. It causes affordability problems, however, when poor customers have large levels of consumption, e.g. due to large family sizes or shared connections. Such problems can be overcome by offering a price menu. In this case, each customer can choose the price option (high/low fixed charge and low/high volumetric charge) which minimizes his water bill (le Blanc, 2008, p. 6).

### 3.3.2 Efficiency

Under-pricing a single-part charge implies that water users do not face the true costs of water supply. This results in inefficiently high levels of consumption (World Bank, 2000, p. 12).[6] The issue is more complex with two-part consumption charges. If only the fixed charge is reduced, and the volumetric charge is set equal to marginal costs, an efficient level and allocation of water consumption can be achieved. In contrast, with Feldstein-pricing, the marginal price of water is in fact inefficiently high. Empirical evidence indicates, however, that the corresponding welfare losses may be small (Feldstein, 1972; García Valiñas, 2005). With menus of two-part charges, at least the allocation of water consumption across water users and uses will be inefficient as marginal prices are not uniform.

### 3.3.3 Financial Sustainability

A subsidy which is implemented by a general reduction of the average price level is badly targeted. It also benefits all non-poor water users. This implies that the price reduction usually cannot be recovered a cross-subsidy. Water suppliers face a lack of funding which can only be compensated by government support and transfers (World Bank, 2000, p. 12-13). There are only two exceptions: (1) with a two-part pricing scheme, the reduction of the fixed component can be recovered by an increase of the variable component and vice versa, and (2) a reduced charge for newly established connections can be compensated by a surcharge imposed on existing customers, as for example in Argentina (Foster, 2004, p. 19-20).

### 3.3.4 Administrative simplicity

A general reduction of the average price level for a single-part charge can be easily implemented (World Bank, 2000, p. 12). Higher decision-making costs have to be incurred with two-part pricing, such as Feldstein-pricing or price menus. In this case, the challenge may consist in designing fixed and variable components such that supply costs are covered overall. Also, price menus increase decision-making costs for water users as they have to choose a pricing scheme which is most appropriate for their individual needs.

---

[6] Additional welfare losses result from public taxes which the government has to raise to close the financial gaps of water suppliers (see Section 3.3.3) (Timmins, 2002).

### 3.4 Options Related to the Tariff

A tariff incorporates a subsidy if it is differentiated across water users and uses. Tariff differentiation can be roughly classified into self-selection and administrative selection (Komives et al., 2006, p. 5; le Blanc, 2008, p. 19; Yepes, 2003, p. 4-5).

Self-selection means that water users' decisions determine whether or not they pay a subsidized water price. This approach is usually implemented by making the unit water price increase in the *level of consumption*. A certain subsistence amount of water – the so-called lifeline block – is priced below the average such that it corresponds to the ability to pay of the poorest customers (Bithas, 2008, p. 225; Groom et al., 2008, p. 4). In turn, the unit price for higher levels of consumption is above the average price level. Increasing block tariffs (IBTs) with a step-wise increase of the marginal unit price are most common (OECD, 1999, 2003). Komives et al. (2005, p. 29) find that roughly 80 per cent of the surveyed water suppliers worldwide apply IBTs for residential customers. IBTs can also be designed such that the size of the lifeline block is not fixed but depends on the number of persons supplied by a connection (Dahan and Nisan, 2007, p. 3; Meran and von Hirschhausen, 2009, p. 14; OECD, 2009, p. 91). Related to IBTs are a uniform price with rebate (UPR), which produces a lump-sum absolute reduction of all customers' water bills (Boland and Whittington, 2000), and a certain amount of consumption included in the fixed minimum charge (Castro-Rodríguez et al., 2002; Estache et al., 2002, p. 62-63). In both cases the unit price for the initial consumption block is zero. Alternatively, self-selection can also be induced by differentiating the tariff for different levels of *service quality*. In particular, the price may be higher for water supplied through in-house connections than for public taps (Komives et al., 2006, p. 3; le Blanc, 2008, p. 7; Whittington, 2003, p. 72). Connected customers can then choose between different levels of service quality and corresponding tariffs. In general, self-selection is only applicable for consumption charges (and only for volumetric consumption charges if it is based on the level of consumption).

In contrast, administrative selection can be implemented for any object and assessment base of water pricing. In this case, some authority – such as the water supplier or its regulator – decides which groups of water users are eligible for a price discount. This decision can be based on *individual welfare means*, i.e. poor customers pay lower prices than their wealthier counterparts. This approach requires a means test which collects user-level data on income and other indicators, such as household size, housing characteristics, location of a dwelling or assets owned by the user. It is currently used in Chile, the most prominent example, but also in a variety of other countries including Argentina, Paraguay and many former Soviet states (Foster, 2004; Foster and Yepes, 2006; Gómez Lobo, 2001; Gómez Lobo and Contreras, 2003a, 2003b; World Bank, 2000,

