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MEASURING EFFICIENCY OF NATURAL GAS DISTRIBUTORS IN BRAZIL

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Overview

This paper investigates the technical efficiency and the total factor productivity of Brazilian Gas Distribution companies. To this end the “Data Envelopment Analysis (DEA)” and the “Malmquist Index” methods were used. In the absence of a competitive market, as in the case of the gas distribution natural monopoly, regulators in many countries have based their policies on incentive schemes, which rely on performance benchmarking. To evaluate performance, efficiency measures are needed, which are then an important element in the Regulatory Framework. In the Brazilian context, despite the relative novelty of the gas sector regulation, some preliminary analyses of its impact can be made, as this paper attempts to show.

Methodological Approach

The efficiency of a company in terms of its inputs and outputs may be obtained through an estimation of a frontier function, which will subsequently become the standard against which the efficiency of a firm is measured. Deviations from the frontier might then be construed as firms’ inefficiencies.

The methodology used in this paper to classify natural gas distribution companies in Brazil, according to the measurement of their technical efficiency is based on estimations of frontier functions, through the Data Envelopment Analysis (DEA) non-parametric technique.

As the deregulation process is relatively new in Brazil, it is important to observe the utilities productivity development over time, i.e., to have a dynamic view of the firms’ productivity behaviour. To do so, the Total Factor Productivity (TFP) is calculated through the Malmquist Index.

Additionally, the computation of partial productivity levels were used to measure efficiency. This measure is defined here as the ratio, in physical terms, between an output and an input. The purpose of its use in this paper is to perform an exploratory analysis of data to serve as a reference to an evaluation of the values obtained through the application of the DEA.

Results

The focus of the analysis is on measuring technical efficiency of nine natural gas distribution companies operating in Brazil.

The technical efficiency of the distribution companies is measured through the DEA calculated for 2004. The calculation of the TFP is calculated for the period between 2000 and 2004. The computations will carry out through the DEAP software, Version 2.1 (Coelli, 1996).

Technical and Scale Efficiencies for the Input-Oriented CRS and VRS Models

| DMU | CRS TE | VRS TE | Scale | Return to Scale |
|----------|--------|--------|-------|-----------------|
| Comgás | 0.338 | 1.000 | 0,338 | decreasing |
| Algás | 0.143 | 0.559 | 0,256 | increasing |
| Bahiagás | 0.885 | 1.000 | 0,885 | decreasing |
| CEG | 0.205 | 0.357 | 0,574 | decreasing |
| Compagás | 0.222 | 0.305 | 0,728 | ir increasing s |
| Gasmig | 0.482 | 0.487 | 0,990 | decreasing |
| MSgás | 1.000 | 1.000 | 1,000 | |
| PBGás | 0.424 | 1.000 | 0,424 | increasing s |
| Potigás | 0.601 | 1.000 | 0,601 | increasing |

Input-Oriented Malmquist Index - (or TFPC – Total Factor Productivity Change) for 2000 - 2004

| Company | Technical Efficiency Change (CRS) | Technology Change | Technical Efficiency Change (VRS) | Scale Efficiency Change | TFPC |
|----------|-----------------------------------|-------------------|-----------------------------------|-------------------------|-------|
| Comgás | 1.483 | 0.758 | 1.000 | 1.483 | 1.123 |
| Algás | 1.077 | 0.823 | 1.004 | 1.072 | 0.886 |
| Bahiagás | 1.000 | 0.823 | 1.000 | 1.000 | 0.823 |
| Compagás | 1.629 | 0.700 | 1.075 | 1.516 | 1.139 |
| Gasmig | 1.246 | 0.823 | 1.089 | 1.145 | 1.025 |
| PBGás | 1.385 | 0.719 | 1.000 | 1.385 | 0.995 |
| Potigás | 1.452 | 0.689 | 1.000 | 1.452 | 1.000 |

Conclusion

This paper presents a analysis of natural gas distribution companies in Brazil. Even with the limited amount of public data available, it was possible to obtain interesting results through relatively simple DEA techniques. One of these was that the main source of inefficiencies in Brazilian gas distribution companies is related to their scale of operation.

There is however a caveat to the DEA approach, namely its sensitivity to the sample's characteristics — such as the number of observations — and the choice of inputs and outputs. This caveat corroborates the perception by Regulators that despite the simple and useful tool DEA provides for the fine-tuning of regulatory practices, the evaluation of efficiencies and the establishment of benchmarks serve essentially as indicators of the performance of distribution companies and as a way to decrease the asymmetry of information between the Regulator and regulated companies. In Brazil, the need to complement DEA results with qualitative judgement is even more important, because of the high level of heterogeneity among companies, which is brought about by the size of the country, different climates, customs and competing energy source prices, among other factors.