



Efficiency in Brazil's water and sanitation sector and its relationship with regional provision, property and the independence of operators



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ABSTRACT

The purpose of this paper is to assess the comparative efficiency of Brazil's water and sanitation sector. We run a Stochastic Frontier Analysis (SFA) model for a panel of 127 providers covering more than 70 percent of the country's urban population in the period 2003–2010. We use a database built on the National System of Sanitation Statistics (SNIS). The model is fitting and shows a modest efficiency average. The study has policy implications in the discussion of state-level run v. municipal-level run, government-owned v. private-provision, and corporatized providers v. dependent ones. The optimal industrial organization of the sector is discussed from the efficiency perspective. We find that regional and micro-regional firms' have lower costs than municipal providers. Administrative independence seems not relevant when explaining the cost structure, but ownership is. The joint provision of water and sanitation results in higher fixed costs compared to water-only operators. We find that there are not regional differences in cost structures. However, there are slight variations in the efficiency levels and in their dispersion in each region. Finally, inefficiency decreased at a rate of 4.9 percent per year during the time frame under study.

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1. Introduction

From the early 1900s, the provision of water and sewerage services in Brazil had been organized through local public and private utilities. In 1971, the Water and Sewerage National Plan (PLANASA) was launched as a means to rationalize the planning, investment, tariff and credit policies of the industry. Its main goal was to increase geographical coverage in urban centers. During the period 1971–92, companies of regional scope were created at the state level – all state-owned – which replaced many former local-based ones. This organizational structure is still in place despite the dissolution of PLANASA in 1992; that is, from an initially designed decentralized local structure, the system has evolved into a centralized one with state-owned state-level companies which coexist with smaller scale firms.

Brazil is divided into 27 states and 5564 municipalities. Even though the Brazilian Constitution (1988) established that water and

sewerage provision was a municipal concern, approximately 75 percent of the country's population is served by the 27 state-level companies (one is private). To date, 4002 municipalities have reached concession agreements with state-level companies currently serving approximately 119 million people in urban areas, 936 municipalities have a local-level provision serving approximately 40 million people in urban areas and in between 18 municipalities receive the service from 6 micro-regional providers accounting for 0.7 million people.¹

Thus, although a municipal jurisdiction model was constitutionally established, the agglomeration model initially promoted by PLANASA prevailed. In 2007, the Basic Sanitation Law N. 11,445 was enacted, which laid down both the national operation principles as well as the general framework for each state to carry out its specific implementation strategy. Along this line, the law provided for the creation of social monitoring instruments and institutionalized the regulatory agencies. In 2012, a total of 23 state regulatory agencies existed, all enjoying law enforcement power in the water and

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¹ See DIAGNÓSTICO DOS SERVIÇOS DE ÁGUA E ESGOTOS – 2011 in <http://www.snis.gov.br/PaginaCarrega.php?EWRterterTERter=101>.

sanitation sector; most of these agencies were authorized to supervise other services as well.

The Basic Sanitation Law also enables the municipalities to group themselves into regional consortiums for the provision of water and sanitation services. It is based on the rationale of strong scale economies providing the service and hindering the small municipal companies from achieving universal coverage. For all intents and purposes, this did no more than legalize an already common practice (i.e. the delegation of the provision from municipalities to the states).

The choice of municipal-level versus regionally-integrated water utilities has an economic nature – a cost/benefit decision – targeting an optimal agglomeration scale. Along the same line, the choice between an administratively independent provider or a municipal department operating the service is subject to a cost/benefit analysis as well. On the one hand, when the provision of a service is carried out by a small municipal-owned utility or a municipal department, its operation under the municipality's structure can result in cost savings in areas such as headcount expenses, office space, transportation vehicles, and so on. These situations are not detailed in the database used for this paper. On the other hand, the provision of a service through either an independent municipal company or a regulated private firm can produce gains arising from the incorporation of professional management, business-oriented practices, non-politically biased managerial decisions, and tariff settings that more closely match the inherent cost structure.

Then, we will distinguish providers: i) by its jurisdiction (state-level, municipal, micro-regional; ii) by its property condition (private or state-owned), and iii) by its dependency (dependent of a municipality, independent–corporatized–provider).