p. 17-19). Tariff differentiation may be applicable to all consumption or to subsistence consumption only. The amount of the tariff discount is often subject to a burden limit. It is assessed for each water customer such that his payments for water supply do not exceed a certain percentage of his income. Alternatively, the differentiation may also come as a fixed absolute (e.g. a voucher) or relative reduction of water-related expenditures (World Bank, 2006, p. 58-59). An administrative differentiation can also be based on proxies of individual welfare. One option consists in making prices dependent on the *geographical location* of the user. That is, the price is generally reduced in neighbourhoods which are poor on average. Such differentiation is usually based on some kind of poverty mapping and may take into account different criteria (similar to an individual means test) (Coady et al., 2004, p. 63). Geographically differentiated tariffs exist, for example, for consumption charges in general in Bogotá (Foster and Yepes, 2006, p. 27; Gómez Lobo and Contreras, 2003a, p. 8), for flat rates paid by customers without individual meters in Lima (SUNASS, 2010) or connection subsidies in Dakar (Debomy et al., 2005, p. 2). Another proxy of individual welfare to differentiate the tariff may be the *economic activity* of a water user. Typically, lower water prices are imposed on residential customers than on commercial and industry water users (Yepes, 2003, p. 4).

### 3.4.1 Affordability

*Differentiation by the level of consumption* benefits the poor if these actually exhibit low consumption levels, i.e. if consumption is positively correlated with income (OECD, 2009, p. 91). Hajispyrou et al. (2002), Groom et al. (2008) and Ruijs (2009) show in case studies for Cyprus, Beijing and Sao Paulo that IBTs in fact increase the welfare of poor water customers compared to a uniform tariff. Boland and Whittington (2000) point out that UPR schemes allow for an even stronger price reduction for subsistence water consumption than IBTs for given level of overall revenue. However, there are also studies how do not find a systematically positive effect of IBTs in terms of affordability (see, e.g., Rietveld et al., 2000). This observation can be explained by the shortcoming that simple IBT schemes refer to the level of consumption per connection and disregard the number of people depending on that connection. This number may be high when families are large, when several households share one connection or when water is sold to neighbours. These conditions are likely to be met for a substantial share of poor customers (Bithas, 2008, p. 225; Boland and Whittington, 2000, p. 229; Debomy et al., 2005, p. 8; Estache et al., 2002, p. 62-63; Foster and Yepes, 2006, p. 23; OECD, 2003, p. 81; 2009, p. 91; Rietveld et al., 2000; Whittington, 1992, p. 76; 2003, p. 66). As a consequence, consumption may be high at a connection even though customers are poor. This effect is hardly mitigated by economies of scale associated with shared consumptive activities such as housecleaning or cooking (Dahan and

Nisan, 2007). As high levels of consumption bring about a relatively high unit price, the ability to pay for basic water needs may be impaired for these poor customers. In case studies, Foster et al. (2002b, p. 7) and Komives et al. (2006, p. 10) show that the error of exclusion under IBTs may be 50 per cent and higher.[7] Obviously, these drawbacks can be overcome as soon as the tariff considers the number of customers per connection, e.g. by allowing for a larger lifeline block for large families (Liu et al., 2003).

*Differentiation by service quality* can be more effective in reaching the poor than IBTs. This is because the willingness to accept a low-quality service such as public standpipes can be supposed to be a better indicator of poverty than consumption. Moreover, service differentiation is the only tariff option which is not only available to water users with in-house connections but also to those who have at least access to a standpipe. This approach may allow errors of exclusion as low as 23 per cent in Bangalore (Foster et al., 2002b, p. 7).

Theoretically, tariff *differentiation by individual welfare means* can be employed to subsidize every poor connected to the network. Empirical studies, however, report relatively high errors of exclusion – for example, 89 per cent in Chile - which even go beyond the values observed for IBTs (Foster et al., 2002a; Foster and Yepes, 2006, p. 29; World Bank, 2000, p. 17). On the one hand, this failure can be explained by an improper design of the means test and additional, restrictive eligibility criteria, such as a burden limit or the requirement to agree on a payment schedule for overdue bills. On the other hand, eligible water users may fail to apply for a tariff discount due to a lack of information or the administrative burden produced by the application process. Moreover, they may not have an incentive to apply when non-payment is not sanctioned by disconnection anyway.

*Differentiation by geographical location* is a good means to make tariffs affordable if poor and wealthy customers live in clearly segregated neighbourhoods (Coady et al., 2004, p. 48; Komives et al., 2006, p. 16; le Blanc, 2008, p. 36). In addition, the exclusion of poor customers living in non-poor districts can be avoided by allowing them to apply for a reduced tariff, as it is done in Colombia (Gómez Lobo and Contreras, 2003a, p. 9). Empirical evidence for the performance of geographically differentiated schemes is very mixed. Errors of exclusion close to zero have been found for Colombia. However, it is emphasized that this not only attributable to tariff differentiation but rather to a generous design of the subsidy which is paid up to relatively high levels of income and available to 97% of all connected households (Foster and Yepes, 2006, p.

[7] However, it has to be emphasized that this low coverage ratio does not solely result from the specific characteristics of IBTs but is also attributable to the shortcomings of subsidies incorporated into consumption charges in general.

29; Gómez Lobo and Contreras, 2003a, p. 17). In other cases, significantly higher errors of exclusion have been found, e.g. 60% in Bangalore, India (Foster et al., 2002a; Komives et al., 2006, p. 17).

