Cost Comparisons of Multinet and United States Gas Distribution Businesses Allowing for Operating Environment Differences

Prepared for
Multinet Pty Ltd

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Contact: Dr Denis Lawrence
Email: denis@meyrick.com.au
Phone: +61 438 299 811

Meyrick Consulting Group Pty Ltd (trading as Meyrick and Associates)
ABN 60 113 345 743
6 Kurundi Place, Hawker, ACT 2614, AUSTRALIA
TEL +61 2 6278 3628 FAX +61 2 6278 5358
EMAIL denis@meyrick.com.au
WEB www.meyrick.com.au

AUSTRALIAN CAPITAL TERRITORY NEW SOUTH WALES VICTORIA

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EXECUTIVE SUMMARY

The Essential Services Commission (ESC) is currently conducting a Gas Access Arrangement Review for 2008 to 2012. Multinet Pty Ltd has engaged Meyrick and Associates to compare Multinet's total costs and operating and maintenance expenditure (opex) efficiency with United States gas distribution businesses (GDBs), taking differences in operating environments beyond management control into account.

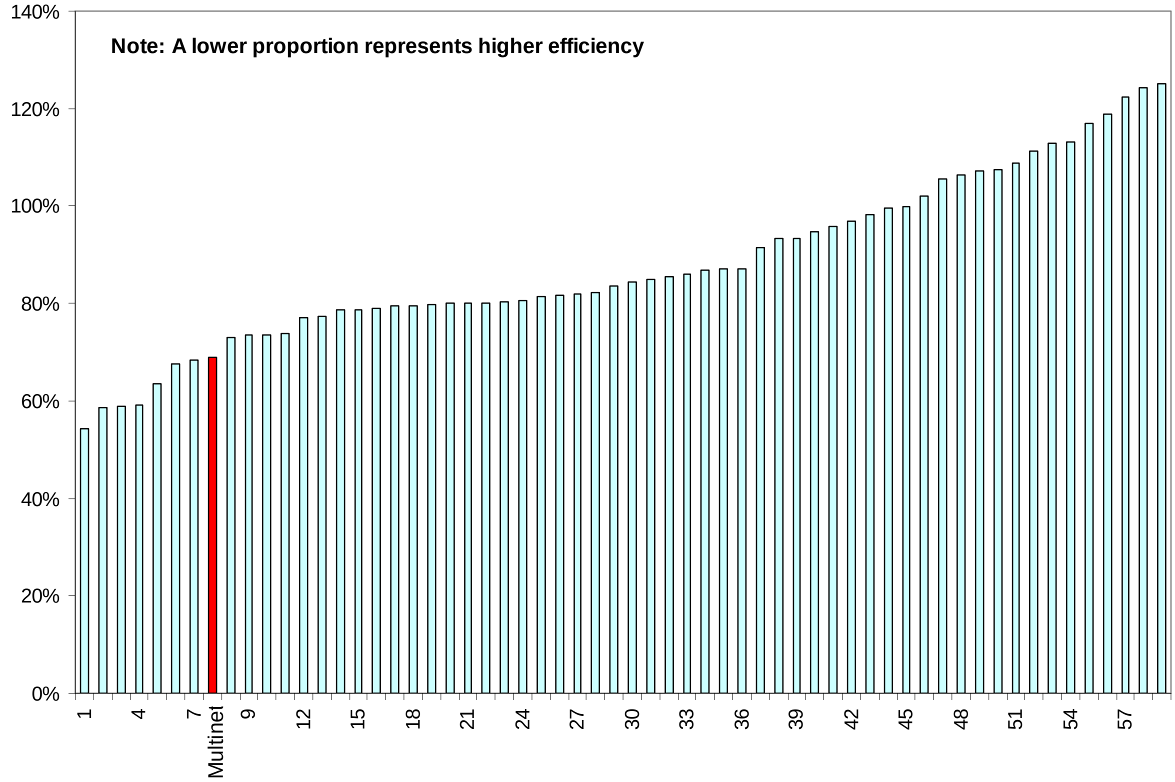
We estimate an econometric cost function model based on pooled data for 69 US GDBs and Multinet allowing for key operating environment differences including scale, customer composition and energy density. The US data spans the period 1996 to 2005 and the Multinet data spans the period 1998 to 2006.

The efficiency measure used in this study is the ratio of Multinet's actual costs to those predicted by the estimated cost function model for both total cost and opex. The costs predicted by the model are those applying to the firm of average efficiency in the sample, given Multinet's characteristics. The extent to which Multinet is more efficient than the average US GDB (if the US GDBs faced the same operating environment characteristics as Multinet) is indicated by the extent to which this efficiency measure is less than one.

The conclusion of this study is that Multinet is clearly more efficient in terms of both total costs and opex compared to the average of a large sample of US GDBs if those firms faced the same operating environment conditions as Multinet. The key findings are:

- Multinet ranked second most efficient in terms of total cost in the overall sample of 60 GDBs for the representative year, 2002, and eighth most efficient in terms of opex (see figure A).
- based on these results Multinet ranks in the top seventh of efficiency performers for both total cost and opex efficiency relative to US GDBs.
- in 2006 actual total costs for Multinet were 59 per cent of what the model predicted and actual opex was 82 per cent of what the model predicted.
- formal statistical tests indicated that Multinet had significantly lower total costs than the average US GDB in the database when difference in scale, technology and key operating environment variables are allowed for; and
- the efficiency conclusions were invariant to a range of sensitivity analyses including changes in assumptions regarding Multinet's cost of capital relative to the US GDBs and the use of actual exchange rates rather than the purchasing power parities used in constructing the database.

Figure A: **Multinet and US GDB opex efficiency – actual cost as a proportion of that predicted by the cost function model, 2002**



Source: Regression estimates using Meyrick GDB database

The results of this study are consistent with an earlier cost function study by Pacific Economics Group (PEG 2001b) which found that Multinet's actual 1999 opex costs were around 50 per cent of that predicted by their cost function model estimated for a total of 43 US GDBs. The US and Multinet databases used in the current study have been constructed independently of those used by PEG but our analysis comes to a similar conclusion, reinforcing the robustness of the finding.

1 INTRODUCTION

Multinet Pty Ltd operates a gas distribution business (GDB) in Victoria and has engaged Meyrick and Associates ('Meyrick') to conduct an econometric analysis of the efficiency of Multinet and United States GDBs. We compare Multinet's total costs and operating and maintenance expenditure (opex) with those of US GDBs using econometric cost function estimation and allowing for differences in operating environment characteristics to the extent data are available. This study is part of the information being compiled by Multinet for input to the Gas Access Arrangement Review for 2008 to 2012 being conducted by the Essential Services Commission (ESC).

Meyrick and Associates have provided regulatory and performance measurement advice to a wide range of regulators and infrastructure utilities in Australia, New Zealand and Canada over the past decade. The authors of this report pioneered the application of total factor productivity and efficiency measurement to energy supply in Australia.

The study presented in this report estimates a cost function based on pooled data for 69 US GDBs and Multinet allowing for key operating environment differences including scale, customer composition and energy density. It updates and expands an earlier cost function study undertaken for Multinet by Pacific Economics Group (PEG 2001b) which found that Multinet's actual opex in 1999 was only half that of the average US GDB if the US GDB operated under the same conditions as Multinet.

The following parts of this section of the report summarise the terms of reference for the study and list Meyrick and Associates' benchmarking experience and the qualifications of the consultants involved. In the following section of the report we outline the general methodology used in the study and the approach to efficiency measurement. In section 3 we provide a brief overview of previous studies comparing the efficiency of Australian GDBs to overseas GDBs. In section 4 we describe the database used and compare Multinet's characteristics to those of the included US GDBs. In section 5 we present the econometric results from estimating a translog cost function and in section 6 we draw conclusions regarding Multinet's total cost efficiency and opex efficiency relative to the average US GDB.

