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Regulation, competition and ownership in electricity distribution companies: the effects on efficiency

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1 Introduction

In the last 20 years there has been a wave of reforms in the electricity sector, in particular, in its distribution activity, seeking to improve efficiency and to transfer the productivity gains to consumers. However, there are striking differences in the policies that have been implemented world-wide. While several regulators have adopted incentive regulation, some countries rely on competition policy alone and in others no regulation is applied. Sometimes competition for consumers is allowed whereas in other cases each distribution company has its captive consumers. While privatisation has accompanied the reforms in several countries, public ownership remains in others. The question that arises is which types of policies lead to efficiency improvements. This paper provides an empirical examination of this issue.

Economic theory provides arguments of the policies´ effect on the achievement of efficiency. Failure to achieve the efficiency frontier can be explained by the existence of X-inefficiency. X-inefficiency arises in the context of asymmetric information. In such cases managerial slack can occur, that is, the manager may exert low level of effort to reduce costs. Many mechanisms can help reducing managerial slack. First, several authors argue that the pressures of competition lead to efforts toward cost reduction. One explanation is the lesser discretion held by the managers in a competitive environment. The risk of a bankruptcy, which is greater in a competitive environment, is also a disciplining device. In addition, the positive effect of competition on reducing managerial slack might derive from the possibility of yardstick competition. Tirole (1997), Vickers (1995) and Meyer and Vickers (1997) agree that yardstick competition is more useful in industries with competition than in monopolies because the exogenous conditions facing firms are more likely to be correlated when these firms are in the same product market. Second, the threat of a takeover also serves as a mechanism to discipline managers. This threat is stronger with private capital. With a public enterprise there are fewer feasible mechanism by which the ownership of the firm can be transferred. Finally, the regulatory regimes have different incentives properties. The economic theory indicates that incentive regulation such as yardstick competition gives incentives to firms to reduce costs by rewarding their good performance in comparison with a benchmark performance.

This paper tests whether electricity distribution firms operating in a competitive environment, with private ownership of the capital and where incentive regulation has been adopted are more productively efficient.[1] This is the first attempt to do this. There are no previous empirical studies which evaluate the effect of these three characteristics on efficiency. To test this I use a sample of 56 electricity distribution firms from Australia, New Zealand, United Kingdom and from 10 Latin American countries in the year 2000. I apply several benchmarking techniques to this sample. I test the robustness of my results using parametric techniques, such as Ordinary Least Squares (OLS) and Stochastic Frontier Analysis (SFA) and non-parametric techniques such as Data Envelopment Analysis (DEA).

In applying benchmarking techniques to test the hypothesis I can identify which companies perform better than others. Indeed, these techniques are used by some regulators to overcome informational asymmetries. The regulator does not know if the regulated firm is productively efficient due to his lack of information regarding the efficient cost level but through the application of benchmarking techniques the informational gap is reduced by relying on performance rankings based on comparative efficiency measures.

The results confirm the view that a higher competition is related with lower costs. In addition, firms where incentive regulation has been adopted and firms which rely on competition policy have lower distribution costs. But, contrary to the theoretical literature, the results indicate that public firms perform better than private firms.

[1] A firm is productively or technically efficient if it produces an amount of output using the minimum level of inputs or if it produces the maximum amount of output given a level of inputs.

The study is structured in the following way. Section 2 describes the methodology employed. An outline of selected previous empirical studies is presented in Section 3. Section 4 provides a description of the data used, testing the existence of outliers and analysing the characteristics of the countries studied. Section 5 presents the models. Then, Section 6 presents the results obtained with the different techniques: ratio analysis, regression analysis and DEA and evaluates the consistency of the results. Finally, the conclusions are presented in Section 7.

2 Benchmarking methodology

The performance of a firm in transforming the inputs into outputs can be measured by productivity ratios. These ratios are partial productivity measures. When a firm delivers a range of services or outputs using a number of inputs, these partial measures are not useful to rank the performance of the firms. In order to assess the firms' productivity, a comprehensive measure of economic performance is required.

Benchmarking methodology allows comparing the performance of different firms and assessing their potential efficiency improvements. The traditional methodology to measure efficiency is the standard econometric approach, OLS. Since the seminal paper of Farrell (1957), who followed the work of Debreu (1951) and Koopmans (1951), new methodologies have been developed. The new techniques include the estimation of production or cost frontiers either using a mathematical programming approach (DEA) or an econometric approach (SFA). The three techniques are used in the present paper in order to evaluate the robustness of the results.

Frontier techniques measure the efficiency relative to the best practice in the sample. Instead, standard regression analysis (OLS) provides measures of efficiency against the average practice in the sample. Both OLS and SFA techniques require specifying a functional form and assuming a distribution of the disturbance errors. They allow identifying the importance of the cost drivers and the goodness of fit. One of the main problems with OLS method is that it assumes that the whole residual is attributed to inefficiency (or efficiency). Instead, SFA models incorporate the possibility that some component of the residual may result from measurement errors or from the omission of explanatory variables. In these models the error term has two components: one to account for random effects (v) and another to account for technical inefficiency (u).

The non–parametric approach to frontier estimation proposed by Farrell (1957) was reformulated as a mathematical programming problem by Charnes *et al* (1978), giving rise to the DEA approach. DEA simultaneously models the interaction between multiple inputs used and outputs produced. This implies that substitution possibilities are explicitly considered. It uses a linear programming method to construct a non-parametric piecewise linear frontier over the data. One of the main advantages of this technique is that it does not require specifying a functional form. However, DEA has some drawbacks. It is a deterministic rather than a statistical technique. As a result, there is no information about statistical significance or confidence intervals. Its reliance on a few observations also implies that the efficiency scores are sensitive to outliers which can distort the efficient frontier.

DEA allows accounting for operating environment characteristics that influence the firm efficiency but are outside the control of the manager such as consumers' characteristics, consumers' density, weather conditions, etc. This can be done by directly including the environment variables in the DEA model or by conducting a second stage estimation[2].

3 Previous empirical studies

A number of empirical studies have applied benchmarking techniques to assess the relative efficiency of electricity distribution companies. This section outlines some of them, which are of interest for the present study. Whilst benchmarking techniques are

[2] For a review of the different techniques see Cubbin and Tzanidakis (1998).

applied by regulators in some countries[3], the most relevant studies, which I will summarise below, are those that perform international comparisons or address questions similar to the one proposed here.

International comparisons have been performed by a few numbers of studies. Jamasb and Pollitt (2001) analyse 63 firms from 6 European countries for 1997-98. The authors find that the efficient frontiers tend to be dominated by smaller utilities than the UK firms. Rossi and Ruzzier (2001) and Estache *et al* (2002) perform international comparisons for several firms from South American countries. Both studies apply DEA and SFA techniques and find that the different approaches are consistent in their means, rankings, identification of the best and worst performers and that the efficiency scores are stable over time.

