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Water scarcity and affordability in urban water pricing: A case study of Chile

María Molinos-Senante [a, b, c, *], Guillermo Donoso [d, e]

[a] Departamento de Ingeniería Hidráulica y Ambiental, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna, 4860, Santiago, Chile
[b] Facultad de Arquitectura e Instituto de Estudios Urbanos, Pontificia Universidad Católica de Chile, El Comendador, 1916, Santiago, Chile
[c] Centro de Desarrollo Urbano Sustentable CONICYT/FONDAP/15110020, Av. Vicuña Mackenna, 4860, Santiago, Chile
[d] Departamento de Economía Agraria, Pontificia Universidad Católica de Chile, Casilla 306-22, Santiago, Chile
[e] Centro de Derecho y Gestión del Agua, Pontificia Universidad Católica de Chile, Casilla 306-22, Santiago, Chile

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ABSTRACT

Water demand management is one of the main issues in the water policy agenda. The objective of this work is to design a water rate model that internalizes the scarcity value of water and at the same time improves social concerns such as equity and affordability. The proposed water rate focuses on the variable component of the tariff and follows an increasing block strategy. An empirical application is developed for two Chilean regions. This application illustrates that the implementation of the proposed water rate creates incentives to improve water use sustainability and equity among users.

1. Introduction

At present, several factors such as population growth, rapid urbanization, higher water contamination and pollution, and increased water demands due to increased economic growth are putting considerable pressure on available water resources. With increasing water scarcity and decreasing supply augmentation options, water managers and policy makers worldwide are turning to water demand management solutions (Saleth and Dinar, 2000). Water demand management is now one of the main issues in the water policy agenda (Franceys and Gerlach, 2011).

Under this scenario, economic policy instruments have received widespread attention over the last three decades, and have increasingly been implemented to achieve environmental policy objectives. Water pricing is one of various economic policy instruments that could be used to affect the environmentally, socially, and economically efficient use of water (Dinar et al., 2015). A water tariff can take many different forms. Each form or design addresses a specific objective. In general, the main objectives pursued by water tariffs are (1) economic efficiency, (2) water conservation incentives, (3) equity, and (4) affordability (Grafton et al., 2015).

Numerous studies addressing urban water-pricing topics have been conducted (e.g. Barbosa and Brusca, 2015; Chun, 2014; Farolfi and Gallego-Ayala, 2014; Sibly and Tooth, 2014; Guerrini and Romano, 2013; Olmstead and Stavins, 2009; Letsoalo et al., 2007). From a policy perspective, the European Union Water Framework Directive promoted taxing water users in a way that reflects the scarcity value of water. Additionally, several countries have revised their water pricing policies in such a way so as to help manage reduced water supplies. For example, the prices of water in Israel reflect the true scarcity value of the resource (Becker, 2015). In Mexico, water users have faced different water tariffs depending on their geographical situation in order to reflect relative water scarcity (Guerrero-Garcia-Rojas et al., 2015). Thus, water pricing is an important means to reduce water consumption (Dalhuisen et al., 2003). However, the effectiveness of these water pricing policies depends on the type of tariff and its value (Beecher and Kalmbach, 2013).

Most metered water tariffs include a combination of fixed and uniform volumetric variable charges (Molinos-Senante, 2014).

* Corresponding author. Departamento de Ingeniería Hidráulica y Ambiental, Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna, 4860, Santiago, Chile.
E-mail addresses: mmolinos@uc.cl (M. Molinos-Senante), gdonosoh@uc.cl (G. Donoso).

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Several OECD countries, for example Australia, Austria, Denmark, Finland and the United Kingdom, with successful water pricing schemes use a two-part tariff structure. This form of water tariff has fixed and variable elements. In countries that apply this two-part tariff, the fixed element varies according to some characteristic of the user, and the variable element often uses average cost pricing. Rogers et al. (2002) points out that one of the main advantages of the two-part tariff system is the stabilized revenue base it affords the supplier.

An important issue when setting water tariffs as a demand management economic policy instrument is equity. Affordability and water poverty are a real issue in several countries since a lack of access to improved water and sanitation services (WSS) has significant impacts. Basically, the different types of policies that have been applied to insure affordability can be classified as (i) income-support policies and (ii) tariff related policies (OECD, 2003). An example of income-support programs is the provision of subsidies directly to the most vulnerable households; such as the Chilean case (Donoso, 2015). On the other hand, Spain applied tariff related policies, in order to ensure affordability and equity, by applying discounts to water tariffs to low income families (Calatrava et al., 2015). However, in several cases, tariff related policies to insure affordability have led to a tariff structure that does not satisfy economic efficiency or generates water conservation incentives.