1.1 Terms of reference

Multinet's terms of reference to Meyrick requested an extension of the Meyrick GDB database to include overseas GDBs, notably the United States where energy utilities have to lodge set data every year with the Federal Energy Regulatory Commission (FERC). It was recognised that commercial data suppliers were likely to be the most practical source of data for the US but that Meyrick would be required to 'clean' the database to ensure only utilities focusing on distribution activities were included, that obvious data errors and inconsistencies were removed and that the available US data aligned as closely as possible with the Australian data in terms of definitions and coverage. Once the Australian/US database was formed Meyrick was requested to estimate a cost function model which would aim to provide information on where Multinet ranks relative to an average US GDB if it were faced with Multinet's operating environment conditions.

A copy of the letter of retainer for the study is presented in Attachment A.

1.2 Meyrick and Associates' experience and consultants' qualifications

Meyrick and Associates has been operating in Australia for 15 years as a specialist infrastructure consulting firm. Meyrick provides strategic policy advice and rigorous quantitative research to industry and government, particularly on infrastructure matters. Meyrick's experience and expertise covers a wide range of economic and industry analysis topics including:

- infrastructure regulation;
- benchmarking of firm and industry performance;
- productivity measurement;
- infrastructure pricing issues;
- corporatisation and privatisation of government enterprises; and
- analysis of competitive neutrality issues.

This report has been prepared by Dr Denis Lawrence, Director of Meyrick and Associates, with assistance from Meyrick Associates Dr John Fallon and John Kain.

Denis Lawrence has undertaken several major energy supply industry benchmarking studies including: benchmarking the performance of New Zealand's 29 electricity lines businesses and advising the Commerce Commission on appropriate X factors for each of the distribution businesses; benchmarking the performance of Australian and New Zealand gas distribution businesses for the Commerce Commission; benchmarking the productivity performance of the Australian state electricity systems against best practice in the US and Canada at both the system–wide level and for individual power plants; benchmarking the productivity, service quality and financial performance of 13 Australian electricity distribution businesses; and reviewing benchmarking work undertaken for regulators in NSW and Victoria. Denis has worked on regulatory issues for electricity utilities, regulators, state Treasury departments, international agencies and prospective investors.

Denis holds a PhD in Economics from the University of British Columbia, Canada. Denis' summary CV is presented in Attachment B.

John Fallon is an Associate of Meyrick and Associates and Director of Economic Insights. John has extensive experience in economic modelling, econometric techniques, cost–benefit analysis, discounted cash flow analysis, and performance measurement. He has also been an adviser on economic regulation issues in several major price determinations and regulatory hearings in relation to airports, electricity, gas, rail, seaports and water infrastructure, for both private and public clients. John has been an adviser on competition issues in relation to several high profile mergers in the airline, energy, wholesale and retail sectors. John holds a PhD in Economics from the University of Western Ontario, Canada.

John Kain is an Associate of Meyrick and Associates and Principal of Erldunda Associates. Prior to becoming a consultant John was employed by ACT Electricity and Water (ACTEW) as Chief Engineer and General Manager Engineering. Since leaving ACTEW, John has operated as an independent consultant in the energy distribution industry, specialising in the analysis of network costs and tariffs. John's clients have included the ACCC and distribution businesses. He has worked on several major benchmarking studies for Meyrick including assisting the NZ Commerce Commission with setting CPI–X thresholds for lines businesses. John holds Science and Engineering degrees from Sydney University.

Denis Lawrence has read the Federal Court Guidelines for Expert Witnesses and this report has been prepared in accordance with the Guidelines. A declaration to this effect is presented in Attachment C to the report.

2 BENCHMARKING METHODOLOGY

In this report we adopt the same econometric approach to benchmarking cost efficiency as that used by PEG (2001b, 2004a). In this section we provide a description of the method in general terms drawing on PEG (2001b, pp.3–5). In section 5 of the report we provide details of the specific functional form used in this study.

The methodology starts by positing that a firm *i*'s actual costs (C_i) are the product of its minimum achievable costs (C_i^*) and an efficiency factor ($efficiency_i$) as follows:

(1) $$C_i = C_i^* \cdot efficiency_i .$$

Minimum total costs will generally be a function of the various dimensions of output and the prices paid for the firm's inputs. Costs should increase as both outputs and input prices increase.

A simple linear in logarithms GDB cost function can be specified as:

(2) $$\ln C_{i,t}^* = a_0 + a_1 \cdot \ln N_{i,t} + a_2 \cdot \ln W_{i,t} + u_{i,t}$$

where N_i is customer numbers, W_i is the wage rate the company faces and $u_{i,t}$ is an error term.

Combining equations (1) and (2) we obtain:

$$\begin{aligned}\ln C_{i,t} &= \ln\left(C_{i,t}^* \cdot efficiency_i\right) \\ &= \ln C_{i,t}^* + \ln efficiency_i \\ &= \left(a_0 + a_1 \ln N_{i,t} + a_2 \ln W_{i,t} + u_{i,t}\right) + efficiency_i \\ &= \left(a_0 + efficiency^{average}\right) + a_1 \ln N_{i,t} + a_z \ln W_{i,t} \\ &\quad + \left[u_i + \left(efficiency_i - efficiency^{average}\right)\right]\end{aligned}$$

(3) $$= \alpha_0 + \alpha_i \ln N_{i,t} + \alpha_2 \ln W_{i,t} + e_{i,t}$$

where: we now have a relationship in terms of actual observed costs rather than (unobservable) minimum achievable costs; α_0, α_1 and α_2 are parameters to be estimated; and, $e_{i,t}$ is an error term. The α_0 coefficient now measures the efficiency factor for the average firm in the sample as well as the a_0 constant from equation (2). Similarly, the error term $e_{i,t}$ reflects both measurement error and differences between firm *i*'s efficiency factor and that of the sample mean.

By estimating the cost function (3) econometrically we can predict firm *i*'s costs given its output and the input prices it faces. For instance, the logarithm of Multinet's costs can be predicted as follows:

(4) $$\ln \hat{C}_{Multinet,t} = \hat{\alpha}_0 + \hat{\alpha}_1 \cdot \ln N_{Multinet,t} + \hat{\alpha}_2 \cdot \ln W_{Multinet,t}$$

where $\hat{C}_{Multinet,t}$ is Multinet's predicted cost in period t, $N_{Multinet,t}$ is Multinet's actual customer numbers in period t and $W_{Multinet,t}$ is its actual input price in that period. The $\hat{\alpha}_0$, $\hat{\alpha}_1$ and $\hat{\alpha}_2$ are estimated coefficients. The predicted cost thus incorporates the average efficiency of the sample through the estimated coefficient $\hat{\alpha}_0$. PEG (2001b, p.5) goes on to note that if the expected value of $u_{i,t}$ is zero then it can be shown that the percentage difference between Multinet's actual cost and that predicted by the model is equal to the percentage difference between Multinet's efficiency factor and that of the sample mean. That is,

(5) $$\ln\left(C_{Multinet,t} \Big/ \hat{C}_{Multinet,t} \right) = \ln\left(efficiency_{Multinet} \Big/ efficiency^{average} \right)$$

and this ratio can be used as a measure of the firm's cost efficiency performance.

An advantage of the econometric cost function approach to estimating firm efficiency is that as well as giving us the point estimate of efficiency from equation (5), we are also able to perform statistical tests of whether the firm's efficiency score is significantly different from that of the sample average firm.

PEG (2001b) note that the precision of efficiency estimates will improve as the:

- size of the sample increases;
- number of business condition variables in the model declines;
- business conditions of sample companies become more heterogeneous;
- business conditions of the company in question become closer to those of the typical firm in the sample; and,
- model is more successful in predicting the costs of the sampled companies.

The approach outlined here for forming estimates of total cost efficiency for a sample of firms can be readily extended to examine the efficiency of key cost components such as opex. An important advantage of forming these component cost efficiency estimates within the cost function framework is that interactions between different input components, such as opex and capital, are explicitly allowed for in the estimation process.

