APPENDIX G – RWE Energy - Cost Benchmarking Techniques

Review of Benchmarking Techniques

Benchmarking techniques are increasingly used as an aid to regulating network utilities, particularly in the electricity sector. For example, regulatory agencies in the UK, the Netherlands, Austria and Scandinavia have attempted to apply these techniques in the last few years.

The purpose of benchmarking is to estimate the level of costs that a particular company might reasonably be expected to incur, given the conditions in which it operates, and its corresponding efficiency, by exploiting information about the costs of other companies.

Benchmarking uses a variety of quantitative techniques to estimate such "efficient costs". The most widely used techniques are the following:

- Regression-based techniques, such as Ordinary Least Squares (OLS) and Corrected Ordinary Least Squares (COLS);[1] and
- Techniques based on linear programming, such as Data Envelopment Analysis (DEA).

We now provide a brief description of these methods in turn below.

Regression-based techniques

The first step in using regression-based techniques is to define an equation which describes the relationships between a dependent variable (y, which represents a company's costs) and several explanatory variables (x_1, x_2, x_3, etc., representing the company's operating conditions and demand).

The technique then estimates a set of coefficients (a, b, c, d, etc.) applying to each variable and defining a line that "best fits" the data:

$$y = a + b \cdot x_1 + c \cdot x_2 + d \cdot x_3 + ...$$

Figure 1 shows a simple example of regression techniques with one explanatory variable (X).

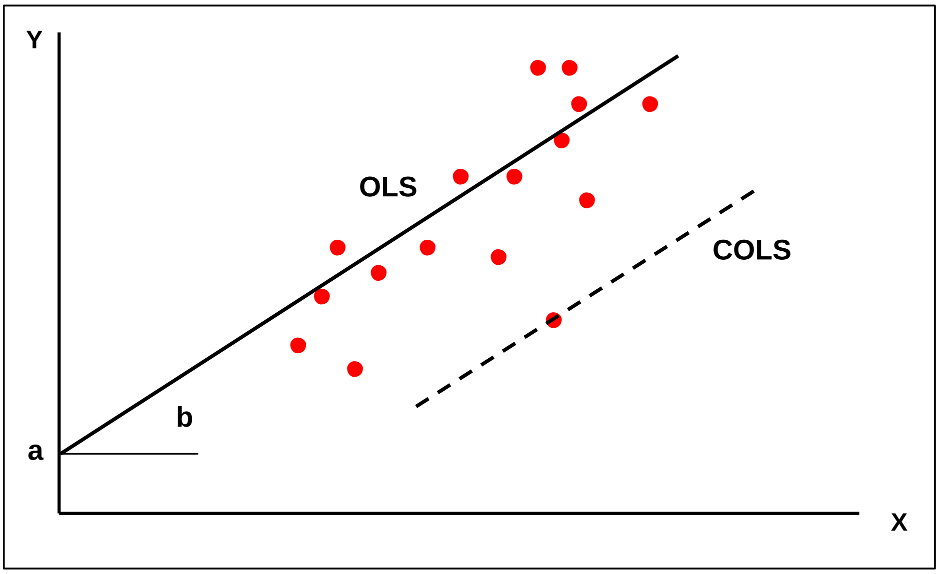
Each dot represents one company as the intersection of its output (X) and its costs (Y). The solid line (OLS) represents the "Ordinary Least Squares" regression line, which defines the average or expected value of Y (costs) for each value of X (output). It is defined by the intercept, a, and the gradient, b. Without delving into the details of the technique, it amounts to "drawing a line through the middle of the dots".[2]

Given the information available, the OLS line defines the costs that one would expect a company to incur, given its output. Some companies have higher costs (dots above the line) and some have lower costs (dots below the line).

Figure 1: Regression techniques – OLS and COLS

[1] Another common technique is stochastic frontier analysis (SFA). We do not discuss COLS or SFA further in this report.

[2] To be precise, the line represents the relationship which minimises the sum of the squares of the vertical distances between each dot and the line. Hence, the name of Ordinary *Least Squares*.



For the purpose of estimating “efficient costs”, however, some regulators have found this expected value unsatisfactory. According to their reasoning, if some companies achieve costs below this line, then the line cannot define the “frontier” of the most efficient cost levels.

To estimate “efficient costs”, therefore, they shift the OLS regression line until no company has lower costs – a method known as “Corrected Ordinary Least Squares”. COLS – represented by the dashed line in Figure 1 – keeps the same gradient as the OLS line (b), but changes the intercept (a) until no company lines below the line.

COLS is an extreme version of the regression technique, based on the presumption that the “lowest data point” defines efficient costs rather than simply being an outlier reflecting data measurement problems or other extraneous factors, and on the assumption that the estimated OLS gradient is still valid at the frontier.