There is a lack of empirical studies analysing to what extent tariff *differentiation by economic activity* makes water more affordable to the poor. It may be fair to assume that the majority of poor water users are in fact residential. However, commercial customers, running small family businesses, for example, may also face affordability constraints and usually do not receive a subsidy.

#### 3.4.2 Efficiency

Tariff differentiation generally implies that the marginal cost of water supply is not imposed on each customer and unit of water consumed. This results in a suboptimal allocation of water. Water users facing a low (high) price choose an inefficiently high (low) level of consumption (Boland and Whittington, 2000, p. 224; World Bank, 2000, p. 19). IBTs, for example, have been found to produce significant welfare losses compared to a uniform tariff (Groom et al., 2008; Hajispyrou et al., 2002; Rietveld et al., 2000; Ruijs, 2009).[8]

The actual extent of welfare losses can be reduced by choosing the design of tariff differentiation appropriately. The first requirement is that as few water users as necessary receive a price discount, i.e. that the subsidy be targeted only to customers with affordability constraints and subsistence consumption levels in order to avoid inefficient distortion. In this respect, differentiation by consumption appears to be particularly detrimental as it grants subsidies to low-volume customers irrespectively of whether these are poor or rich. This shortcoming is aggravated by the fact that limiting the size of the first block (or rebate) to subsistence consumption is often difficult for political reasons (Boland and Whittington, 2000, p. 225-226; Foster and Yepes, 2006, p. 24; Groom et al., 2008, p. 17; Komives et al., 2005, p. 24; le Blanc, 2008, p. 35). Boland and Whittington (2000) argue that an UPR performs better than an IBT in terms of efficiency. More importantly, however, differentiation by consumption in general is usually outperformed by other types of tariff differentiation. For example, errors of inclusion under IBTs are found to be as high as 71 per cent in Bangalore and compare with significantly lower values for differentiation by service quality (30 per cent), by individual welfare means

[8] It is a common misunderstanding that a progressive tariff differentiation as under an IBT is efficient because it matches the rising marginal cost curve of water supply and penalizes large customers (for further elaboration, see Boland and Whittington, 2000, p. 224; Sterner, 2003, p. 329).

(below 40 per cent) or geographical location (below 50 per cent) (Foster et al., 2002a, 2002b). Welfare losses of administratively differentiated tariffs are likely to be particularly low when subsidies are restricted to subsistence consumption levels and capped by a burden limit – as in Chile. Indeed, the actual targeting performance of administrative selection hinges on the quality and stringency of the eligibility criteria (le Blanc, 2008, p. 19; World Bank, 2000, p. 17). Moreover, there may be collusion between the water user and the authority assessing the eligibility for tariff discounts, particularly when this responsibility is at the municipal level (Gómez Lobo, 2001).

The second requirement is that that price for all remaining water uses and users should equal the marginal cost of water supply. The optimal tariff thus differentiates only between subsidized and non-subsidized users and uses and does not allow for further intermediate stages. For tariff differentiation by consumption this implies a simple two-block structure where the majority of customers choose a consumption level in the second block where the price is efficiently high, i.e. only intramarginal consumption is subsidized (Estache et al., 2002, p. 78).

### 3.4.3 Financial Sustainability

Theoretically, differentiated tariffs may allow water suppliers to recover their costs without government subsidies if only the average price level is set correctly. The tariff differentiation can be determined to incorporate a cross-subsidy, i.e. such that subsidies granted to some consumers are perfectly compensated by the higher prices paid by others.[9] The decisive question is, however, whether such tariff structure can actually be implemented. Under certain conditions, the necessary price add-on which has to be imposed on subsidizing customers to allow for cost recovery may reach levels which are not politically feasible. This may be the case when the price discount needed to safeguard affordability for some customers is substantial, when the number of subsidized customers is relatively high and/or when the number of subsidizing customers is relatively low. In fact, a tariff system with a cross-subsidy increases the threat that customers facing a relatively high price opt out of grid-based supply and use alternative water sources instead, such as private wells (Yepes, 2003, p. 7).

---

[9] In fact, a cross-subsidy may produce a conflict between financial sustainability and efficiency if the average price level for a volumetric consumption charge which is necessary to recover the costs of the water supplier is equal to marginal costs – possibly because fixed costs are covered by an additional fixed charge. In this case, for example, an IBT which would be desirable in terms of efficiency – including a lifeline block priced below and a second block prices at marginal costs – cannot be designed financially sustainable by definition. The second block would have to be priced above marginal costs.

These observations necessarily mean that attaining financial sustainability is particularly problematic for tariff options which are characterized by a high error of inclusion. As has been pointed out in Section 3.4.2, this holds particularly true for tariff differentiation by consumption. Cost recovery problems may be less severe for tariffs differentiated by service quality or administrative selection which exhibit lower errors of inclusion. However, in this case the eventual performance again depends on the design of the eligibility criteria (see Section 3.4.2).

The impossibility to implement a cross-subsidy does not necessarily result in a deficit for the water supplier. The subsidy provided to some water users may be recovered by direct government transfer to the water supplier on behalf of the user, an approach that has been implemented in Chile (Foster and Yepes, 2006).

