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Regulation and performance: A production frontier estimate for the Latin American water and sanitation sector

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ABSTRACT

The objective of this paper is to analyze the efficiency of the water sector in Latin American countries. We try to find factors affecting efficiency rather than identifying which country or individual provider is more or less efficient. We also consider which model would be more fitting for the water sector production in this region. Our motivation is to develop instruments to make benchmarking operative for regulatory actions that can reduce information asymmetry and increase efficiency in Latin American countries. We estimate econometric efficiency frontiers using data from a regional survey conducted by the Latin American Association of Water Regulators. The paper develops a model based on the core variables that explain the phenomena and explores "environmental" (contextual or beyond management control) variables to achieve fair comparisons. The study does not "name and shame" services but provides elements to foster the development of indicative goals at the regional level.

1. Introduction

One of the goals of public utility regulation is to ensure that present and future consumers have access to services with efficient provision, high product and service quality, and reasonable tariffs. Efficiency comparisons are central to tariff revisions. Benchmarking studies are generally commissioned by regulators, as well as by firms, to estimate relative efficiency or productivity changes. They are crucial to mitigating information asymmetry and to determining the X factor that affects prices during the tariff period.

The regulatory use of the results of these kinds of studies could follow a more ambitious or a more limited approach, for instance, using efficiency or productivity estimates to discuss tariffs and performance goals.[1] Hargreaves et al. (2006) summarize their use in England and Wales to set the X factor in the pricing formula. This more rigorous application is called "yardstick competition". A lighter approach, the so-called "sunshine competition" applied in the Netherlands, seeks to evidence the best practices through "naming and shaming" (inefficient) providers (De Witte and Dijkgraaf, 2007). Another though more modest approach is to reach a consensus on some floor performance standards in order to emulate other realities.

"Yardstick competition" has been introduced in countries with private provision to replicate competition incentives. In countries with public provision, "sunshine competition" has been advanced as a means to provide good incentives to providers. In any case, a benchmarking activity in the utility context is one way to provide competitive incentives in a monopolistic market.

The way in which the benchmarking is established in the Netherlands does not imply an expensive structure. It leaves all the decisions of products and service performance up to the provider, including the definition and control of minimum standards. Annual data gathering yields exhaustive information about costs, quality and levels of service, in addition to comparing providers via performance indicators. The information is elaborated at different company levels, at process (production, distribution, sales, and the management), and at subprocess levels (such as the cost of 1 m of pipes or the cost of installing a meter) inside and outside the providers. (De Witte and Dijkgraaf, 2007).

Comparative studies at an aggregate level indicate which services are weak in terms of efficiency and leave it up to the managers to decide where and when the improvements have to be implemented. Our motivation is to develop instruments to make benchmarking operative for regulatory actions addressing asymmetric information issues in Latin American countries. From a global perspective, Latin America could be situated at an

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[1] In an extreme case, it could be used to set the X-Factor directly (Bernstein and Sappington, 1999).

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intermediate level in terms of coverage, quality and cost recovery through tariff collection.

The objective of this paper is to analyze the efficiency of the water sector in Latin American countries. We try to find factors affecting efficiency rather than identifying which country or individual provider is more or less efficient. We also try to identify a fitting model for water sector production in this region.

We use econometric methods (Stochastic Frontier Analysis, SFA) to estimate the relative efficiency of water and sanitation providers in Latin America in the period 2003/2008. We develop a model based on the core variables that explain the phenomena. We also explore "environmental" (contextual or beyond management control) variables[2] to achieve fair comparisons. The study does not "name and shame" services but provides elements to foster the development of indicative goals at the regional level.

This paper contributes to the empirical discussion, as well as offering some considerations on suitable variables to include and the functional form that would better characterize the productive technology. The estimates require the simultaneous analysis of variables to be included and the relevant functional forms. We identify inputs and outputs and some environmental variables that could characterize the regional water sector. In other sectors where previous studies of this type have been conducted, such as electricity, a consensus exists on both aspects.

The database was based on a survey conducted by the Latin American Association of Water Regulators (ADERASA) — an organization comprising 16 Latin American countries. The response to the successive surveys was voluntary and the quality of the responses from the providers increased. Over time we developed studies with earlier waves of the survey but only cross-section estimates have been made to date, highlighting their potential when designing regional standards for comparisons and improving performance (Romero, 2005; Ferro and Romero, 2007a,b,c, 2009). In this paper, we go one step further using a panel instead of a cross-section database.