Several studies have analysed the effects of public and private ownership on the efficiency of electricity distribution firms. The results are not conclusive about the effect of ownership. On one hand, Neuberg (1977) estimates a cost function for distribution firms in US in the year 1972. The author finds no empirical evidence to support the claim that the privately owned firms are more cost efficient than publicly owned firms. Pollitt (1995) applies DEA and estimates a cost function for a sample of 136 US firms and nine UK firms in the year 1990. The author does not find strong evidence that ownership affects performance of utilities.[4] Scarsi (1999) studies 76 Italian firms: 37 municipal firms and 39 ENEL (the Italian electricity monopolist) zones. The author finds no statistically significant differences between privately and publicly owned firms. On the other hand, Kumbhakar and Hjalmarsson (1998) in a study of the Swedish distribution

[3] For instance, the Independent Pricing and Regulatory Tribunal (IPART) commissioned London Economics (1999) to measure the technical efficiency of the New South Wales (NSW) distribution companies. In the Netherlands, DTe (2002) uses DEA to evaluate the relative performance of the electricity distribution companies. Ofgem (1999) uses Corrected Ordinary Least Squares (COLS) to measure the relative efficiency of the 14 United Kingdom (UK) electricity distribution firms in 1997-98.

[4] With the cost function estimation, he finds a negative coefficient on the ownership dummy, indicating lower costs in public firms but the coefficient is not statistically significant. With the DEA estimation, the author finds that the public firms outperform the private ones but the null hypothesis of no difference between ownership types cannot be rejected.

utilities in the period 1970-1990, find that the private firms are relatively more efficient than the public firms.

Regarding the effect of the regulatory method employed, Hattori *et al* (2002) examine the relative performance of price cap versus rate of return regulation. The sample comprises twelve UK distribution firms and ten Japanese distribution firms in the period 1985-1998. The results indicate that, in most cases, the UK electricity distribution utilities have performed better than the Japanese electricity distribution. The performance gap is particularly evident during the last three years of the sample when UK electricity distribution companies operate under a price cap while Japanese firms operate within a rate of return regulation regime.

4 Data

4.1 Data description

i) The sample and its sources

The sample includes 56 electricity distribution companies spread in 12 countries: Australia, New South Wales (NSW) (5), New Zealand (22), Argentina (2), Bolivia (2), Brazil (3), Chile (1), Colombia (1), Mexico (1), Paraguay (1), Peru (3), UK (13) Uruguay (1) and Venezuela (1). A list with the names of the firms is provided in Annex B. The data employed correspond to the year 2000.[5]

ii) Definition of outputs and inputs

[5] The data are obtained from the following sources: i) Australia: from the IPART publication “Price and service report for 2000/01. NSW Distribution Network Service Providers” ii) New Zealand: from the *Information Disclosure*, information that the firms must provide according to electricity regulation in 1994, Electric Act 1992, section 170 iii) South American firms: from the “Comisión de Integración Energética Regional” (CIER) publication “Informe Económico Técnico de las Empresas Eléctricas y de Tarifas Eléctricas en los países de la CIER” (2000), iv) Mexico: from the regulator, Comisión Reguladora de Energía (CRE) and v) UK: from the Ofgem publication “Reviews of Public Electricity Suppliers 1998-2000–Final Proposals”.

In order to measure the efficiency of the firm, a cost function characteristic of the industry is defined. The outputs defined in this study are: number of consumers (000's), energy delivered (GWh) and network length (Km). The input defined is operating costs (million of US$ adjusted by PPP).

The number of consumers represents the number of connection points supplied. The energy delivered reflects the capacity requirements of the distribution system. The length of the network is considered an output because it is a proxy for the dispersion of the consumers. In addition, an aggregate output is calculated following the methodology employed by the Ofgem in the 1999 Distribution Price Control Review. A composite variable is constructed, attaching a weight of 0.5 on number of consumers and 0.25 on both, energy delivered and network length. The construction of this aggregate output is made to adjust the number of consumers (*adcons*) for each firm so that the differences in energy delivered per consumer and length of line per consumer are accounted for[6].

The input considered is operating costs, which include costs of operation and maintenance, commercialisation costs and administrative costs. For the vertically integrated firms, the costs correspond only to distribution and commercialisation activities plus a fraction of administrative costs. In order to determine this fraction, the weight of distribution and commercialisation costs in the total cost is used[7]. The operating costs are in million of dollars and adjusted using the Purchasing Power Parity (PPP) factors, obtained from the World Bank.

In addition, environmental variables are used in order to assess the effect of the existence of competition, of the private or public firm's ownership and of the regulatory method applied. These environmental variables are dummy variables, which are described in section 4.3.

[6] See Ofgem (May, 1999).
[7] This is a common practice. For example, Hattori *et al* (2002) use the weight of labour costs to calculate the fraction of general and administration costs attributable to the distribution activity for the Japanese companies.

iii) Limitations

Most of the data is obtained from the regulators. This gives some reassurance in the sense that the data is verified. But, the firms may practice gaming such as distorting the data provided to regulators. The other important source is the CIER, a regional organism which collects data from several Latin American countries, constructing a homogeneous database. This also gives some reassurance regarding the verification and comparability of the data. Yet, there is no information on the differences in data accountability between all the countries. Therefore, it is important to be cautious with the results since differences in accountability can affect them.

Another aspect which is not considered is the development of no regulated activities by the firms. If the firm is allowed to perform other activities, sharing costs with the distribution activity, these costs should be deducted from the distribution costs and thus the firm should be more efficient. The existence of these activities and the effect on efficiency is not studied.

4.2 Descriptive statistics

In order to test the existence of outliers in the sample, descriptive statistics and relationships between variables are analysed. In fact, two outliers are detected by observing the relationship between operating costs adjusted by PPP and consumers. Annex A presents two graphics where the presence of the outliers is detected[8].

Descriptive statistics such as the mean, the standard deviation, the maximum and the minimum are calculated for the whole sample (56 firms) and for the sample excluding the two outliers. These tables are presented in Annex A. Comparing both tables it is possible to observe the important differences between the mean, the standard deviation and the maximum of each variable. In conclusion, the two outliers, which are CEMIG (Brazil) and CFE (Mexico) are excluded from the sample.

4.3 Analysis of countries

The electricity sectors of the countries considered have different characteristics which can influence the level of productive efficiency of their firms. The countries are classified according to the existence or not of competition at the distribution level in the electricity sector, according to the type of ownership (private or public) and to the type of regulation applied.

i) Competition

In a full retail competition model there is competition at the distribution level because all customers can choose their suppliers, i.e. consumers either have direct access to competing generators or through their choice of retailer. The distributors compete as retailers. The countries with competition at the distribution level include Australia, Brazil, Colombia, New Zealand and UK[9]. In the other countries the distributors maintain a monopoly over energy sales to the final consumers. They each have a franchise to serve a given set of captive customers. Among these countries are: Argentina, Bolivia, Chile, Mexico, Peru, Paraguay, Uruguay and Venezuela. Two dummy variables are created to account for the effect of competition on efficiency. *C0* is 1 when there is no competition while *C1* is 1 when there is competition at the distribution level.

ii) Capital ownership

[8] The first graph presents the relationship between operating costs adjusted by PPP and consumers when the whole sample is considered, observing that two firms are much bigger than the rest. The second graph presents the same relationship when these two firms are excluded.