### 3.4.4 Administrative simplicity

With tariffs differentiated by self-selection, decision-making costs are relatively low for the water supplier or regulator. In order to allocate the subsidy, no knowledge about individual income levels is need. However, it may be difficult for water customers to take appropriate consumption decisions. Under an IBT, the average and marginal price signals are not straightforward and may impair customer's ability to react to prices – particularly when a change in consumptions levels results in a move from one block to another (Boland and Whittington, 2000, p. 229). Obviously, considering the number of persons supplied by an connection in order to improve the affordability of an IBT (see Section 3.4.1) increases decision-making costs: Water customers may have to apply for block extensions and report their family size while water suppliers have to verify that this information is correct (Dahan and Nisan, 2007, p. 4; OECD, 2003, p. 88; 2009, p. 91).

Administrative simplicity is lower under tariff systems with administrative selection. In this case, the characteristics of water users have to be assessed and updated on a regular basis to distribute (implicit) subsidies (Fankhauser and Tepic, 2007, p. 1047). Transaction costs are likely to be highest when individual welfare means, rather than easier observable characteristics of geographical location or economic activity, are used for tariff differentiation. The actual extent of transaction costs under means-tested tariff schemes, as well as the distribution of these costs among the water supplier, the regulator and water users, depends on several aspects. Firstly, costs usually increase in the quality of data. Data collection may be based on reported income, as in many former Soviet states, on an outside inspection of the water user's dwelling, or on an extensive face-to-face interview, as in Chile (Gómez Lobo and Contreras, 2003a, p. 5; World Bank, 2000, p. 17). Decision-making costs increase if customers are also required to submit additional documentation, such as pay stubs or electricity bills, or if the water supplier has to collect supporting information from third parties, such tax offices. Both proceedings are particularly cumbersome, if not infeasible, in countries with strong informal economies (Coady et al., 2004, p. 49). Secondly, transaction costs increase if a price reduction is not funded by a cross-subsidy but by a direct government subsidy, as in Chile. This requires a high amount of institutional capacity to actually transfer the subsidy to water users or the water supplier (Gómez Lobo and Contreras, 2003a). Thirdly, the administrative burden associated with a tariff scheme is higher for all actors involved if the system to identify and reach the poor is single-purpose rather than multi-purpose. In the latter case, the system is also used for other social transfer programs and the associated costs are shared (Coady et al., 2004, p. 49; Gómez Lobo, 2001; le Blanc, 2008, p. 19). In Chile, for example, administrative costs of the multi-purpose system account for 1.2 per cent of the total of the different subsidies distributed through this system – compared with a share of 17.8 per cent if only the water subsidy scheme had to bear all costs (Estache et al., 2002, p. 76).[10] Fourthly, transaction costs increase for water users if they have to apply for the water subsidy (Gómez Lobo, 2001). It may be difficult for them to determine in advance whether they are eligible for the subsidized tariff or not. Some users fearing high administrative hurdles may then decide not to apply even though they would be eligible. In this case, it may be helpful if the water supplier or a public authority informs eligible water users. Transaction costs of a central authority may be lower than the aggregated information costs of individual water customers (Irwin, 1997, p. 3).

### 3.5 Options Related to the Implementation Process

A water supplier may also create a subsidy by deliberately choosing to implement a water price not perfectly strictly. This implies that (some) water users' effective bills are below the level which would correspond to their actual use and cost of the water service. There are two basic means to relax price implementation. Firstly, the water supplier may reduce its efforts to monitor the network and actual water consumption. Thereby, it may allow for illegal withdrawals and meter manipulations. Secondly, the water supplier may abstain from sanctioning payment arrears by disconnection (Komives et al., 2006, p. 4; World Bank, 2000, p. 10). A policy of relaxed implementation is usually not explicitly announced. Nevertheless, such subsidies may be

[10] Similarly, transaction costs of tariffs differentiated by geographical location can be reduced. In Colombia, for example, municipalities are allowed to base tariff differentiation on the stratification which has been developed for differentiating the land tax (Gómez Lobo and Contreras, 2003a, p. 10).

substantial. In Colombia, they have been estimated to account for 24 per cent of all subsidies in water and sanitation (Estache et al., 2002, p. 21).

### 3.5.1 Affordability

Whether poor water users benefit from lax price implementation depends first of all on how this policy is applied. If implementation efforts are generally reduced, they are similar to a universal subsidy and may reach many poor. If the decision is made on a by-case basis, the underlying decision criteria are decisive for the actual effect for affordability. Usually, however, a pro-poor bias can be observed (Estache et al., 2002, p. 21). For example, it is often particularly poor customers who are not disconnected in the case of payment arrears. Nevertheless, the eventual performance with respect to affordability also depends crucially on the risk perceptions of water customers. If poor customers are risk-averse and/or value the risks of detection (in the case of meter manipulations and illegal withdrawals) and disconnection as high, they may decide to comply, and will not benefit from a relaxed implementation policy (World Bank, 2000, p. 10). What is more, relaxing the implementation process may deteriorate affordability problems in the long run - quite similar to a reduction of the average price level (see Section 3.3.1). This because it reduces the efficiency and financial sustainability of water supply and results in increased water scarcity and deficient infrastructure – and both effects are likely to impair affordability for the poor even further.