More details on the specific approach adopted in this report are presented in sections 4 and 5.

3 PREVIOUS GAS DISTRIBUTION EFFICIENCY STUDIES

There have been four major studies undertaken previously of gas pipeline efficiency performance in Australia. These are Bureau of Industry Economics (1994), IPART (1999) Pacific Economics Group (2001a,b,c) and Meyrick and Associates (2004). PEG (2004a) used a similar approach to the 2001 PEG studies but for two New Zealand GDBs.

Bureau of Industry Economics (1994)

While now somewhat dated, the Bureau of Industry Economics (BIE 1994) international benchmarking study was the first major comparative study of gas supply performance in Australia. It compared prices and technical efficiency of 42 utilities including five Australian utilities, 23 US utilities, nine Canadian utilities, four Japanese utilities and one UK utility. Technical efficiency was calculated using the quantity only version of data envelopment analysis (DEA) using energy deliveries and customer numbers as the outputs, employee numbers, distribution kilometres of mains and transmission kilometres of mains as the inputs and the number of degree days and customer density (customers per kilometre of main) as operating environment variables.

The BIE noted that input coverage was likely to be somewhat inconsistent due to varying amounts of contracting out between utilities and the unavailability of data on operating and maintenance expenses. No account was able to be taken of differences in pipeline age and construction methods (eg cast iron versus polyethylene).

Under the assumptions of constant returns to scale and no differences in operating environments, the Australian utilities were found to be around 20 per cent behind industry best practice. Canadian and Japanese utilities were found to be the most efficient on average. Including the operating environment condition variables of climate and density in the DEA analysis led to the Australian utilities increasing their then average efficiency score to 10 per cent behind best practice. The BIE study predated many of the major reforms that have taken place in the Australian gas distribution industry.

IPART (1999)

In 1999, the New South Wales Independent Pricing and Regulatory Tribunal (IPART) published a research paper titled *Benchmarking the Efficiency of Australian Gas Distributors*. Eight Australian GDBs were benchmarked against a sample of 51 US local distribution companies (LDCs) using the quantity only version of data envelopment analysis. Sensitivity testing of the DEA efficiency scores against efficiency scores derived from stochastic frontier analysis (SFA) and corrected ordinary least squares (COLS) was also undertaken.

The outputs included in the study were energy deliveries (in terajoules), residential customer numbers, the number of non–residential customers and the reciprocal of unaccounted for gas. The inputs included were the length of mains in kilometres and operating and maintenance expenditure. The number of heating degree–days and the age of the network were included as operating environment variables in a second stage Tobit regression.

The Australian GDBs were found to be around 27 per cent behind best practice on average. Multinet was found to achieve best practice while the least efficient of the Australian distributors was AGLGN (ACT) (the forerunner of ActewAGL) at 58 per cent behind best practice. IPART found that neither of its included operating environment variables of climate and density were statistically significant. It rationalised the climate result by stating that the higher demand for gas in the northern hemisphere is likely to be offset by higher input requirements to deal with the adverse climatic conditions.

Pacific Economics Group (2001a,b,c)

In 2001 PEG benchmarked the gas distribution operations of the three Victorian GDBs – Multinet, TXU (now SP AusNet), and Envestra – against its database of US gas utilities. The variables included in the analyses were:

- Number of gas delivery customers (outputs);
- Total gas throughput (outputs);
- Opex (inputs);
- Value of plant (inputs);
- Labour costs (inputs);
- Percentage of distribution miles in total distribution and transmission miles (operating environment);
- Percentage of distribution mains that are cast iron (operating environment);
- Percentage of electricity distribution capital in the gross value of distribution plant (operating environment); and
- Percentage of sales volume to non–industrial users (operating environment).

PEG benchmarked the opex performance of the Australian GDBs against those of 43 GDBs in the United States using a translog cost function model. PEG used standard regression techniques to compare the actual opex for the utility in question with that predicted by the model. The model predicted opex is that for an average utility after adjusting for the included operating environment conditions.

PEG found that Multinet's actual O&M cost was nearly 50 per cent below the model's point prediction, making Multinet a superior performer compared to the sample of US utilities.

Similarly, Envestra's and TXU's actual opex were 34 per cent and 28 per cent, respectively, below the model's predictions.

Meyrick and Associates (2004)

Meyrick undertook a comparative benchmarking study of Australian and New Zealand gas transmission and distribution pipeline businesses for the New Zealand Commerce Commission using data sourced from New Zealand and Australian regulatory data. The study used the multilateral TFP index method applied to 2003 data to obtain a snapshot of comparative performance. Cost efficiency comparisons were presented for 10 Australian and four New Zealand GDBs. The distribution model contained two outputs (throughput and customer numbers) and two inputs (operating and maintenance expenditure and capital measured by kilometres of main).

Undertaking proxy adjustments for both customer and energy density differences led to the productivity levels of the New Zealand GDBs being found to be around 21 per cent behind those of the Australian GDBs. The three Victorian GDBs were among the most efficient performers after allowing for operating environment differences.

Pacific Economics Group (2004a)

In 2004 PEG benchmarked the cost performance of two New Zealand GDBs, Vector and NGC, relative to a sample of 40 US gas distribution utilities for the period 1997–2002 using a broadly similar cost function methodology to that of its earlier Australian studies. PEG found that Vector's total cost was 21 per cent below the value predicted by the model and that NGC's total cost was 30 per cent below the value predicted by the model. In both cases the effect was found be statistically significant at the 99 per cent confidence level.

The 2004 study contained a number of changes relative to the methodology used in the earlier Australian studies. In particular, adjustments were made to the US historic cost asset values to bring them closer to the optimised deprival value method used in New Zealand and similar depreciation rates were to used to those applying in New Zealand. The New Zealand utilities were also included in the sample for regression estimation whereas the Australian GDBs had not been included for actual estimation in the earlier study.

4 THE DATABASE USED

To estimate a cost function model we require data on GDB costs, output quantity, input prices and key operating environment characteristics. We follow the approach of PEG (2004b) in using customer numbers to proxy GDB output quantity. Inputs are divided into two broad categories: opex and capital. PEG (2001b, 2004a) further divided opex into labour, and materials and services but there is inadequate information available for Australian GDBs to construct separate labour series and, given the prevalence of contracting out in Australia, the main interest is in total opex rather than its components. There is inadequate information available for US GDBs to follow the Meyrick and Associates (2007) approach to constructing multiple capital input components. Instead, we follow the PEG (2004a) approach of using an overall measure of capital input based on aggregate asset value. We include two key operating environment variables measuring customer composition and energy density.

4.1 Data Sources and Variables

This study uses data for 69 US gas distribution businesses and Multinet. The US data spans the period 1996 to 2005 and the Multinet data spans the period 1998 to 2006. Not all the US firms have observations available for every year but 8 of the 10 years have observations for at least 58 GDBs and the total number of US observations used in the econometric analysis is 580.

The US component of the Meyrick GDB database is based on data from Platts (2007) Energy Advantage service. Platts is a division of the McGraw–Hill group of companies which specialises in supplying energy industry data and associated services. The Platts data on individual gas businesses are assembled form a range of official sources including Federal Energy Regulatory Commission (FERC) Form 2 filings, Energy Information Administration (EIA) form 176 filings and Annual Reports to the individual state Public Utility Commissions.

There are a large number of firms in the US involved in the gas supply industry with a wide range of functional coverage. Some firms specialise in interstate transmission of gas while others provide a range of vertically integrated services from gas production through to end delivery to consumers. The original database contained around 1,250 firms identified as gas utilities involved in gas deliveries to customers but most were excluded at the first stage of data review because they were not involved in gas distribution or, if they were involved in gas distribution, they had less than 10,000 customers. This left a sample of just over 200 utilities for each of the 10 years. Following PEG (2004a, p.16) we then undertook a second stage of data review where additional firms were excluded because data were incomplete or did not appear to be plausible. This process led to our final sample size of 69 GDBs which includes 28 of the businesses previously included in the study undertaken by PEG (2004b) plus an additional 41 firms with substantial involvement in gas distribution.