[9] In Australia, New Zealand and UK there is full retail competition. In Colombia, distributors compete in each zone because they do not have a license to supply a given set of consumers. In Brazil in the largest distribution areas there are distinct licenses that are allowed to compete.

Regarding the capital ownership, private capital dominates in some countries such as UK, Argentina, Brazil, Chile and Peru. In other countries such as Australia, Mexico, Paraguay and Uruguay the capital at the distribution level is entirely public. In the rest of the countries there is a mixture of private and public capital. Two dummy variables are created to assess the effect of the ownership on efficiency. *O0* is 1 in the case of a firm with public ownership and *O1* is 1 in the case of a firm with private ownership.

iii) Regulatory method

Regarding the regulatory method, the countries can be classified into four categories: 1) countries which use benchmarking approaches, 2) countries which apply some type of price cap, 3) countries which rely on competition law and 4) countries which do not have regulation. These categories reflect the degree of incentives given to firms to reduce costs. The first category implies the strongest incentives to cost reductions while the last implies no incentives. In the first group are Australia, Chile, Peru and UK. Australia applies a revenue cap while UK uses a price cap. Both adjust by factor X and use benchmarking techniques to evaluate the scope for cost reduction. In Chile and Peru the distribution companies compete with a reference efficient model firm. The second group includes Argentina[10], Bolivia, Brazil and Colombia, where price caps are applied. Third, in New Zealand the electricity sector has to comply with competition law. The last group includes Paraguay (where there is no regulation) and countries where there is now some type of regulation but this is not reflected in the data used in the present study. These countries are Mexico, Uruguay and Venezuela[11].

[10] In Argentina auctions are combined with a price cap. Distribution companies operate under a 95-year concession contract, which is broken into nine 10-year management periods. Before the start of each period, the regulator sets the tariffs to be applied during that period and calls for a competitive auction for control of the company.

[11] In Mexico distribution prices will be regulated using a price cap regime (Inter American Development Bank, 1999). In Uruguay the new regulatory framework provides a tariff regime based on an efficient model firm. In Venezuela the Comision Nacional de Energia Electrica (CNEE), created by the 1999 Law, will establish the principles, methodologies and models that will define the tariff regime (Inter American Development Bank, 1999).

According to the strength of the incentives given by the regulatory method, four dummy variables are created to assess the effect of the regulatory method on the efficiency. *D3* is 1 when the firm has the strongest incentives through the use of benchmarking techniques. *D2* is 1 when the firm applies price cap regulation. *D1* is 1 when competition law is applied. *D0* is 1 when there is no regulation. Annex B provides a table summarising the dummy variables for each company.

5 Models

For the estimations the two outliers detected are excluded from the sample. Thus, the number of observations is 54. The correlation matrix is calculated, finding that energy delivered and consumers are highly correlated (0.94). This could have negative consequences in the estimations, resulting in multicolinearity. Thus, energy and consumers are not included together in the estimations.

5.1 Ordinary Least Squares

i) Model

First, a basic log-linear model is estimated. The equation estimated is the following:

$$l\cos ts_i = \beta_0 + \beta_1 lconsumers_i + \beta_2 llines_i + e_i \qquad i = 1,\dots N$$

The dependent variable is the logarithm of operating costs adjusted by PPP. The variable *lconsumers* is the number of consumers in logs and *llines* is the length of the network in logs. *N* is the number of firms in the sample. This model is called OLS–1LL. Variants of this model are also estimated. A model replacing consumers with energy delivered is estimated (OLS–2LL) and a model excluding the variable lines (OLS–3LL).

Second, a model with the aggregate output as cost driver is estimated (OLS–4 LL):

$$l\cos ts_i = \beta_0 + \beta_1 ladcons_i + e_i \qquad i = 1,...N$$

where *ladcons* is the adjusted number of consumers in logs and represents the aggregate output. The same equations are estimated with variables in levels.[12]

ii) Effect of regulation, competition and ownership

To assess the effect of regulatory method, competition and ownership on efficiency, dummy variables are included in the previous regressions. For example, the following model is estimated.

$$l\cos ts_i = \beta_0 + \beta_1 lconsumers_i + \beta_2 llines_i + \beta_3 D0 + \beta_4 D1 + \beta_5 D3 + \beta_6 C1 + \beta_7 O1 + e_i$$

where *D0* is 1 when the firm is not regulated, *D1* is 1 when the firm complies with competition law and *D3* is 1 when the firm has the strongest incentives (benchmarking techniques). The dummy variable *D2* is equal to 1 when the regulatory method provides some incentives for cost reduction (price cap regime). *C1* indicates competition at the distribution level. The variable *C0* is equal to 1 when there is no competition. *O1* indicates private ownership while *O0* accounts for public ownership. In each group of dummies, one dummy variable is excluded to avoid multicolinearity. This model is called OLS–5LL. The model is also estimated using the composite output (OLS–6LL).

5.2 Stochastic Frontier Analysis

i) Model

The estimation of a cost function is considered more appropriate than the estimation of a production function because the output is exogenous for each firm given the universal

[12] The software used is LIMDEP version 7.0.

service obligation. Input prices are needed in order to estimate a cost function. Wages in manufacturing are used as a proxy for the labour cost. The information is obtained from the International Labour Organisation (ILO) for all the countries except for Uruguay. For this country the information is obtained from the National Institute of Statistics in Uruguay[13],[14]. Since capital is a tradeable input, its price is assumed to be equal across all countries and is not included in the regression.