### 3.5.2 Efficiency

Obviously, lax implementation efforts reduce the incentive to save water and may result in significant overconsumption. Moreover, the allocation of water consumption across different water users and uses may be distorted due to differentiated monitoring and enforcement efforts by the water supplier and heterogeneous risk perceptions of water users (World Bank, 2000, p. 11). Generally, non-compliance and the resulting inefficient distortions will be less important if water customers are risk-averse or exhibit good payment behaviour for cultural reasons.

### 3.5.3 Financial Sustainability

As this approach usually does not provide for a cross-subsidy, it affects the water supplier's budget negatively and will require additional government support. This detrimental effect will be lower if implementation efforts are not relaxed across the board but primarily for poor customers. Moreover, the reduction of revenues will be the smaller, the more water users pay their bills despite relaxed implementation efforts – e.g., due to risk aversion or traditionally good payment behaviour (World Bank, 2000, p. 11). More profoundly, however, relaxing monitoring and enforcement may draw the entire pricing system into question and deteriorate payment behaviour in the long run.

#### 3.5.4 Administrative Simplicity

It is the basic appeal of this approach that it reduces the necessary administrative efforts, particularly the monitoring and enforcement costs of water pricing schemes.

## 4 Summary and Conclusion

This paper has outlined that policy-makers have a variety of pricing options at their disposal to address the affordability of urban water supply – at least in theory. By modifying one or more of the different components of water price design – object of pricing, assessment base, average price level, tariff and implementation process – policy-makers can determine for which water users the burden of water pricing is reduced and for which not. Obviously, it always depends on the specific design patterns of existing pricing schemes – such as the size of a price discount or the eligibility criteria which have to be met to receive this discount – whether all water users are able to afford their basic water needs. However, the review of theoretical and empirical literature carried out in this paper clearly revealed two overarching sets of limits to addressing affordability by water price design.

First of all, the performance of water prices is constrained by the technological and socio-economic environment into which they are embedded. For example, a reduced consumption charge will only support water users who are connected to the network, while those predominantly poor without access to the service will not benefit. Likewise, an increasing block tariff based on consumption per connection cannot help poor customers with large families or shared connections. Table 1 summarizes the most important technological and socio-economic limits associated with the different water pricing options under consideration.

Secondly, addressing affordability usually brings about trade-offs with respect to other criteria. If the average price level is reduced, for example, water users do not face the full costs of water supply and consume too much in terms of efficiency, and the water supplier cannot recover its costs. Tariff differentiation implies that the incentives to use or save water are not efficiently allocated among different groups of water users and uses. Table 2 provides an overview of such trade-offs for the different options of water pricing.

Due to these limits, there is no generally superior pricing option to address affordability. The decision which pricing option to implement has to be made on a case-by-case basis. It has to take into account the specific characteristics of the technological and socio-economic environment prevailing in a city or country. Moreover, it has to find a balance between affordability and other pricing objectives, which is eventually a question of political preferences. In many cases, an optimal water pricing scheme will have to encompass a combination of pricing options. This review is meant to provide some guidance for this political decision-making process.

Finally, the limits to addressing affordability by water pricing, as they are pointed out in this paper, also indicate that additional, non-price measures will be required in many cases to improve poor water users' ability to pay. Estache et al. (2002) and OECD (2003) provide overviews of potential policies. Firstly and most importantly, additional measures to improve access to water supply may be warranted. These may include infrastructure investments in general, universal service obligations for water suppliers, the use of non-conventional, low-cost supply technologies (e.g., condominials), and also measures to regulate, legitimize and promote non-grid-based alternatives for water supply (e.g., community-based approaches). Secondly, water users may be granted income support by direct income transfers, housing allowances or special loans. Moreover, utility payments can be designed to better match income streams, e.g., by more flexible and/or frequent billing are pre-payment. Thirdly, the cost of water consumption may be reduced, for example, by allowing lower service quality for the poor (e.g., a higher probability of service interruption) or by introducing service limiters to limit water consumption (instead of disconnection). Fourthly, measures to reduce consumption itself may be employed. Options may encompass demand management or conservation programmes for the poor, which provide inter alia free water audits, free repair of leaks and the replacement of inefficient appliances. A portfolio of (constrained) water pricing reductions and such complementary instruments may help promote affordability of water supply effectively for all poor.