The Multinet data are drawn from the detailed Victorian GDB productivity database reported in Meyrick and Associates (2007). Multinet data on opex, the depreciated optimised replacement cost value of the capital stock based on the original GHD asset valuation (reported in SKM 1998), energy deliveries and customer numbers, total distribution use of system charges, deliveries by customer type and energy density are used in this study. The construction of the Multinet database is described in detail in Meyrick and Associates (2007).

The opex cost used in this study includes distribution activities only and excludes all distribution capital costs and all retail related costs. It includes all directly employed labour costs, contracted services and materials and consumables costs associated with operating and maintaining the distribution network. The US data excludes administrative and general costs, and customer service costs including the costs of meter reading. Full retail contestability costs (which are principally meter reading costs) were excluded from the Multinet data. To the extent that some customer service and overhead costs are included in the Multinet data, Multinet will be at a relative disadvantage in the comparisons.

The US data include the cost of gas purchased for subsequent distribution. To ensure like–with–like comparisons, we have included a notional cost of gas purchased in the Multinet cost data based on the volumes it actually delivered but priced at a weighted average of the city gate gas prices for the included US GDBs. The weights were based on the volumes delivered by the included US firms and the city gate prices were obtained from EIA (2007).

The opex price index used for Multinet is the opex price index reported in PEG (2006). It is made up of a 62 per cent weighting on the Electricity, gas and water sector Labour price index with the balance of the weight being spread across five Producer price indexes covering business, computing, secretarial, legal and accounting, and advertising services. Minor adjustments were made to tailor the national index to Victorian conditions. Since the functions of electricity and gas distribution are broadly analogous, the PEG (2006) deflator is considered the best currently available for GDB opex as well. It has increased at an average of 3.5 per cent per annum over the last five years and this rate is used to extend the 2005 index value forward to 2006.

The opex price index for US GDBs is a weighted average of labour costs and the costs of purchased intermediate input services for utilities. The weights were 35 per cent for labour costs and 65 per cent for intermediate inputs. The weights were based on average weights for the period 1998–2005 for inputs used by utilities from the US Bureau of Economic Analysis KLEMS database (BEA 2007a, b). The labour cost data series was based on total compensation for all employees in the electricity, gas and sanitary services sector (Bureau of Labor Statistics 2002, 2004, 2006). The price index for other operating expenditure was based on the price index for utilities' purchased services from the KLEMS database (BEA 2007b). The differences in the weights for Multinet and the US reflect the fact that the Multinet labour cost index covers both direct and indirect labour whereas the cost of indirect labour is reflected in the cost of intermediate services purchased for the US firms.

The price index for capital relates to the user cost of capital services. It is the product of a price deflator for the capital stock and a gross return on capital which covers both depreciation and a return on capital.

For Multinet the capital price deflator is the implicit price deflator for the Electricity, gas and water sector net capital stock (ABS 2006). The gross rate of return was taken to be 10 per cent based on the Multinet average observed gross rate of return for the period 1998 to 2006. The gross rate of return is the residual of total distribution use of system revenue and opex divided by the depreciated optimised replacement cost of fixed assets.

For the US GDBs the capital price deflator is the implicit price deflator for the net stock of private fixed assets for Utilities (BEA 2007 c, d) and the gross return was 12.3 per cent based on the overall average of all included GDBs and years.

In order to calculate the gross rate of return for the US firms in the sample it was necessary to estimate the capital stock value in a form as analogous as possible to the depreciated optimised replacement cost concept used for Multinet. US utility asset values are reported in nominal depreciated historic cost values. We also have annual reported depreciation for the period 1989 to 2005. The main concerns with this form of capital stock value are that it does not take adequate account of the effects of inflation and the approaches to estimating depreciation are likely to vary considerably between the US firms in the sample and they may bear little resemblance to the economic depreciation approach adopted for Multinet. US asset values were, thus, constructed as follows. Firstly, the gross capital expenditure for each period was estimated as the difference in the reported net asset value from one year to the next plus the depreciation reported for that year. Next, a new estimate of the capital stock in 1989 constant prices was formed for the first year of the sample, 1996, based on the end of period asset value for 1989 (the first year this information is available for) plus real capital expenditure less economic depreciation. Economic depreciation is assumed to apply to all firms in the sample at the declining balance rate of 3 per cent per annum based on estimates of gas distribution weighted average asset lives. Estimates for each subsequent year up to and including 2005 were obtained using the same approach. The real asset values were then converted to nominal values using the implicit price deflator for the net stock of private fixed assets for Utilities. This approach is broadly similar to that reported in PEG (2004a).

The Multinet data in Australian dollars were converted to US dollars using purchasing power parities (PPPs). PPPs are the rates of currency conversion that eliminate differences in international price levels and are commonly used to make comparisons of both relative prices and real variables between countries. Separate PPPs were used for opex and capital costs. The PPP used for opex was that for GDP for Australia relative to the US (OECD 2007). The PPP for capital costs was based on that for construction fixed assets available for the benchmark years 1996, 1999 and 2002 for Australia relative to the US (OECD 1999, 2002, 2004). Estimates for the years between the benchmarks were based on interpolation and estimates for 2003–2006 were based on extrapolation using changes in the GDP PPP over that period. PEG (2001a,b,c) also used an OECD PPP to convert Australian dollars costs for Envestra, Multinet and TXU to US dollars.

The final variables included in the study are the two key operating environment characteristics of the percentage of throughput that is not industrial and not to electricity generators, and the average consumption per residential customer. The former measure provides key information on the GDB's customer composition and how important residential deliveries are relative to total throughput. The second measure captures the energy density of residential consumption and, thus, is a proxy for key climatic differences. Incomplete data on mains length for the US prevented inclusion of a customer density measure.

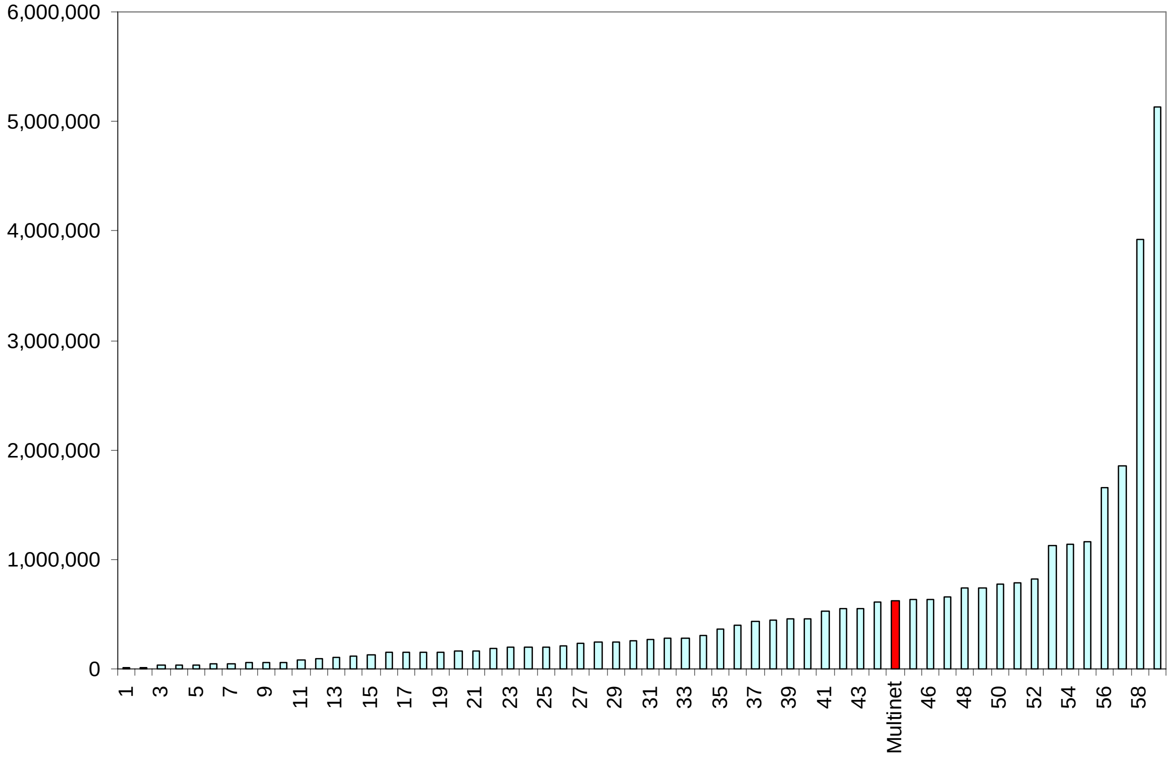
For Multinet gas energy throughput in terajoules was converted to thousands of cubic feet (Mcf) using a conversion factor of 934.2 Mcf per terajoule.