The specification chosen is that of Battese and Coelli (1995). In this specification the error term u_i which accounts for technical inefficiency is expressed as an explicit function of a vector of firm-specific variables and a random error. Thus, this model allows explicitly including dummy variables to investigate the determinants of the inefficiencies. The model estimated is the following:

$$lcosts_i = \beta_0 + \beta_1 lconsumers_i + \beta_2 llines_i + \beta_3 lw_i + v_i + u_i$$

where the variable *lcosts* is the log of the operating costs in millions of dollars and *lw* is the log of manufacturing wages. v_i is a random variable which is assumed to be iid. $N(0, \sigma_V^2)$ and independent of u_i, which is a non-negative random variable that accounts for technical inefficiency. u_i is assumed to be independently distributed as truncations at zero of the $N(m_{it}, \sigma_U^2)$ distribution, where $m_{it} = z_{it}\delta$. z represents the firm-specific variables. In the present case,

$$m_i = \delta_0 + \delta_1 D0 + \delta_2 D1 + \delta_3 D3 + \delta_4 C1 + \delta_5 O1$$

where the dummy variables are the same as defined in the OLS estimation. This model is called SFA–1LL. Alternatively, the cost function is estimated using the composite output

[13] A different source of information is used for Uruguay because the information available at the ILO for this country are indices and not monetary values.

as explanatory variable (SFA–2LL). The same equations are estimated using a translogarithmic specification (SFA–1TL and SFA–2TL).[15]

5.3 Data Envelopment Analysis

The three outputs defined (energy delivered, consumers and network length) are employed[16]. The input used is operating costs adjusted by PPP. Two specifications, which represent the underlying technology, are estimated: Constant Returns to Scale (CRS) and Variable Returns to Scale (VRS). The input orientation is chosen. This option is more appropriate when the firms provide a public service because they have an obligation to supply the demand.[17]

Although environment factors which account for density are not directly included in DEA estimation, the DEA scores adjust for customer density and for load density in the model specification. In fact, the customer density is considered because firms with relatively similar mixes of operating costs per network kilometre are compared. Load density is considered through the comparison of firms with relatively similar mixes of energy (GWh) per consumer.

5.3.1 Two-stage DEA

To investigate the determinants of efficiency, a regression is estimated in a second stage. Following the procedure suggested by Coelli et al (1998), the efficiency scores obtained in the DEA estimation are regressed against dummy variables that account for these

[14] The data used are in dollars and correspond in the majority of the cases to the year 2000. For some countries the information is not available for the year 2000. In these cases, the latest information is used and adjusted by the inflation.
[15] The software used is FRONTIER 4.1.
[16] Multicolinearity is not a problem for DEA as for regression analysis. In contrast, according to Pedraja Chaparro *et al* (1999), the loss of performance of DEA due to an increased number of variables, is reduced when these variables are correlated.
[17] The software used is DEAP 2.1.

effects. The model estimated is a Tobit (limited dependent variable) because the efficiency scores are censored[18]. The model estimated is:

$$es_i = \alpha_0 + \alpha_1 D_0 + \alpha_2 D_1 + \alpha_3 D_3 + \alpha_4 C_1 + \alpha_5 O_1 + e_i$$

where *es* is the efficiency score (assuming CRS) obtained from DEA and the dummy variables are defined as above.

6 Results

6.1 Analysis of ratios

Ratio analysis yields a preliminary view of the firms' performance before a more comprehensive measure of efficiency is used[19]. I compute three ratios: cost per consumer, cost per line and lines per consumer. Descriptive statistics such as the mean, the standard deviation, the maximum and minimum are presented in Table 1.

Table 1. Ratios

Ratios	Sample size	Mean	Standard deviation	Maximum	Minimum
cost per consumer	54	177	88	477	83
cost per line	54	3952	3519	18963	587
lines per consumer	54	82	73	350	11

In addition, a ranking is performed in order to compare the firms' performance. The rankings in ascending order are presented in Table 2.

[18] The efficiency scores are censored so that they cannot exceed one.

[19] Ratio analysis has several drawbacks. First, it does not consider the differences in the operating environments that exist between the distribution companies. Second, there are a large number of potential unit cost or other ratios and the result might be different according with which ratio is employed. If a firm uses several inputs to produce several outputs, these ratios do not seem to be good indicators of performance.

Table 2. Rankings by cost per consumer, lines per consumer and cost per line

	cost per consumer		lines per consumer		cost per line	
1	Peru - ELN	82,9	Argentina - EDESUR	11,1	Australia - Great Southern Energy	586,5
2	Peru - ENOSA	90,0	Bolivia - Electropaz	11,3	Australia - Advance Energy	597,5
3	N Zealand - Dunedin	95,6	UK - London	15,0	Australia - NorthPower	690,7
4	Bolivia - Electropaz	98,0	Peru - ELN	17,1	N Zealand - Network Waitaki	734,2
5	UK - Eastern	98,3	Chile - CONAFE	19,3	N Zealand - Centralines	745,7
6	Australia - Energy Australia	104,6	Peru - ENOSA	20,0	N Zealand - The Lines Co.	754,4
7	UK - Seeboard	104,9	UK - Seeboard	21,1	N Zealand - Top Energy	875,4
8	UK - Southern	106,5	Brasil - CEB	21,9	N Zealand - Alpine Energy	982,5
9	N Zealand - Waipa Power	109,9	Colombia - CODENSA	22,0	N Zealand - Waipa Power	1155,8
10	Chile - CONAFE	113,9	Peru - LDS	24,3	N Zealand - Northpower	1186,8

Cost per consumer is an indicator of the performance of the firm. But it is a partial measure of performance because other variables which may affect the performance are not considered. For instance, consumers' dispersion is not accounted for in this ratio. A high dispersion indicates higher costs per consumer while little dispersion implies smaller costs per consumer. [20] The dispersion is captured in the ratio lines per consumer. Indeed, many of the firms which appear as most efficient according to the cost per consumer ratio (ELN, ENOSA, Electropaz, Seeboard, CONAFE) are favoured by a higher concentration of consumers. In order to account for the effect of dispersion in the computation of a unit cost, the ratio cost per line is calculated. The ratio cost per line favours the firms with a higher network length. Firms which appear with the smallest cost per line are among the firms with higher lines per consumer. Thus, this ratio is capturing the dispersion of the consumers to a certain degree.

6.2 Ordinary least squares

First, it is important to verify that the regression equations are statistically valid and consistent with economic intuitions. The results for the log-linear specifications are presented in Table 3.

[20] As well as consumer dispersion other characteristics of the area supplied, which are outside the control of the manager, such as topology, climate, etc. influence the performance of the firm.

Table 3. OLS results (t statistics in parenthesis)

dependant variable: lcosts				
	OLS - 1LL	OLS - 2LL	OLS - 3LL	OLS - 4LL
intercept	4.77 (8.95)	-4.65 (-6.54)	-3.79 (-10.18)	5.03 (27.5)
lconsumers	0.85 (13.10)			
llines	0.12 (1.36)	0.23 (1.41)		
lenergy		0.79 (6.19)	0.95 (20.12)	
ladcons				1.02 (30.95)
adjusted R2	0.95	0.88	0.88	0.95
F	554.49	207.26	404.78	957.82
DW	1.87	0.67	0.67	1.50

In each case the coefficients have the expected signs. All the variables are significant except *llines*. The statistics (adjusted R squared and F) indicate that the models are good. Models OLS–2LL and OLS–3LL are discarded because the Durbin Watson indicates that we reject the null hypothesis of no autocorrelation of the residuals. Models OLS–1LL and OLS–4LL are well behaved. Two general heteroscedasticity tests (White and Breusch-Pagan) are performed, concluding that we cannot reject the null hypothesis of homoscedasticity of the residuals.