Thus, policy makers face the challenge of setting water tariffs which deal with multiple objectives such as increasing water use efficiency, ensuring equity and affordability and improving water conservation mainly in water-scarce regions. Moreover, although the tariff setting procedure is generaly regulated by a local or national regulator, it also faces several challenges. Thus, usually regulation focuses on the overall annual revenue but it does not address the issue of tariffs structure. Indeed, water sector worldwide has the tendency to be guided by the subsidiarity principle (Pinto and Marques, 2015a). It should be noted that there are several water tariff structures such as uniform volumetric variable charge (UVC), increasing block tariff (IBT), decreasing block tariff, increasing rate tariff, seasonal tariff, time of use tariff and spatial tariff. All of them have strengths and weaknesses. Hence, the selection of a tariff structure presents a major challenge since it is responsive to the philosophy and objectives of the water company, the regulator and the citizens (Pinto and Marques, 2015b).

In this context, the objective of this study is to design a water rate model that internalizes the scarcity value of water, and at the same time is considered fair and equitable by end users. Moreover, it would improve water use sustainability, since by integrating the water scarcity value, consumers face a higher tariff in areas characterized by higher water scarceness incentivizing them to reduce their water consumption. In order to illustrate the usefulness of the proposed water rate, an empirical application is developed for two regions in Chile with different characteristics: (i) the Atacama region which is an extremely arid area and; (ii) the Aysén region which has abundant water resources.

Currently, in Chile as in many countries the volumetric water charge is uniform. While this water rate structure presents some advantages, it does not directly integrate the value of the water resource. Hence, the water rate proposed involves replacing the UVC by an IBT strategy. This IBT is designed so that large water consumers subsidize low water consumers that usually are low-income households. Although the case studies developed in this paper focused on two Chilean regions, the proposed water rate structure could be applied also in other countries which face water scarcity and present water affordability problems. In this context, in many countries, water is increasingly scarce and therefore, water companies and regulators have already implemented incentives to conserve water (Dinar et al., 2015). Regarding affordability, the social dimension of water sustainability is now on the political agenda in several countries (Barraqué and Montginoul, 2015). Hence, different supporting measures for the poorest families have been implemented.

From a policy perspective, the proposed water rate will be highly useful for authorities and water regulators. On the one hand, the unit water price for the second block involves a "penalization" for high water consumption. Since this block is set above average cost, it generates an additional revenue which finances the water supply subsidy cost to low-income households; hence, the proposed tariff does not place an additional burden on fiscal funds. On the other hand, the proposed water rate introduces a water scarcity factor allowing for the differentiation between regions according to their water scarcity problems. Areas characterized by higher water scarcity would present higher second block rates. This also generates extra revenue which we propose be destined to implement water conservation measures in water-scarce regions. This paper contributes to the current strand of literature by proposing a water rate model that internalizes the scarcity value of water and also improves equity. Unlike other water tariff structures, the one proposed in this paper is based on a cross-subsidy since high water users pay for low users who usually are low-income households.

Following this introduction, the paper is divided into five additional sections. Section 2 describes the basis of the proposed water rate. Section 3 describes the main features of the Chilean urban water and sanitation services. Section 4 presents the two case studies selected while Section 5 discusses the results for these two case studies. Finally, conclusions are presented in Section 6.

2. Water tariff system proposal

2.1. Historical and legal framework

Most metered water tariffs include a combination of fixed and variables charges (Molinos-Senante, 2014). However, taking into account that the objective of this study is to design a water rate that serves to integrate an environmental criteria (water scarcity) and to improve social concerns (equity and affordability) we focus on the variable component of the tariff. Moreover, the volumetric component provides consumers with some degree of flexibility in controlling their water bills, based on their consumption. Thus, water tariffs can play important roles in promoting behavioural changes and in improving affordability and access for the poor (Hoque and Wichelns, 2013).

It should be noted that our study does not focus on introducing new concepts and formulas to establish the variable tariff since in Chile this process is well established through the Executive Decree 453 of the 1998 Law N° 70 (see Section 3). We focus on designing a variable water rate strategy that improves the sustainability in the use of water.

UVC tariffs are widely implemented since they have the advantage of being easily understandable for consumers and it enables water utilities to perform straightforward calculation of water bills. Moreover, they can be as efficient as IBT obtaining revenues if the rate is fixed at an appropriate level (Whittington, 2011). However, it does not integrate the scarcity value of the water in the bill since the result of water waste in not directly communicated via a higher water bill. In this context, to increase water efficiency a clear economic signal must be sent to customers (Barr and Ash, 2015).

An alternative approach to the UVC is an IBT strategy. There are three main features of the IBT structure that support its implementation. First, an IBT is considered as a conservation-oriented rate design since it transmits water scarcity information to customers (Reynaud et al., 2005). Secondly, the IBT approach promotes

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