4.2 Characteristics of the GDBs

While some degree of variation in the data is desirable, and even necessary, in econometric benchmarking studies, more confidence can be placed in the results if the GDB we are benchmarking is not an outlier in the sample. It is, therefore, important to establish how Multinet compares to the sample of US GDBs in terms of size and key characteristics.

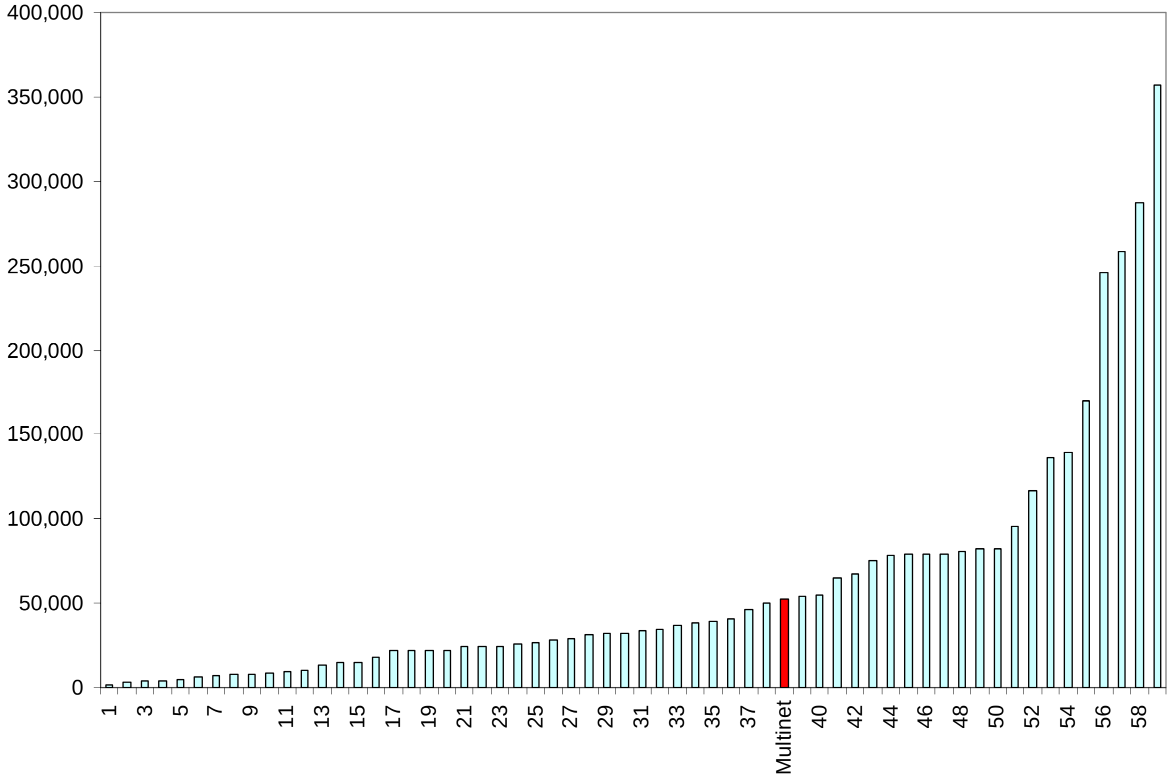
The primary output of customer numbers is plotted for all the GDBs in figure 1 for a representative year, 2002, in terms of increasing size. We can see that two of the US GDBs have considerably more customers than the rest of the sample but excluding these two relatively large GDBs, there is not a disproportionate spread of customer numbers. Multinet ranked sixteenth largest of the 59 included GDBs in 2002. It is, thus, well within the range of the data on this measure. Multinet's 620,000 customers was somewhat above the US sample average of 520,000 customers per GDB.