**Table 1: Possible limits to achieving affordability for different water pricing options**

| Components of price design | Pricing options | | Limits associated with the technological environment | Limits associated with the socio-economic environment |
|---|---|---|---|---|
| Object of pricing | Water consumption (subsidized consumption charge) | | - Low connection rate among the poor | |
| | Installation of a new connection to the water network (subsidized connection charge) | | - Lack of network in poor neighbourhoods<br>- High need (and cost) of additional intra-household fixtures | - Lack of legal land title among the poor<br>- Inability to provide security deposit<br>- Incompatibility between utility payments and income streams among the poor |
| Assessment base | Consumption charge | per volume of consumption | - Low metering rate among the poor | |
| | | per connection | - Low rate of shared connections among the poor | - Low per-capita consumption of poor<br>- Small/average size of poor families |
| | Connection charge per connection | | | |
| Average price level | Reduced single-part price | | | |
| | Two-part price | Fixed charge reduced, volumetric charge not reduced | | |
| | | Fixed charge reduced, volumetric charge increased | - High rate of shared connections among the poor | - High per-capita consumption of the poor<br>- Large size of poor families |
| | | Menu | | |
| Tariff | Self-selected differentiation by consumption | Without consideration of user no. per connection | - High rate of shared connections among the poor | - High per-capita consumption of the poor<br>- Large size of poor families<br>- Resale of water to neighbours |
| | | With consideration of user no. per connection | | |
| | Self-selected differentiation by service | | - Lack of public stand pipes available to the poor | - Low willingness to accept low-quality service |
| | Administrative differentiation by individual welfare means | | | |
| | Administrative differentiation by geographical location | | | - High heterogeneity of income levels within neighbourhoods |
| | Administrative differentiation by economic activity | | | |
| Implementation process | Lax monitoring and enforcement | | | - High risk aversion among the poor |

**Table 2: Trade-offs between affordability and other policy objectives for different water pricing options**

<table>
<tr><th>Components of price design</th><th colspan="2">Pricing options</th><th>Affordability</th><th>Efficiency</th><th>Financial Sustainability</th><th>Administrative Simplicity</th></tr>
<tr><td rowspan="2">Object of pricing</td><td colspan="2">Water consumption (subsidized consumption charge)</td><td>+/-</td><td rowspan="2">+</td><td rowspan="2">+</td><td rowspan="2">+</td></tr>
<tr><td colspan="2">Installation of a new connection to the water network (subsidized connection charge)</td><td>+/-</td></tr>
<tr><td rowspan="3">Assessment base</td><td rowspan="2">Consumption charge</td><td>per volume of consumption</td><td>+/-</td><td>+</td><td>+/-</td><td>-</td></tr>
<tr><td>per connection</td><td>+/-</td><td>-</td><td>+/-</td><td>+</td></tr>
<tr><td colspan="2">Connection charge per connection</td><td>+</td><td>+</td><td>+</td><td>+</td></tr>
<tr><td rowspan="4">Average price level</td><td colspan="2">Reduced single-part price</td><td>+/-</td><td>-</td><td>-</td><td>+</td></tr>
<tr><td rowspan="3">Two-part price</td><td>Fixed charge reduced, volumetric charge not reduced</td><td>+</td><td>+</td><td>-</td><td rowspan="3">-</td></tr>
<tr><td>Fixed charge reduced, volumetric charge increased</td><td>+/-</td><td>-</td><td>+</td></tr>
<tr><td>Menu</td><td>+</td><td>-</td><td>+</td></tr>
<tr><td rowspan="6">Tariff</td><td rowspan="2">Self-selected differentiation by consumption</td><td>Without consideration of user number per connection</td><td>+/-</td><td rowspan="6">-</td><td rowspan="6">+ (with cross-subsidy)/<br>- without cross-subsidy</td><td>+</td></tr>
<tr><td>With consideration of user number per connection</td><td>+</td><td>-</td></tr>
<tr><td colspan="2">Self-selected differentiation by service</td><td>+</td><td>+</td></tr>
<tr><td colspan="2">Administrative differentiation by individual welfare means</td><td>+/-</td><td rowspan="3">-</td></tr>
<tr><td colspan="2">Administrative differentiation by geographical location</td><td>+/-</td></tr>
<tr><td colspan="2">Administrative differentiation by economic activity</td><td>+</td></tr>
<tr><td>Implementation process</td><td colspan="2">Lax monitoring and enforcement</td><td>+/-</td><td>-</td><td>-</td><td>+</td></tr>
</table>

Legend: + Objective can be attained (if other components of water price design are properly designed).

\- Objective cannot be attained (even if other components of water price design are properly designed).

+/- Whether or not objective can be attained depends on the implementation of water pricing and the characteristics of the technological and socio-economic environment.

**References**


Agthe, D.E., Billings, R.B., 1987. Equity, price elasticity, and household income under increasing block rates for water. American Journal of Economics and Sociology 46, 273-286.

Allen, D.W., 1991. What are Transaction Costs? Research in Law and Economics 14, 1-18.

Birner, R., Wittmer, H., 2004. On the Efficient Boundaries of the State - The Contribution of Transaction Costs Economics to the Analysis of Decentralisation and Devolution in Natural Resource Management. Environment and Planning C: Government and Policy 22, 667-685.

Bithas, K., 2008. The sustainable residential water use: Sustainability, efficiency and social equity. The European experience. Ecological Economics 68, 221-229.

Boiteux, M., 1956. Sur la gestion des monopolies publics astreints à l'equilibre budgétaire. Econometrica 24, 22-40.

Boland, J.J., Whittington, D., 2000. The Political Economy of Water Tariff Design in Developing ountries: Increasing Block Tariff versus Uniform Price with Rebate, in: Dinar, A. (Ed.), The Political Economy of Water Pricing Reform. Oxford University Press, New York, NY, pp. 215-235.