Given the preceding heterogeneous landscape, the goal of this paper is to estimate the costs frontier of the water and sanitation service providers in Brazil and thus to determine their relative efficiency. In doing so, we seek to answer the following questions:

- Are there significant differences between state-level companies or municipal and micro-regional companies in terms of efficiency or cost structures?
- Does private provision of the service impact on costs or efficiency levels?
- Does independence of service providers from the public administrations (“corporatization”) have any impact on costs? As a by-product we can assess:
- Which is the efficiency level of the industry and its evolution over time?
- How does water-only providers compare with water and sanitation ones in terms of costs?
- The states are grouped in five regions, with marked differences in development, demography, and social indicators. Do cost structures vary in different regions of the country?

Answering the above questions we hope to shed some light on the optimal industrial organization of the water and sanitation sector. Policies such as agglomeration vs. fragmentation, or corporatization of dependent providers could benefit of the efficiency analysis. For example, if regional independent firms had the highest relative efficiency, we could argue for both an agglomeration of small providers as well as for an institutional division between public administration and the entities that provide the services. Or, non-independent service providers might appear to be more efficient, but the results could be biased because of cost-sharing with the public administration.

Likewise, if evidence is found of either a higher relative efficiency or a lower cost structure for private firms, it might, in turn, be beneficial to study further the business practices that trigger these differences.

The joint provision of water and sanitation services, on the one hand, makes it possible to achieve scope economies via cost-sharing, but at the same time it increases total costs due to greater investments in sewerage provision. Thus, this paper will analyze their net effect.

Another issue concerns differences in economic development and Brazil's cost of living since these may be reflected in cost structures when accounting for geographical differences.

Lastly, the sector under study has experienced significant investments in recent years. Thus, it would be interesting to examine whether efficiency has changed upwards together with modernization.

We use the Stochastic Frontier Analysis (SFA) based on data from the National Water and Sanitation Information System (SNIS).

Following this introduction, Section 2 surveys previous publications in the field; Section 3 explains the method, the model and the data used; Section 4 discusses the results, and Section 5 concludes.

2. Literature background

In order to assess efficiency in the water and sanitation sector, previous studies – surveyed in [Abbot and Cohen \(2009\)](#), [Walter et al. \(2009\)](#), [Worthington \(2013\)](#) and [Berg and Marques \(2012\)](#) – have estimated production or cost frontier using parametric or non-parametric technics. The former group applies mainly Stochastic Frontier Analysis technics (SFA, from hereon) while the second one uses mathematical programming, mainly Data Envelopment Analysis (DEA).

Most parametric studies chose a flexible functional form for the costs or production frontier with the idea of imposing the fewest arbitrary restrictions. In this sense, the Translogarithmic function satisfies quite well this criteria, while the Cobb–Douglas functional form is a special case of it.

Thus, we estimate a translog stochastic frontier cost function for which every firm has to minimize their costs subject to provide the service to customers.

Efficiency had been studied in relation to specific policies such as privatization, the consolidation or fragmentation of firms, or the strength of regulatory body.

The difference in relative efficiency between state-level companies or municipal and micro-regional companies that we deal with is related to the economies of scale literature. The studies surveyed find that the number of connections where economies of scale were found ranges from 100,000 ([Fraquelli and Girardone, 2003](#)) to 766,000 ([Mizutani and Urakami, 2001](#)), through to one million ([Fraquelli and Moiso, 2005](#)), but most of these studies had not employed frontier efficiency measurement techniques. Two worth mentioning exceptions are [Filippini et al. \(2008\)](#) and [Corton \(2011\)](#) and are the closest studies to this one.

Our concern about the public/private provision relates to the group of papers evaluating the impact of ownership. To mention a few, [Feigenbaum and Teeple \(1983\)](#), [Bhattacharyya, Harris, Narayanan and Raffie \(1995\)](#), [Estache and Rossi \(2002\)](#), [Renzetti and Dupont \(2003\)](#), [Kirkpatrick et al. \(2004\)](#) and [Saal et al. \(2007\)](#) discusses the issue. As a conclusion, no clear results emerge from ownership, and they seem very sensitive to data availability and technics utilized.

The impact independence of service providers from the public administrations (“corporatization”) on costs could be considered a subgroup of the impact of ownership literature into efficiency. The point here is whether the strong budget constraint entailing independence improves efficiency performance. Nonetheless, no paper reviewed had tackled this issue specifically. In this sense, our paper allows us to distinguish between improvements in efficiency

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