Figure 1: **GDB customer numbers, 2002**



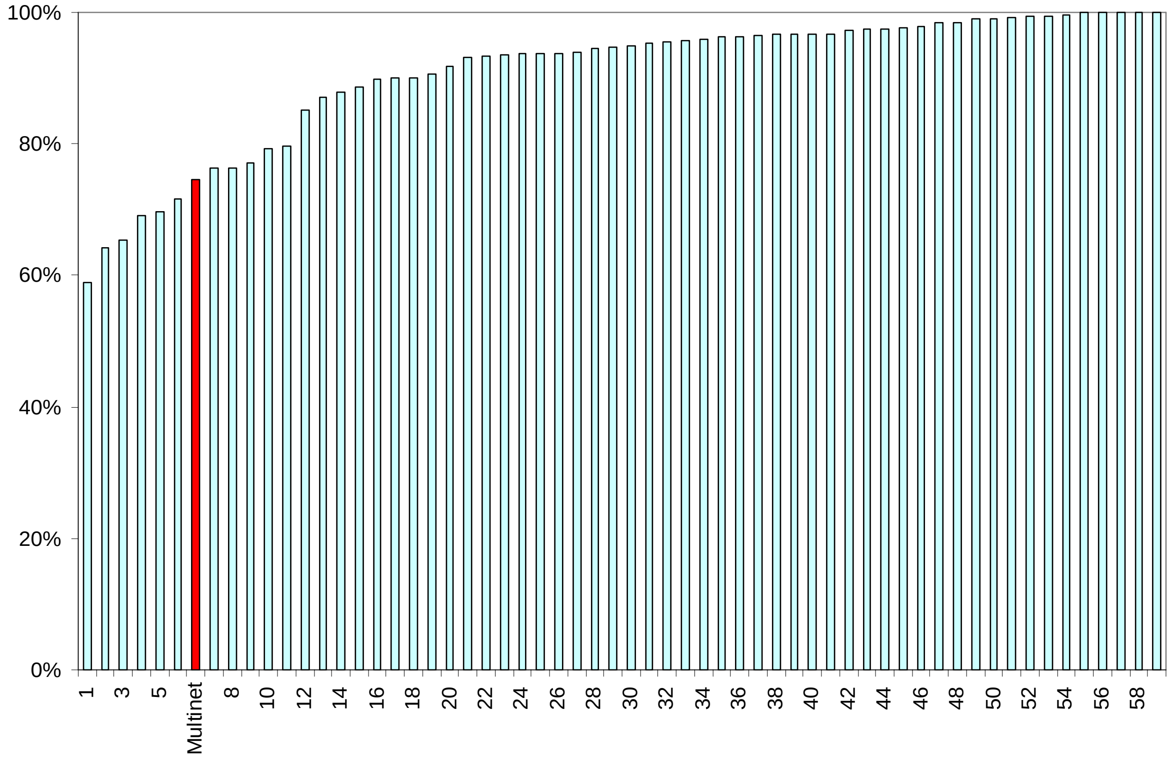
Source: Meyrick GDB database

Figure 2: **GDB throughput – MMcf, 2002**



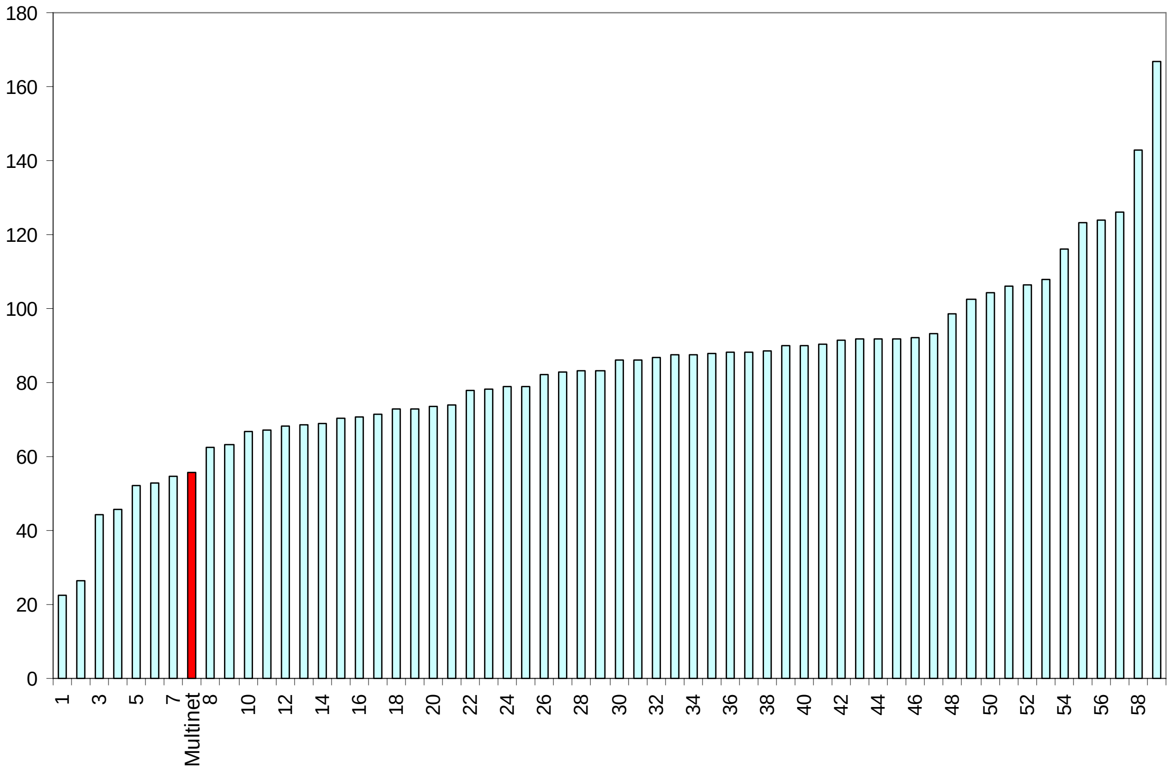
Source: Meyrick GDB database

Figure 3: **Proportion of non–industrial throughput, 2002**



Source: Meyrick GDB database

Figure 4: **GDB residential energy density – Mcf per customer, 2002**



Source: Meyrick GDB database

From figure 2 we see that Multinet ranks 22nd largest of the 59 included GDBs in terms of total throughput in 2002. It is again well within the range of the data on this measure. Multinet's throughput of 54,000 MMcf (million cubic feet) was somewhat below the US sample average of around 61,000 MMcf per GDB.

In terms of operating environment characteristics, we see from figure 3 that Multinet has a relatively low proportion of throughput that is not industrial (where industrial includes supplies to electricity generators) compared to the US sample. Around 75 per cent of Multinet's throughput is non–industrial compared to a US sample average of 89 per cent. Multinet has the seventh lowest proportion of non–industrial throughput of the sample of 59 GDBs.

Similarly, from figure 4 we see that Multinet has a relatively low residential energy density reflecting Melbourne's mild winter climatic conditions compared to many parts of the US. Multinet has the eighth lowest residential energy density at 58 Mcf per household compared to the US sample average of 88 Mcf per household. Multinet's residential energy density is only around one quarter of that of the highest included US GDB. All else equal, a higher residential energy throughput could be expected to reduce a GDB's costs for a given throughput as it will need less inputs to reach fewer households to supply that volume of throughput. Colder North American climates will typically be more conducive to better utilisation of gas distribution assets than the mild winter climates found in Victoria.

While Multinet lies well within the range of the US data on all these measures, its relatively low non–industrial throughput proportion and relatively low residential energy density mean that it is important to make efficiency comparisons on a basis that takes these operating environment differences into account.

5 THE COST FUNCTION RESULTS

5.1 Translog cost function methodology

In this study we estimate a translog cost function model for the pooled US GDB and Multinet data set and use the parameter estimates to make inferences about the efficiency of Multinet relative to the sample average. The translog cost function has been widely used in economic research and in regulatory hearings. It has the major advantage of being an approximation to a wide range of functional forms and is generally a robust functional form for empirical work. The economic theory that underlies the translog cost function also enables a number of parameter restrictions to be imposed that are economically sensible and that also facilitate estimation. In particular, linear homogeneity in prices is imposed (so that a doubling of all prices is reflected in a doubling of costs without any substitution effects occurring) and symmetry in the parameters of price terms is also imposed so that inputs respond in a symmetric manner to relative price effects.

This general approach to cost performance measurement is argued to have some advantages over alternative benchmarking methods (eg PEG 2001b, 2004a). One is that its effectiveness does not require a suitable peer group. The benchmark is based, instead, on the (included) business conditions that a company faces. For opex, an important advantage of the cost function approach is that it accounts for the possible substitution of capital for opex. This is because the opex prediction is derived from a comprehensive cost model that reflects potential opex–capital substitution.

Using the data described above we estimate a translog cost function that includes the following variables:

- output as measured by the total number of customers;
- an opex input price index;
- a capital annual user cost price index;
- the proportion of throughput that is not industrial (where industrial includes supplies to electricity generators);
- energy density as measured by total residential consumption / residential customers; and
- a time trend to capture structural and technological improvements.

The form of the cost function system estimated is as follows:

$$
\begin{aligned}
\ln C = {} & b_0 + b_Q \ln Q + 0.5 b_{QQ} \ln Q \ln Q + b_X \ln P_X + (1 - b_X) \ln P_K + 0.5 b_{XX} \ln P_X \ln P_X \\
& - b_{XX} \ln P_X \ln P_K + 0.5 b_{XX} \ln P_K \ln P_K + b_{QX} \ln Q \ln P_X - b_{QX} \ln Q \ln P_K + b_N \ln NI \\
(1) \quad & + 0.5 b_{NN} \ln NI \ln NI + b_{NX} \ln NI \ln P_X - b_{NX} \ln NI \ln P_K + b_{NQ} \ln NI \ln Q + b_E \ln ED \\
& + 0.5 b_{EE} \ln ED \ln ED + b_{EX} \ln ED \ln P_X - b_{EX} \ln ED \ln P_K + b_{EQ} \ln ED \ln Q + b_T \, TIME \\
& + b_{TT} \, TIME \times TIME + e_C \\
S_X = {} & b_X + b_{XX} \ln P_X - b_{XX} \ln P_K + b_{QX} \ln Q + b_{NX} \ln NI + b_{EX} \ln ED + e_X
\end{aligned}
$$

where 'ln' is the natural logarithm operator, *C*, *Q*, *X* and *K* represent total cost, output quantity, opex and capital, respectively. *P* and *S* represent the price and share in total costs of the relevant input, respectively, *NI* is the proportion of throughput that is not industrial or for electricity generation customers, *ED* is residential customer density, *TIME* is a time trend, and the *e* are the equations' error terms.

Restrictions are imposed on the different "*b*" coefficients as specified in equation 1 to ensure linear homogeneity of degree one in prices (ie if all prices double, cost should also double, all else being equal) and symmetry of relative price effects. The capital share equation is dropped to facilitate the estimation process. The results are invariant to which share equation is dropped for estimation purposes.