The log-linear specification is preferred to a linear specification for two reasons: i) it facilitates the interpretation of the coefficients (i.e. coefficients can be interpreted as elasticities) and ii) some heteroscedasticity problems are detected in the estimation in levels, which are absent in the log-linear specification.

In addition, when the log-linear model is estimated using energy as cost driver we find autocorrelation problems. Therefore, the preferred specifications are the log-linear specification with consumers and lines as cost drivers (OLS–1LL) and the log-linear specification with the composite output (OLS–4LL).

The efficiency scores are calculated for the two preferred specifications in order to compare the relative efficiency of the firms. The efficiency score is calculated as: $(observed\ \cos t - predicted\ \cos t)/predicted\ \cos t$). A firm with a negative score represents a firm with an efficiency greater than the average efficiency (the observed cost is lower than the average efficient cost). Annex C presents the efficiency scores and the rankings for the model with two outputs (OLS–1LL) and with the composite output (OLS–4LL).

6.2.1 Effect of regulation, competition and ownership

The effects of regulation, competition and ownership are evaluated including dummy variables in the two preferred specifications. The results obtained are presented in the Table 4.

Table 4. Effects of regulation, competition and ownership (t statistics in parenthesis)

dependant variable: lcosts				
	OLS - 5LL	OLS - 6LL	OLS - 7LL	OLS - 8LL
intercept	4.68 (6.53)	5.65 (16.05)	4.04 (7.08)	5.16 (25.37)
lconsumers	0.72 (9.19)		0.75 (10.04)	
llines	0.22 (2.07)		0.25 (2.52)	
ladcons		0.97 (16.02)		1.01 (34.91)
D0	-0.03 (-0.1)	-0.11 (-0.42)		
D1	-0.6 (-2.16)	-0.63 (-2.39)		
D3	-0.46 (-2.75)	-0.52 (-3.27)		
C1	0.03 (0.16)	-0.13 (-0.73)	-0.28 (-1.83)	-0.45 (-3.45)
O1	0.3 (2.48)	0.33 (2.98)	0.33 (2.67)	0.37 (3.28)
adjusted R2	0.96	0.96	0.96	0.96
F	199.89	250.66	310.45	422.47
DW	2.26	2.33	2.06	2.10

Observing the performance of models OLS-5LL and OLS–6LL, the coefficients have the expected signs and the statistics indicate that the models are good. Regarding the effect of the regulatory method, I find that the absence of regulation has no significant effect on cost level (*D0*). I find that the use of benchmarking techniques has the effect of reducing costs (*D3* negative and significant). This result agrees with the theoretical literature: strongest regulatory incentives imply lower costs. I find that *D1* is significant and has a negative sign implying that the firms which do not receive regulatory incentives but have to comply with competition law have lower costs. Regarding competition, I find that the existence of competition at the distribution level has no significant effect on cost level (*C1* not significant). Finally, regarding ownership effect, the dummy *O1* has a significant positive sign. This implies that private firms present higher costs. Although this result disagrees with the theoretical literature, it is in accordance with the previous empirical findings. Indeed, the previous empirical studies do not find evidence supporting the allegation that private firms are more efficient than public enterprises.

Both equations are estimated excluding the dummy variables *D* in order to assess the effect of competition and ownership separately and to see whether the non-significance of *C1* is robust. Models OLS–7LL (two outputs) and OLS–8LL (aggregate output) are well behaved. Regarding the effect of competition, I find that competition at the distribution level results in lower costs (*C1* negative and significant)[21]. The variable *O1* presents a positive sign, implying a positive relationship between private ownership and firms' costs.

6.3 Stochastic Frontier Analysis

The results obtained are presented in the Table 5.

[21] Since the t-ratios of the variables *C* increase with the omission of the variables *D*, the correlation of these variables is studied. It is important to indicate that the correlation is not high. In particular, the correlation between *C1* (competition) and *D1* (competition policy) is 0.40. Thus, it does not seem to be multicolinearity problems.

Table 5. SFA results (t statistics in parenthesis)

dependant variable: lcosts			
	SFA-1LL	SFA-2LL	SFA-1TL
intercept 1	-7.56 (-10.3)	-6.29 (-6.69)	-8.58 (-4.69)
lconsumers	0.83 (18.03)		0.89 (3.36)
llines	0.27 (4.32)		0.02 (0.05)
ladcons		1.07 (28.99)	
lw	0.43 (4.99)	0.42 (3.27)	1.18 (1.93)
cc			0.08 (6.68)
ll			0.11 (3.03)
ww			-0.01 (-0.41)
cl			-0.17 (-5.38)
cw			0.11 (7.10)
wl			-0.13 (-3.63)
intercept 2	0.81 (1.62)	1.13 (2.64)	0.23 (0.45)
D0	-0.07 (-1.43)	-0.11 (-0.29)	0.42 (0.62)
D1	-0.41 (-1.12)	-0.61 (-2.07)	-0.43 (-1.53)
D3	-0.71 (-2.21)	-0.62 (-2.55)	-0.79 (-2.39)
C1	-0.67 (-1.79)	-0.63 (-2.08)	-0.67 (-2.35)
O1	0.69 (2.00)	0.60 (2.62)	1.04 (3.67)

Observing model SFA–1LL, I find that the use of benchmarking techniques has the effect of reducing costs (*D3* negative and significant). I find a positive relationship between private ownership and cost level (*O1* significant and positive). In model SFA–2LL, both *D1* and *D3* present negative significant signs, which implies that the use of benchmarking techniques and the use of competition law have the effect of reducing costs. I find that competition at the distribution level has the effect of reducing costs (*C1* negative and significant). *O1* is positive and significant, implying a positive relationship between private firms and costs.

For the translog specification with two outputs (SFA–1TL), cc is the square of $lconsumers$, ll is the square of $llines$, ww is the square of lw, cl is the product of $lconsumers$ per $llines$, cw is the product of $lconsumers$ per lw and wl is the product of lw per $llines$. The variables consumers and wages result significant and have the expected sign. The variable lines is not significant. Regarding the firm-specific effects, I find that the use of benchmarking techniques has the expected effect (*D3* significant and negative). I find that competition at the distribution level has the effect of reducing costs (*C1* significant and negative). *O1* is statistically significant and has a positive sign, implying that private ownership is related with higher costs. The translog specification with the composite output is rejected because the labour cost presents a negative sign.

The computer programme calculates predictions of individual firm technical efficiencies. In the case of a cost frontier, the technical efficiency score takes a value between one and infinity. A coefficient equal to 1 means that the firm is efficient. The efficiency scores obtained for the translog specification with two outputs (SFA–1TL) are presented in Annex C. According to these results, six firms are on the frontier (Dunedin, The Lines Co., Energy Australia, Great Southern Energy, Eastern and Seeboard).