Brown, S.J., Sibley, D.S., 1986. The theory of public utility pricing. Cambridge University Press, Cambridge, UK.

Castro-Rodríguez, F., Da-Rocha, J.M., Delicado, P., 2002. Desperately Seeking θ's: Estimating the Distribution of Consumers under Increasing Block Rates. Journal of Regulatory Economics 22, 29-58.

Coady, D., Grosh, M., Hoddinott, J., 2004. Targeting of Transfers in Developing Countries: Review of Lessons and Experience. World Bank, Washington, DC.

Coase, R.H., 1946. The marginal cost controversy. Economica 13, 169-182.

Dahan, M., Nisan, U., 2007. The Unintended Consequences of IBT Pricing Policy in Urban Water. Water Resources Research 43, W03402, doi:10.1029/2005WR004493.

Debomy, S., Lauria, D.T., Hopkins, O.S., 2005. Pro-poor subsidies for water connections in West Africa : A preliminary study. Executive Summary, Water Supply and Sanitation Working Notes. World Bank, Washington, DC.

Dinar, A., Subramanian, A., 1998. Policy implications from water pricing experiences in various countries. Water Policy 1, 239-250.

Estache, A., Foster, V., Wodon, Q., 2002. Accounting for poverty in infrastructure reform: Learning from Latin America's experience. World Bank, Washington, DC.

Fankhauser, S., Tepic, S., 2007. Can poor consumers pay for energy and water? An affordability analysis for transition countries. Energy Policy 35, 1038-1049.

Feldstein, M.S., 1972. Equity and Efficiency in Public Sector Pricing: The Optimal Two-Part Tariff. The Quarterly Journal of Economics 86, 175-187.

Foster, V., 2004. Towards a Social Policy for Argentina's Infrastructure Sectors: Evaluating the Past and Exploring the Future, Policy Research Working Paper. World Bank, Washington, DC.

Foster, V., Pattanayak, S., Stalker Prokopy, L., 2002a. Can subsidies be better targeted?, Series on Water Tariffs and Subsidies in South Asia. Water Sanitation Program, New Delhi.

Foster, V., Pattanayak, S., Stalker Prokopy, L., 2002b. Do Current Water Subsidies Reach the Poor?, Series on Water Tariffs and Subsidies in South Asia. World Bank, Washington, DC.

Foster, V., Yepes, T., 2006. Is Cost Recovery a Feasible Objective for Water and Electricity? The Latin American Experience, World Bank Policy Research Working Paper. World Bank, Washington, DC.

García Valiñas, M.A., 2005. Efficiency and Equity in Natural Resources Pricing: A Proposal for Urban Water Distribution Service. Environmental and Resource Economics 32, 183-204.

Gawel, E., Bretschneider, W., 2011. Affordability as an Institutional Obstacle to Water-Related Price Reforms, in: Theesfeld, I., Pirscher, F. (Eds.), Perspectives on Institutional Change - Water Management in Europe, Leibniz Institute for Agricultural Development in Central and Eastern Europe (IAMO), pp. 9-34.

Gómez Lobo, A., 2001. Incentive-Based Subsidies: Designing Output-Based Subsidies for Water Consumption, Public Policy for the Private Sector. World Bank, Washington, DC.

Gómez Lobo, A., Contreras, D., 2003a. Subsidy policies for the utility industries: a comparison of the distributional impacts of the Chilean and Colombian water subsidy schemes. University of Chile, Department of Economics, Santiago de Chile.

Gómez Lobo, A., Contreras, D., 2003b. Water Subsidy Policies: A Comparison of the Chilean and Colombian Schemes. The World Bank Economic Review 17, 391-407.

Groom, B., Liu, X., Swanson, T., Zhang, S., 2008. Resource Pricing and Poverty Alleviation: The Case of Block Tariffs for Water in Beijing. Environment & Policy 48, 213-237.

GWI, 2004. Tariffs: Half Way There. Global Water Intelligence (GWI), Oxford, UK.

Hajispyrou, S., Koundouri, P., Pashardes, P., 2002. Household demand and welfare: implications of water pricing in Cyprus. Environment and Development Economics 7, 659-685.

Howard, G., Bartram, J., 2003. Domestic Water Quantity, Service Level and Health. World Health Organization (WHO), Geneva.

Irwin, T., 1997. Price Structures, Cross-Subsidies, and Competition in Infrastructure, Public Policy for the Private Sector. World Bank, Washington, DC.

Keener, S., Luengo, M., Banerjee, S., 2010. Provision of Water to the Poor in Africa: Experience with Water Standposts and the Informal Water Sector, Policy Research Working Paper. World Bank, Washington, DC.

Komives, K., Foster, V., Halpern, J., Wodon, Q., 2005. Water, Electricity and the Poor - Who benefits from Utility Subsidies? World Bank, Washington, DC.