The model was estimated using Zellner's (1962) seemingly unrelated regressions estimator which has superior statistical properties compared to ordinary least squares in this situation. An iterative process was used which produces results equivalent to maximum likelihood estimation.

5.2 Results and cost comparisons

The regression results for the cost function estimation are presented in table 2.

The overall fit of the model is good and 9 of the variables are statistically significant at the (standard) 5 per cent level of significance. As expected, costs increase with increases in output. The results suggest decreasing returns to scale although 95 per cent confidence intervals would be large enough to encompass increasing returns to scale. The coefficient on the opex price variable indicates that opex and capital input prices are positively associated with costs and the effect is strongly statistically significant. The coefficient on the proportion of throughput that is not industrial suggests a negative impact on costs as the proportion of non–industrial throughput increases but the effect is only statistically significant at the 10 per cent level. The coefficient on the residential energy density variable also suggests a negative impact on costs, as expected, and the effect is statistically significant at the 5 per cent level of significance. The negative coefficient on the time trend indicates that costs decline over time and the effect is again statistically significant at the 5 per cent level of significance.

However, the highly significant positive coefficient on the squared time trend variable shows that the rate at which costs reduce, all else equal, diminishes over time. This provides robust evidence of the so–called 'convergence effect' whereby productivity growth progressively becomes constrained by the rate of technological change over time as other inefficiencies are removed.

Table 2: **Cost function regression estimates – United States and Multinet GDB Data**[1]

Coefficient	Estimate	t–statistic[2]	Coefficient	Estimate	t–statistic
b_0	7.152	3.730	b_{NX}	–0.027	–0.516
b_Q	1.303	6.552	b_{NQ}	0.068	0.935
b_{QQ}	–0.044	–3.916	B_E	–1.077	–2.206
b_X	1.139	3.613	B_{EE}	0.121	1.167
b_{XX}	–0.144	–1.057	B_{EX}	0.034	1.523
b_{QX}	–0.024	–3.956	B_{EQ}	0.061	2.318
b_N	–1.487	–1.734	b_T	–0.037	–2.162
b_{NN}	–1.068	–1.676	b_{TT}	0.014	4.423

1 R^2 between observed and predicted is 0.92

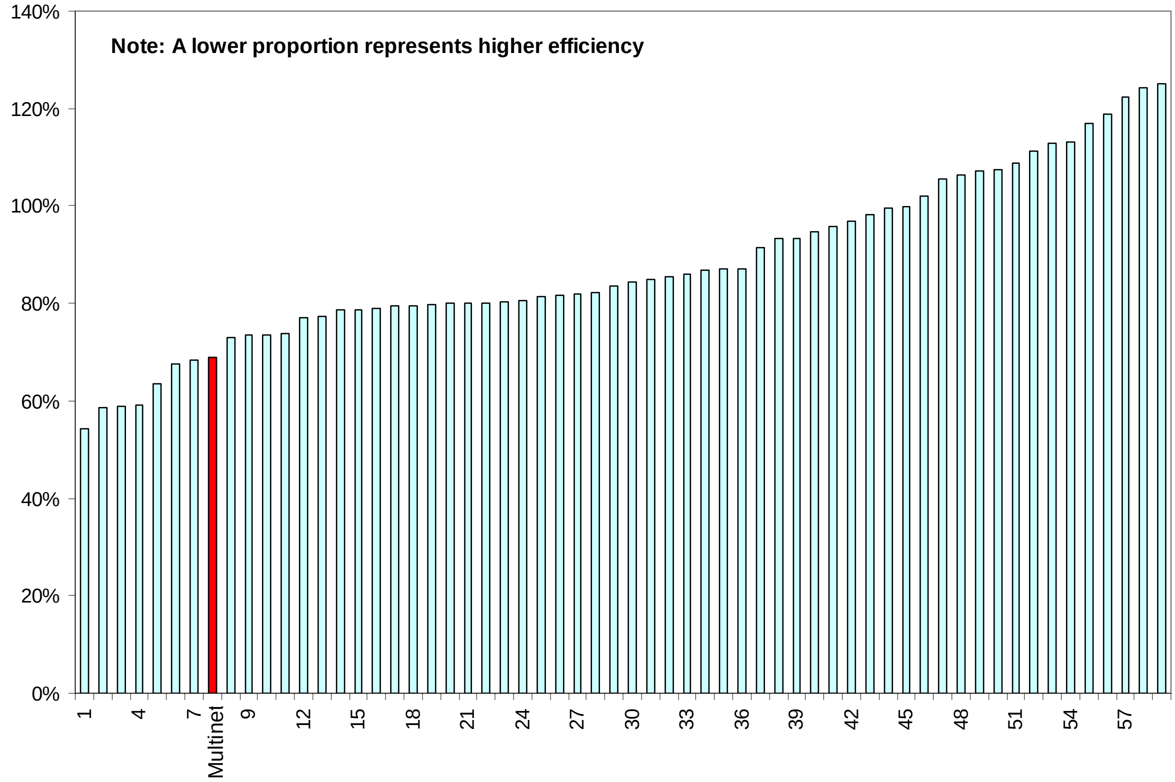
2 Critical t–statistics for testing are: 1.289, 1.658, 1.980 and 2.358 for the 20, 10, 5 and 1 per cent levels significance respectively. If the calculated t–statistic in absolute terms is greater than the critical t–statistic, the coefficient estimate is significant at the level of significance associated with the specific critical t–statistic. A 5 per cent level of significance is used as the standard measure and less than 1 per cent is considered to be a very high level of significance. Results at the 10 per cent level of significance are also considered to be statistically meaningful.

As demonstrated in section 2, we can calculate the efficiency of Multinet relative to that predicted by the model for an average US GDB facing similar operating environment characteristics to Multinet's by using the estimated parameters to predict the relevant cost for Multinet. The efficiency measure used is the ratio of actual costs to predicted costs for both total cost and opex. The extent to which Multinet is more efficient than the sample average (if other firms faced the same operating environment characteristics as Multinet) is reflected in the extent to which the efficiency measure is less than one. Conversely, if actual costs for a GDB are higher than those predicted by the model (ie the ratio is greater than one) then the GDB is less efficient than the sample average (if other firms faced the same operating environment characteristics as the GDB).

The estimate of Multinet's actual costs relative to predicted costs indicates that Multinet is clearly more efficient than the sample average for both total cost and opex. In 2006 actual total costs for Multinet were 59 per cent of what the model predicted and actual opex was 82 per cent of what the model predicted. This result is consistent with the earlier cost function study by PEG (2001b) which found that Multinet's actual 1999 opex costs were around 50 per cent of that predicted by their cost function model estimated for a total of 43 US GDBs. The earlier PEG study did not, however, present the corresponding estimate of total cost efficiency.

In this study Multinet ranked second most efficient in terms of total cost in the overall sample of 60 GDBs for the representative year, 2002. It ranked eighth most efficient in terms of opex as illustrated in figure 5. Based on these results Multinet ranks in the top seventh of efficiency performers for both total cost and opex efficiency relative to US GDBs.

Figure 5: **Multinet and US GDB opex efficiency – actual cost as a proportion of that predicted by the model, 2002**



Source: Regression estimates using Meyrick GDB database

To test whether Multinet's efficiency is statistically significantly different from that of the average US GDB, a t–test was undertaken by including a dummy variable in the regression that had the value one for Multinet and zero for all US GDBs. This allows us to test whether Multinet's cost after allowing for scale, price, operating environment effects and technology is significantly different form the average of the US sample. The test confirmed that total costs for Multinet were lower than the sample average at the 1 per cent level of statistical significance, providing strong statistical confirmation that Multinet had lower total costs than the average US firm in the database when differences in scale, prices, technology and key environmental variables are allowed for.