6.4 Data Envelopment Analysis

Table D-2 in Annex C presents the efficiency scores and the average efficiency obtained assuming CRS and VRS. According to the CRS DEA there are five firms on the frontier (Dunedin, Network Waitaki, ELN, Great Southern Energy and Advance Energy). The results show a considerable variation in efficiency scores ranging from 21% to 100%. The mean of the efficiency scores is 68.5%. CEB appears as the least efficient firm. The score obtained (0.21) indicates that the firm must reduce 79% its inputs to achieve the frontier.

When VRS are assumed, the number of firms on the frontier increases from five to nine. The same firms identified as efficient with CRS are still on the frontier. In addition, Centralines, Energy Australia, NorthPower (Australia) and Eastern are on the frontier with VRS. The mean of the efficiency scores increases to 73%. CEB appears again as the least efficient firm but it must reduce 77% its inputs to achieve the frontier. The difference in the inefficiency is explained by scale inefficiency.

6.4.1 Two-stage DEA

The results obtained are:

$$es_i = 0.68 - 0.12D0 + 0.18D1 + 0.25D3 + 0.02C1 - 0.24O1$$
$$(6.89) \quad (-0.79) \quad (1.79) \quad (2.67) \quad (0.22) \quad (-3.60)$$

The estimated slope coefficients may differ from the marginal effects. The marginal effects are calculated, obtaining:

$$es_i = 0.64 - 0.11D0 + 0.17D1 + 0.24D3 + 0.02C1 - 0.23O1$$
$$(7.07) \quad (-0.79) \quad (1.79) \quad (2.66) \quad (0.22) \quad (-3.61)$$

The sign of the coefficient indicates whether the variable increases or decreases efficiency. The results indicate a positive relationship between the strongest regulatory incentives (benchmarking techniques measured through *D3*) and efficiency levels. I also find a positive relationship between the application of competition law and efficiency levels. Regarding ownership effect, I find a negative relationship between private capital (*O1*) and efficiency levels. The signs of the variables *D0* and *C1* are the expected but they are not statistically significant.

6.4.2 Program evaluation

Program evaluation is used within DEA efficiency evaluation framework to identify differences in performance that can be attributed to the association of the firm with a particular group or program. In the present study this technique is used to evaluate the existence of efficiency differences between public and private firms. Following Brockett and Galony (1996), the Mann-Withney rank test is used. The statistic obtained is 5.30. Therefore, we do not reject the null hypothesis that the two programs (public and private firms) have the same distribution of efficiency scores at a significance level of 5%. This result agrees with Pollitt´s (1995) finding. The author finds that the public firms perform better than the private companies with the DEA estimation but he cannot reject the null hypothesis of no difference between both ownership types.

6.5 Consistency of the results

It is important to evaluate the existence of consistency between the results obtained with the different approaches. Following Rossi and Ruzzier (2001), the consistency conditions between the frontier techniques (SFA, CRS DEA and VRS DEA) are evaluated[22]. The correlation between rankings by each approach and the correlation between rankings by other performance measures (cost per line, per consumer and OLS estimation) are calculated. In addition, the correlation between rankings of best and worst firms is calculated. In summary, the analysis performed indicates that the techniques employed are consistent in their rankings, in the identification of most and least efficient firms and with other measures of performance.

7 Conclusion

In summary, the present study analysed the performance of electricity distribution firms, measuring the relative efficiency through an international comparison. The techniques employed include calculation of partial productivity measures, the traditional OLS estimation and the relatively new SFA and DEA approaches. A consistency analysis was performed, which indicates the robustness of the results regarding the technique used.

According to the three approaches (SFA, CRS DEA and VRS DEA) the frontier is dominated by small firms, mainly small New Zealand and Australian firms. The results agree with Jamasb and Pollitt (2001), who observe in a study of European countries in 1997-98, that the efficient frontiers tend to be dominated by firms smaller than the UK firms. Besides the predominance of small firms, two large UK firms (Eastern and

[22] The consistency conditions are proposed by Bauer *et al* (1998).

Seebord) are on the frontier according to the present study. This difference can be due to a change of the relative efficiencies over time or to the different sample used.

The main contribution of the present study is the assessment of the influence of the regulatory method, the firm's public or private ownership and the conditions of competition on the productive efficiency of the firms. This is the first attempt to do this. There are no previous empirical studies which evaluate the effect of these three characteristics on efficiency. The inclusion of the three characteristics together allows isolating the effects. The theoretical literature suggests, first, that firms which operate in a competitive environment (i.e. they have to compete for customers) are more productively efficient than firms which have captive customers. Second, that private firms are relatively more efficient than public companies. Third, that among the regulatory methods, the use of yardstick competition or benchmarking techniques gives the strongest incentives to the firms to be efficient.

With regards to the effect of competition, the results obtained in the present study confirm the view that a higher competition is related with lower costs. Firms which operate in a competitive environment are more productively efficient than firms which have captive customers.

Regarding the influence of the regulatory method, it is crucial to note the finding of a negative significant relationship between the strongest regulatory incentives (given by the use of yardstick competition or benchmarking techniques) and firms' costs, confirming the view of the theoretical literature. In addition, the present study finds a negative significant relationship between the use of competition policy and firm's costs. In the sample considered, New Zealand is the country where competition law is applied. At the same time New Zealand firms receive pressures from competition. This result agrees with the tendency towards reducing the regulatory intervention, relying more on competition law, as competition develops. As suggests the literature and confirm the empirical findings, competition improves productive efficiency, and thus, this may reduce the need for regulation.

Finally, concerning the effect of ownership, we do not find evidence that private firms are more efficient than public companies. A positive significant relationship between private firms and costs is found. This result is in accordance with the previous empirical studies, which do not find evidence of a higher efficiency of the private firms. However, according to the Mann-Withney rank test, we cannot reject the null hypothesis that the public and private firms have the same distribution of efficiency scores.

According to the theoretical literature, the firms which we should expect to be most inefficient are Ande (Paraguay), Ute (Uruguay) and Enelven (Venezuela) because they are unregulated public firms without competitive pressures at the distribution level. Observing the results obtained Enelven and UTE are identified as inefficient by the three techniques. Yet, Ande is less inefficient than expected. According to CRS DEA, Ande could reduce its inputs 23.3% but according to SFA it is very close to the frontier. This result may be explained by the omission of the quality of the service in the analysis. A public firm with no regulation and no competition may provide a poor service and thus incur in fewer costs, appearing as more efficient.

The study should be enhanced in some aspects. First, the last paragraph suggests that a further improvement to the present study would be the incorporation of a measure of quality of the service. The inclusion of this variable would be crucial since there is a trade-off between improving quality and reducing costs. Second, the issue of comparability of data is very important in an international comparison. Different data accountability in countries may influence the results. In order to benefit from this kind of comparison studies, coordination and cooperation between regulators to collect, exchange and make data comparable across countries is vital. Related with the availability of data, the possibility of increasing the sample size would improve the robustness of the results derived from the present study. Finally, the study could be improved by considering the development of unregulated activities by the firms and the effect of this on efficiency.