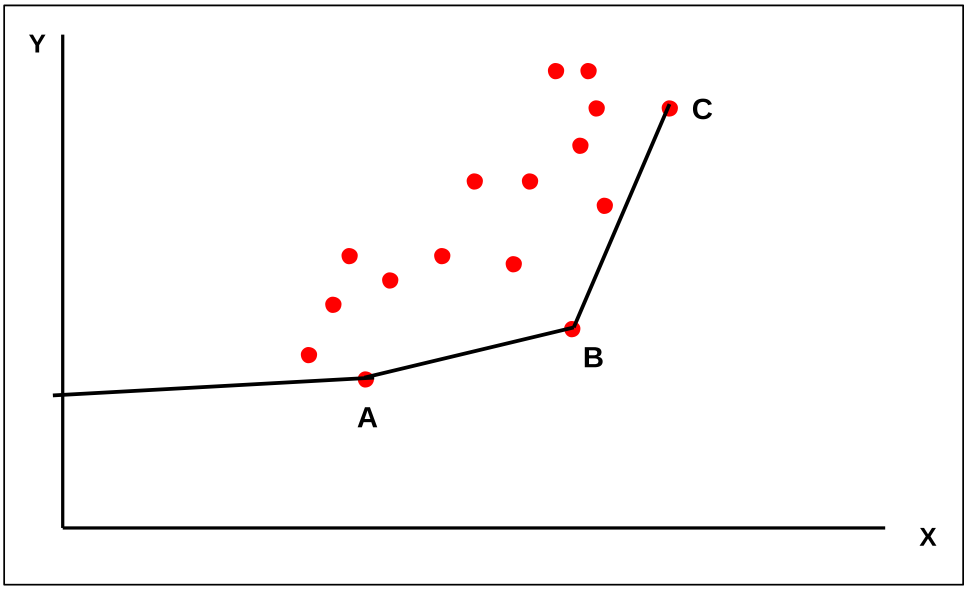
Data Envelopment Analysis

An alternative benchmarking methodology is known as Data Envelopment Analysis (DEA).

DEA is a “non-parametric” technique, as it does not begin with an equation and try to identify its parameters. Instead, the method uses linear programming techniques to draw an “envelope” around data observations, **as shown in Figure 2**. This figure plots each company’s costs (Y axis) in relation to its output (X axis). DEA would define the envelope ABC (the “efficiency frontier”), which joins up the observations with the lowest costs for given levels of output, or the highest output for given levels of cost.

Since the DEA technique relies on linear programming, it offers no statistical framework for modelling the performance of firms outside the sample, and cannot offer predictions on the effect of changes in any particular firm’s costs or outputs. Furthermore, DEA is unable to assess the relevance or significance of variables, and it is therefore necessary to make assumptions based on other criteria about which variables to use.

Figure 2: Data Envelopment Analysis – DEA



Drawbacks of benchmarking techniques

Both benchmarking techniques based on regression analysis (OLS, COLS) and linear programming (DEA) suffer from a number of drawbacks, which limits their usefulness for the regulation of firms' revenues.

One of the main problems for benchmarking techniques is that there are usually only a small number of observations available relative to the number of explanatory variables. For example, in the electricity sector the costs of an electricity distribution network depend upon a large number of factors, including the geographical characteristics of its service territory, the load characteristics of its customers and the company's history of load growth. None of these factors could be fully described without using a multitude of variables. However, the number of electricity distribution networks available within one regulatory regime is often 10-20, which is barely sufficient to produce useful results with a single variable regression, let alone multivariate analysis.

Also, networks are complex constructions offering multiple outputs. However, to conduct statistical analysis on the (usually) small number of regulated businesses, regulators must avoid specifying a model with too many variables. Alternatively, regulators can combine output variables into a single variable, as a way around this problem; however there is no theoretical basis which informs on the appropriate method for combining variables.[3]

The multiplicity and increasing complexity of these size measures shows the difficulty of trying to encapsulate something as complicated as "network size" in a small number of variables. Using a "composite size variable" to measure size in one variable hides the loss of statistical significance, but does not overcome the problem, which is due to the basic incompleteness of information.

The problem of small sample size can be overcome by using international comparisons as a way of increasing the number of companies. However, cross-border comparisons may require the inclusion of new variables, or the data may need to be normalised, to account for

[3] For example, in 1999 Ofgem created a "Composite Scale Variable" by calculating a weighted average of customer numbers, kWh delivered and line length. In 2004, instead, Ofgem adopted a Cobb-Douglas formula for combining the same variables.

cross-border differences in regulation, accounting standards, or other country-specific issues.

Data quality can be a major problem for benchmarking. Unlike the FERC Form 1 process in the US, the history of data standardisation does not have a long history in Europe and data on regulated networks tends to be compiled and presented in different ways that undermine the value of comparisons. For instance, different companies and regulators may take a different approach to any of the following issues:

- Defining the activities that lie within the scope of a network business;
- Allocating costs between the network business and other businesses owned by the same company;
- Defining operating expenditure (to be expensed), or capital expenditure (to be capitalised and depreciated) or defining the treatment of depreciation and return on assets (depreciation and return is an alternative to capital expenditure as a measure of capital costs);
- Defining output measures (e.g. network length).

Another potential drawback with the use of benchmarking techniques is the interpretation of results. For instance, the gap between the efficient frontier and any observation in DEA analysis if often regarded as “inefficiency”, i.e. as unnecessary costs caused by inefficient management of the company, and not due to the conditions in which the company operates. This interpretation is found in references to the “efficient frontier”, or to the “measurement of efficient costs” and “efficiency scores”. In fact, such references to efficiency and inefficiency presume too much.

Strictly speaking, the residual (i.e. the gap between observed costs and benchmarked costs) represents the costs that the model has “failed to explain”. The residual could, in principle, be due to any factor not contained in the model and, given a small sample size, benchmarking models cannot contain more than a few variables.

Unfortunately, it is never possible to claim with certainty that a benchmarking model captures every possible cost driver, and it is therefore misleading to ascribe the residual solely to “inefficiency”, or to describe the benchmark as a measure of “efficient costs”, when the residual may in fact reflect any number of problems with the data or model specification.

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