Following this introduction, Section 2 makes a brief review of the literature on econometric estimates of efficiency frontiers in the international water and sanitation sector and discusses the previous work in the region. Section 3 presents the descriptive statistics of the database. Section 4 estimates the frontier and we discuss the results in Section 5. Finally, Section 6 concludes.

2. A review of the literature

This review discusses the methodology and variables included in previous efficiency studies that use econometric methods. It highlights aspects that are relevant to the modeling process and the sector under study. We also summarize extra-regional studies.

The literature has grown and become increasingly more complex over time. An analysis of the variables reveals that the output is approximated either by water production volume or by clients. The capital and labor inputs are approximated by means of network length and full-time staff, respectively. Unit labor cost is usually a proxy for the average of the salaries paid to full-time staff. The cost of the capital input is measured frequently by non-labor costs divided by the network length.

The literature does not fully concur on the environmental variables. It is often assumed that certain variables improve productivity (or reduce costs). For instance, two commonly used variables are the geographic concentration of the clients and the proportion of metered clients. We can see ambiguous results in "unaccounted for water", depending on whether the losses are billed to clients. Many providers bill water losses to clients, offering no incentives to control leakages. Larger losses are associated with lower water pressure, frequent service interruptions and low overall quality levels. Decision units in our sample (that is, providers) fall within different regulatory and institutional frames. In this study, we try to determine whether those differences affect efficiency estimates.

In the Latin American context, we identify four groups of studies referring to water and sanitation efficiency frontiers: 1) studies generated in Brazil, 2) those developed in the Public Utility Research Center (PURC) of the University of Florida at Gainesville (which comprise studies on the Caribbean, Central America, Peru, and Brazil), 3) the estimates by the Centro de Estudios Económicos de la Regulación (CEER) of the Universidad Argentina de la Empresa (UADE) in Buenos Aires, and 4) the studies commissioned by ADERASA.

In the case of Brazil, Motta and Moreira (2004) examine efficiency in the sanitation sector; Tupper and Resende (2004) analyze related efficiency and regulatory issues; Moreira and Fonseca (2005) compare productivity measures based on mathematical programming and stochastic frontiers; and Da Silva e Souza et al. (2007) estimate a stochastic cost frontier for private and public water companies.

Of the group of studies carried out by the PURC, Corton (2003) examines the comparative efficiency of the water and sanitation enterprises in Peru; Mobbs and Glennie (2004) work on DEA using the first ADERASA survey database; Lin (2005) analyzes Peru's quality of service; Lin and Berg (2008) study consistency between methodologies in Peru; Sabbioni (2005), (2008) estimates econometric frontiers in the sanitation sector in Brazil; Berg (2006) examines the different benchmarking approaches; Berg (2007) studies the conflict resolution for the water and sanitation providers' performance; Berg and Corton (2007) analyze the efficacy of the benchmarking techniques for less developed countries; Corton and Berg (2008) apply benchmarking techniques to study the Central American water industry; Marques and Berg (2010) develop a "meta-study" on the empirical literature in the water sector performance studies; and Berg (2010) synthesizes the techniques and findings of different authors in an interesting and very didactic text.

At CEER, numerous studies were conducted on comparative efficiency in other infrastructure sectors in the 1990s. In the water sector we can mention Ferro (1999) on partial indicators, Ferro (2007) on econometric frontiers, and Ferro and Romero (2007b) who survey the literature on efficiency frontier use in the sector. Ferro and Romero (2008) estimate a cost function for many Latin American countries with a cross-section database.

The above three references are academic papers which use a common source of data for the estimates: ADERASA's, containing information from more than one hundred providers in 16 countries. In addition to the preceding database "Sistema Nacional de Informações sobre Saneamento" (SNIS) from Brazil, ADERASA's survey is a rich source for regional studies and its database offers valuable information to build partial productivity indicators, average costs, regulatory accountancy, quality, and so on. Its progressive improvement allows for data consistency and comparison. ADERASA commissioned three studies with different versions of the database: Romero (2005) makes an exploratory approach with the first wave of the survey using data from 2003 until 2008; Ferro and Romero (2007a) provide estimates made with DEA and econometric techniques for the 2005 survey; and Ferro and Romero (2009) develop a panel study with DEA and econometrics for the accumulated data from 2003 to 2008.

[2] These variables could be employed to design characteristics which differentiate the operational environment, regulatory demands (regarding quality), geography, distribution conditions (sparse or concentrated), the weather, the state of the network, among others.