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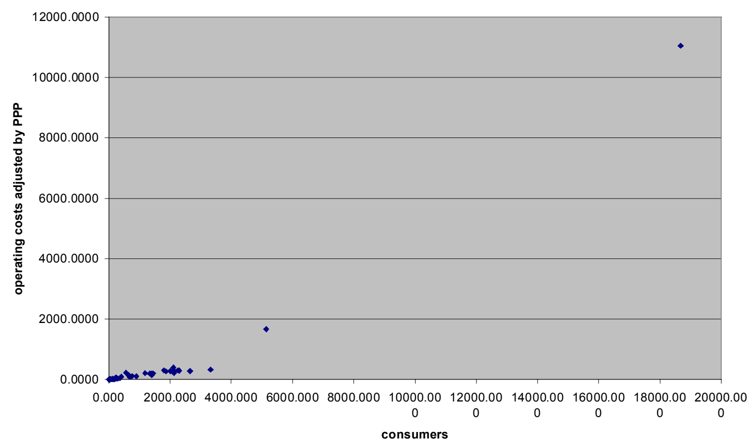
Annex A

Analysis of data

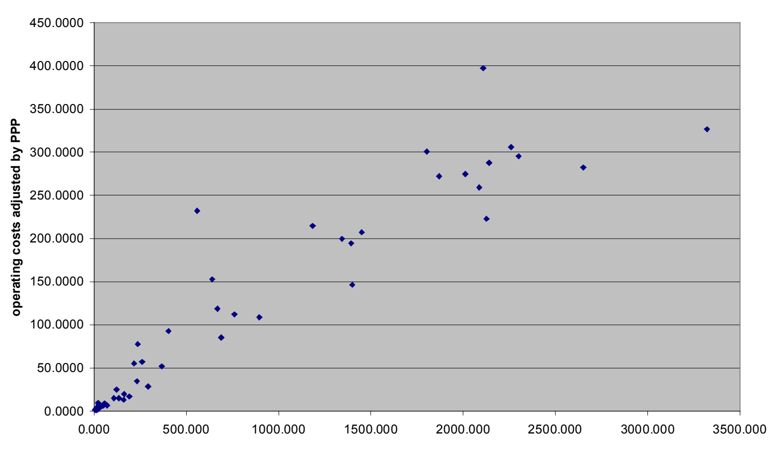
Graph 1 presents the relationship between operating costs (adjusted by PPP) and consumers when the whole sample is considered. It is possible to observe that all the firms are grouped together except two firms, which are much bigger than the rest. These are a Mexican firm (CFE) and a Brazilian firm (CEMIG).

Graph 1



Graph 2 shows the relationship between operating costs (adjusted by PPP) and consumers when these two firms are excluded from the sample. In this graph we can observe a positive relationship between costs and consumers and the dispersion of the firms is not too large.

Graph 2



Annex B

Table B-1 Firms´ classification according to competition, ownership and regulatory method

Firms	C0	C1	O0	O1	D0	D1	D2	D3
1 N Zealand - Alpine Energy		x	x			x		
2 N Zealand - Buller Electricity		x		x		x		
3 N Zealand - Hawke's Bay Network		x		x		x		
4 N Zealand - CentralPower		x		x		x		
5 N Zealand - Dunedin Electricity		x	x			x		
6 N Zealand - Horizon Energy Dist.		x		x		x		
7 N Zealand - Powerco		x	x			x		
8 N Zealand - Orion		x	x			x		
9 N Zealand - Marlborough Lines		x		x		x		
10 N Zealand - MainPower		x		x		x		
11 N Zealand - Counties Power		x		x		x		
12 N Zealand - Centralines		x		x		x		
13 N Zealand - Eastland Network		x		x		x		
14 N Zealand - Electricity Ashburton		x		x		x		
15 N Zealand - Network Waitaki		x		x		x		
16 N Zealand - Electricity Invercargill		x	x			x		
17 N Zealand - Northpower		x		x		x		
18 N Zealand - The Lines Company		x		x		x		
19 N Zealand - Westpower		x		x		x		
20 N Zealand - Waipa Power		x		x		x		
21 N Zealand - Top Energy		x		x		x		
22 N Zealand - Vector		x		x		x		
23 Argentina - EDESUR	x			x			x	
24 Argentina - EDEERSA	x		x				x	
25 Bolivia - CRE	x			x			x	
26 Bolivia - Electropaz	x			x			x	
27 Brazil - CEB		x		x			x	
28 Brazil - COSERN		x		x			x	
29 Chile - CONAFE	x			x				x
30 Paraguay ANDE	x		x		x			
31 Uruguay - UTE	x		x		x			
32 Peru - ELN	x		x					x
33 Peru - ENOSA	x		x					x
34 Peru - LDS	x			x				x
35 Colombia - CODENSA		x		x			x	
36 Venezuela - ENELVEN	x		x		x			
37 Australia - Energy Australia		x	x				x	
38 Australia - Integral Energy		x	x				x	
39 Australia - NorthPower		x	x				x	
40 Australia - Great Southern Energy		x	x				x	
41 Australia - Advance Energy		x	x				x	
42 UK - South Western		x		x				x
43 UK - Eastern		x		x				x
44 UK - Norweb		x		x				x
45 UK - Northern		x		x				x
46 UK - ScottishPower		x		x				x
47 UK - Hydro-Electric		x		x				x
48 UK - Midlands		x		x				x
49 UK - Seeboard		x		x				x
50 UK - Yorkshire		x		x				x
51 UK - Southern		x		x				x
52 UK - Manweb		x		x				x
53 UK - London		x		x				x
54 UK - East Midlands		x		x				x