Komives, K., Halpern, J., Foster, V., Wodon, Q., 2006. The Distributional Incidence of Residential Water and Electricity Services, World Bank Policy Research Working Paper. World Bank, Washington, DC.

le Blanc, D., 2008. A Framework for Analyzing Tariffs and Subsidies in Water Provision to Urban Households in Developing Countries, DESA Working Paper. United Nations, Department of Economic and Social Affairs, New York.

Liu, J., Savenije, H., Xu, J., 2003. Water as an economic good and water tariff design: Comparison between IBT-con and IRT-cap. Physics and Chemistry of the Earth 28, 209-217.

McCann, L., Colby, B., Easter, K.W., Kasterine, A., Kuperan, K.V., 2005. Transaction cost measurement for evaluating environmental policies. Ecological Economics 52, 527-542.

Meran, G., von Hirschhausen, C., 2009. Increasing Block Tariffs in the Water Sector - A Semi-Welfarist Approach, DIW Berlin Discussion Paper. Deutsches Institut für Wirtschaftsforschung (DIW), Berlin.

North, D.C., 1990. Institutions, institutional change and economic performance. Cambridge University Press, Cambridge.

O'Dea, G., Cooper, J., 2008. Water scarcity: Does it exist and can price help solve the problem, Water-Working Paper. Independent Pricing and Regulatory Tribunal of New South Wales, Sydney.

OECD, 1999. The Price of Water: Trends in OECD Countries. OECD, Paris.

OECD, 2003. Social Issues in the Provision and Pricing of Water Services. OECD, Paris.

OECD, 2009. Managing Water for All - An OECD Perspective on Pricing and Financing. Organization of Economic Co-operation and Development (OECD), Paris.

OECD, 2010. Pricing Water Resources and Water and Sanitation Services. Organization of Economic Co-operation and Development (OECD), Paris.

Raghupati, U.P., Foster, V., 2002. Water Tariffs and Subsidies in South Asia: A Scorecard for India, Series on Water Tariffs and Subsidies in South Asia. World Bank, Washington, DC.

Ramsey, F.P., 1927. A Contribution to the Theory of Taxation. Economic Journal 37, 47-61.

Rietveld, P., Rouwendal, J., Zwart, B., 2000. Block rate pricing of water in Indonesia: an analysis of welfare effects. Bulletin of Indonesian Economic Studies 36, 73-92.

Rogers, P., de Silva, R., Bhatia, R., 2002. Water is an economic good: How to use prices to promote equity, efficiency, and sustainability. Water Policy 4, 1-17.

Ruijs, A., 2009. Welfare and Distribution Effects of Water Pricing Policies. Environmental and Resource Economics 43, 161-182.

Sterner, T., 2003. Policy instruments for environmental and natural resource management. Resources for the Future Press, Washington, DC.

SUNASS, 2010. Estudio Tarifario - Determinación del proyecto de la fórmula tarifaria, estructura tarifaria y metas de gestión aplicables a la empresa de servicio de agua potable y alcantarillado SEDAPAL S.A. Superintendencia Nacional de Servicios de Saneamiento (SUNASS), Gerencia de Regulación Tarifaria, Lima.

Timmins, C., 2002. Measuring the Dynamic Efficiency Costs of Regulators Preferences: Municipal Water Utilities in the Arid West. Econometrica 70, 603-629.

UN, 2000. United Nations Millennium Declaration. United Nations (UN), New York.

UN, 2002. Substantial Issues Arising in the Implementation of the International Covenant on Economic, Social and Cultural Rights. General Comment No. 15 (2002). The Right to Water (Arts. 11 and 12 of the International Covenant on Economic, Social and Cultural Rights). United Nations (UN) Economic and Social Council, New York.

Whittington, D., 1992. Possible Adverse Effects of Increasing Block Water Tariffs in Developing Countries. Economic Development and Cultural Change 41, 75-87.

Whittington, D., 2003. Municipal water pricing and tariff design: a reform agenda for South Asia. Water Policy 5, 61-76.

Whittington, D., 2006. Pricing Water and Sanitation Services, Human Development Report 2006. United Nations Development Programme (UNDP), Human Development Report Office.

Whittington, D., Okorafor, A., Okore, A., McPhail, A., 1990. Strategy for cost recovery in the rural water sector: A case study of Nsukka District. Water Resources Research 26, 1899-1913.

WHO, 2010. Progress on Sanitation and Drinking-Water. 2010 Update. World Health Organization (WHO), Geneva.

WMO, 1992. The Dublin Statement on Water and Sustainable Development, International Conference on Water and the Environment: Development issues for the 21st century. World Meteorological Organization (WMO), Dublin.

World Bank, 2000. Maintaining Utility Services for the Poor - Policies and Practices in Central and Eastern Europe and the Former Soviet Union. World Bank, Washington, DC.

World Bank, 2006. Infrastructure in Europe and Central Asia Region: Approaches to Sustainable Services. World Bank, Europe and Central Asia Region, Infrastructure Department, Washington, DC.

Worthington, A.C., Hoffman, M., 2008. An Empirical Survey of Residential Water Demand Modelling. Journal of Economic Surveys 22, 842-871.

Yepes, G., 2003. Los subsidios cruzados en los servicios de agua potable y saneamiento. Interamerican Development Bank (IADB), Washington, DC.