Annex C

Ordinary Least Squares

Table C-1. Efficiency scores by OLS-1LL and by OLS-4LL

Company	OLS-1LL		OLS-4LL	
	Efficiency score	Ranking	Efficiency score	Ranking
1 N Zealand - Alpine Energy	-0,05	6	-0,06	4
2 N Zealand - Buller Electricity	0,10	53	0,09	52
3 N Zealand - Hawke's Bay Network	-0,01	27	0,00	28
4 N Zealand - CentralPower	-0,03	11	-0,03	13
5 N Zealand - Dunedin Electricity	-0,06	4	-0,06	2
6 N Zealand - Horizon Energy Dist.	-0,11	1	-0,03	15
7 N Zealand - Powerco	-0,02	21	-0,02	18
8 N Zealand - Orion	-0,03	13	-0,04	12
9 N Zealand - Marlborough Lines	0,11	54	0,11	53
10 N Zealand - MainPower	0,06	49	0,05	48
11 N Zealand - Counties Power	0,02	41	0,03	41
12 N Zealand - Centralines	-0,04	9	-0,05	6
13 N Zealand - Eastland Network	0,03	42	0,03	40
14 N Zealand - Electricity Ashburton	0,04	47	0,02	37
15 N Zealand - Network Waitaki	-0,07	2	-0,07	1
16 N Zealand - Electricity Invercargill	-0,04	8	-0,03	16
17 N Zealand - Northpower	-0,03	12	-0,04	10
18 N Zealand - The Lines Company	-0,04	10	-0,05	8
19 N Zealand - Westpower	0,07	50	0,06	49
20 N Zealand - Waipa Power	-0,06	3	-0,06	3
21 N Zealand - Top Energy	-0,02	17	-0,03	14
22 N Zealand - Vector	0,04	45	0,03	39
23 Argentina - EDESUR	0,03	43	0,04	47
24 Argentina - EDEERSA	0,07	51	0,09	51
25 Bolivia - CRE	0,05	48	0,07	50
26 Bolivia - Electropaz	-0,03	14	0,00	30
27 Brazil - CEB	0,10	52	0,11	54
28 Brazil - COSERN	-0,01	25	0,00	34
29 Chile - CONAFE	-0,02	19	0,00	36
30 Paraguay ANDE	-0,02	22	-0,01	23
31 Uruguay - UTE	0,02	38	0,03	38
32 Peru - ELN	-0,05	5	-0,02	21
33 Peru - ENOSA	-0,05	7	-0,01	24
34 Peru - LDS	0,02	40	0,04	46
35 Colombia - CODENSA	0,02	39	0,03	44
36 Venezuela - ENELVEN	0,04	46	0,03	42
37 Australia - Energy Australia	-0,03	15	-0,04	11
38 Australia - Integral Energy	0,00	30	-0,02	22
39 Australia - NorthPower	-0,02	18	-0,04	9
40 Australia - Great Southern Energy	-0,02	20	-0,05	5
41 Australia - Advance Energy	0,00	35	-0,05	7
42 UK - South Western	0,00	34	0,03	45
43 UK - Eastern	-0,02	16	-0,03	17
44 UK - Norweb	0,00	29	0,00	29
45 UK - Northern	0,02	37	0,00	35
46 UK - ScottishPower	0,00	33	0,00	32
47 UK - Hydro-Electric	0,04	44	0,03	43
48 UK - Midlands	0,00	32	0,00	27
49 UK - Seeboard	-0,02	24	-0,02	20
50 UK - Yorkshire	-0,01	26	-0,01	26
51 UK - Southern	-0,02	23	-0,02	19
52 UK - Manweb	0,00	31	0,00	31
53 UK - London	0,01	36	0,00	33
54 UK - East Midlands	-0,01	28	-0,01	25

Stochastic Frontier Analysis and Data Envelopment Analysis

Table C-2. Efficiency scores and rankings

Company	SFA -1TL		DEA CRS		DEA VRS	
	Efficiency score	Ranking	Efficiency score	Ranking	Efficiency score	Ranking
1 N Zealand - Alpine Energy	1,03	8	0,959	7	0,970	10
2 N Zealand - Buller Electricity	3,45	50	0,349	50	0,662	37
3 N Zealand - Hawke's Bay Network	1,35	23	0,601	37	0,603	38
4 N Zealand - CentralPower	1,25	20	0,772	22	0,783	25
5 N Zealand - Dunedin Electricity	1,00	1	1,000	1	1,000	1
6 N Zealand - Horizon Energy Dist.	1,53	30	0,858	16	0,914	16
7 N Zealand - Powerco	1,08	11	0,740	26	0,765	28
8 N Zealand - Orion	1,09	12	0,805	19	0,871	19
9 N Zealand - Marlborough Lines	3,81	51	0,238	53	0,242	53
10 N Zealand - MainPower	2,95	47	0,365	49	0,369	50
11 N Zealand - Counties Power	2,27	43	0,463	43	0,468	45
12 N Zealand - Centralines	1,16	17	0,866	13	1,000	2
13 N Zealand - Eastland Network	2,20	42	0,471	42	0,481	44
14 N Zealand - Electricity Ashburton	2,16	41	0,518	38	0,531	42
15 N Zealand - Network Waitaki	1,07	10	1,000	2	1,000	3
16 N Zealand - Electricity Invercargill	1,09	13	0,778	21	0,909	17
17 N Zealand - Northpower	1,43	27	0,860	14	0,864	21
18 N Zealand - The Lines Company	1,00	2	0,896	12	0,906	18
19 N Zealand - Westpower	3,05	48	0,380	48	0,390	49
20 N Zealand - Waipa Power	1,09	14	0,936	9	0,968	11
21 N Zealand - Top Energy	1,13	15	0,780	20	0,791	23
22 N Zealand - Vector	1,89	39	0,460	44	0,465	46
23 Argentina - EDESUR	2,14	40	0,460	45	0,519	43
24 Argentina - EDEERSA	3,40	49	0,283	52	0,299	52
25 Bolivia - CRE	3,81	52	0,343	51	0,358	51
26 Bolivia - Electropaz	1,74	37	0,860	15	0,921	15
27 Brazil - CEB	6,04	54	0,210	54	0,227	54
28 Brazil - COSERN	1,56	31	0,706	29	0,790	24
29 Chile - CONAFE	1,61	34	0,751	25	0,753	29
30 Paraguay ANDE	1,03	9	0,767	24	0,865	20
31 Uruguay - UTE	2,28	44	0,501	40	0,568	40
32 Peru - ELN	1,46	28	1,000	3	1,000	4
33 Peru - ENOSA	1,40	25	0,929	10	0,954	12
34 Peru - LDS	2,83	46	0,485	41	0,536	41
35 Colombia - CODENSA	1,72	36	0,508	39	0,585	39
36 Venezuela - ENELVEN	3,94	53	0,416	46	0,447	48
37 Australia - Energy Australia	1,00	3	0,990	6	1,000	5
38 Australia - Integral Energy	1,56	32	0,771	23	0,781	26
39 Australia - NorthPower	1,01	7	0,940	8	1,000	6
40 Australia - Great Southern Energy	1,00	4	1,000	4	1,000	7
41 Australia - Advance Energy	1,46	29	1,000	5	1,000	8
42 UK - South Western	1,82	38	0,608	36	0,674	36
43 UK - Eastern	1,00	5	0,913	11	1,000	9
44 UK - Norweb	1,22	19	0,677	30	0,738	30
45 UK - Northern	1,58	33	0,627	34	0,689	35
46 UK - ScottishPower	1,31	22	0,625	35	0,690	34
47 UK - Hydro-Electric	2,64	45	0,404	47	0,453	47
48 UK - Midlands	1,41	26	0,675	31	0,736	31
49 UK - Seeboard	1,00	6	0,848	18	0,933	13
50 UK - Yorkshire	1,21	18	0,729	27	0,796	22
51 UK - Southern	1,15	16	0,851	17	0,929	14
52 UK - Manweb	1,62	35	0,646	33	0,711	33
53 UK - London	1,38	24	0,667	32	0,727	32
54 UK - East Midlands	1,26	21	0,712	28	0,777	27