Sensitivity analyses were undertaken to test the sensitivity of the results to changes in key assumptions relating to the construction of the database and other explanatory variables. The conclusion that Multinet was more efficient than the sample average for both total cost and opex held in each of the scenarios examined. The use of a measure of total energy density (rather than residential energy efficiency) also did not affect the conclusion but was inferior statistically.

The two main scenarios that were tested were: using the same gross rate of return in the cost of capital for Multinet as for the US firms, ie a 12.3 per cent gross rate of return on the asset base; and, using actual exchange rates (obtained from RBA 2007) rather than PPPs. For each scenario and for both scenarios combined the predicted effects for total costs and opex were similar to those implied by the model when a 10 per cent rate of return on the asset base and PPP exchange rates were used. A t–test confirmed that total costs for Multinet were lower than the sample average at a 1 per cent level of statistical significance for the higher gross rate of return scenario and at close to a 10 per cent level of statistical significance for the exchange rate scenario. When both scenarios were combined the t–test confirmed that total costs for Multinet were lower than the sample average at a 5 per cent level of statistical significance.

6 CONCLUSIONS

The conclusion of this study is that Multinet is clearly more efficient in terms of both total costs and opex compared to the average of a large sample of US GDBs if those firms faced the same operating environment conditions as Multinet. Multinet ranked second most efficient in terms of total cost in the overall sample of 60 GDBs for the representative year, 2002, and eighth most efficient in terms of opex. In 2006 actual total costs for Multinet were 59 per cent of what the model predicted and actual opex was 82 per cent of what the model predicted.

This result is consistent with the earlier cost function study by PEG (2001b) which found that Multinet's actual 1999 opex costs were around 50 per cent of that predicted by their cost function model estimated for a total of 43 US GDBs. The US and Multinet databases used in the current study have been constructed independently of those used by PEG but our analysis comes to a similar conclusion, reinforcing the robustness of the finding.

ATTACHMENT A: LETTER OF RETAINER

Multinet GAS

321 Ferntree Gully Road
Mount Waverley Vic 3149
Australia

5 January 2007

Attention: Denis Lawrence
Director - Economics
Meyrick and Associates
6 Kurundi Place
Hawker ACT 2614

Dear Denis

Multinet Gas – 2008-2012 Access Arrangement Revision – Stage 3

Multinet Gas (Multinet) is required to submit a revised Access Arrangement on 30 March 2007. As part of this review Multinet is required to submit a forecast of costs for the 2008 – 2012 period inclusive.

The Essential Services Commission (the Commission) has issued Consultation Paper No1 and No2 for the purposes of providing the businesses with guidance.

1. You are asked to extend the databases of your previous work to include publicly available data for United States gas distribution businesses.

Specifically the work program involves expanding the range of utilities covered in the database to include overseas gas distribution businesses notably the United States where energy utilities have to lodge set data every year with the Federal Energy Regulatory Commission (FERC) and provide annual statistical reports to the American Gas Association. Estimation efforts for the larger database would most likely concentrate on estimation of cost function models – either the older translog form that PEG uses or the more recent generalised quadratic family of functions that have a number of estimating advantages.

You may be required to source commercial data sources that are available such as the Opri Natural Gas Local Distribution Company (LDC) Database. While this will reduce the data collection burden, you may also be required to 'clean' the database to ensure you are only including appropriate utilities focusing on distribution activities and that obvious data errors and inconsistencies are removed. This is particularly important given that the Commission's potential consultant would have good familiarity with the US data. Further work would then be required to ensure that the available US data aligned as closely as possible with the Australian data in terms of definitions and coverage.

Once the Australia and New Zealand/US database was formed you would then proceed to estimate a cost function model which would aim to provide information on where Multinet ranks relative to an average US gas distribution business if it were faced with Multinet's operating environment conditions.

A full report that fully documents the methodology used in detail and discuss the results obtained. They must be suitable for submission to the Commission if Multinet chose to use them in this way.

Multinet Gas (DB No. 1) Pty Ltd (ABN 66 086 026 986), Multinet Gas (DB No. 2) Pty Ltd (ABN 57 086 230 122)
trading as Multinet Gas Distribution Partnership (ABN 53 634 214 009)

As a result of comments made by the Commission in Consultation Paper No 1, it is important for your report to comply with the Federal Court Guidelines for Expert Witnesses (attached). Please read the attached Guidelines and ensure your report complies with the Code.

Summarise your experience and qualifications and attach your curriculum vitae.

Summarise your instructions and attach this letter of retainer.

In the introduction to the report, list the facts, matters and assumptions on which your opinion is based and the source of those facts, matter and assumptions.

Acknowledge that you have read the Guidelines.

List all reference material and information on which you have relied.

Identify any person and their qualifications, who assists you in preparing the report or in carrying out any research or test for the purposes of the report.

Include detailed reasons for your opinion.

Provide a summary of your opinions.

List any limitations, incomplete matters or qualifications to your opinion.

At the end of your report, you should include a declaration that you have read the attached Guidelines and that you "*have made all inquiries I believe are desirable and appropriate and that no matters of significance which I regard as relevant have, to the best of my knowledge, been withheld.*"

We look forward to hearing from you.

Yours faithfully

Andrew Schille
Access Arrangements & Pricing Manager

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ATTACHMENT B: CURRICULUM VITAE

Denis Lawrence

Director, Meyrick and Associates

6 Kurundi Place
Hawker ACT 2614
Australia
TEL +61 2 6278 3628
Email: denis@meyrick.com.au

For the past 20 years Dr Denis Lawrence has played a leading role in the regulation, benchmarking and performance measurement of infrastructure enterprises. He has advised Australian and overseas regulators and utilities on a wide range of quantitative and strategic issues in the energy, telecommunications, post and transport sectors.

Denis' consulting projects include advising the New Zealand Commerce Commission on the implementation of a leading–edge productivity based regulatory regime for electricity distribution; advising Australian electricity and gas distribution businesses on productivity measurement issues and their regulatory implications; advising the Commerce Commission on gas network benchmarking and regulation; reviewing the work of Australian regulators for utilities; advising the Australian Competition and Consumer Commission on incentive regulation in electricity supply; and, advising the Queensland Competition Authority on service quality incentives.

Denis has also advised electricity regulators and utilities in Canada, Saudi Arabia and Hong Kong.

Denis has developed a quantitative framework for calculating the distribution of benefits from a firm's productivity improvements among the key stakeholder groups of customers, employees and shareholders. He has applied this framework for leading telecommunications and transport firms.

Denis joined Meyrick and Associates in 2001. Prior to that Denis was Director of Tasman Economics' Canberra office and held senior executive positions in the Australian Bureau of Industry Economics and the Australian Industry Commission.

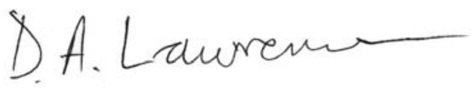
Denis holds a PhD in Economics from the University of British Columbia, Canada, and a BEc (Hons) from the Australian National University.

Recent Projects

- Total factor productivity modelling and benchmarking of gas distribution businesses
- Construction of total factor productivity models for electricity distribution businesses
- Advising the NZ Commerce Commission on the regulation of key gas distribution companies
- Critique of total factor productivity modelling of electricity distribution in Victoria undertaken by the Essential Services Commission and assessment of regulatory implications
- Econometric modelling of the operating and maintenance expenditure efficiency of electricity distributors taking operating environment differences into account
- Examining the effects of changes in the terms of trade and productivity growth on national welfare
- Advice to regulators and utilities in Canada, Hong Kong and Saudi Arabia on electricity tariff setting, incentive regulation and best practice pricing principles
- Benchmarking study of the operating and capital expenditure performance of 13 of Australia's 15 electricity distributors
- Total factor productivity modelling of the efficiency and profitability of electricity lines businesses for the NZ Commerce Commission
- Development of service quality incentive schemes for electricity distributors.

ATTACHMENT C: DECLARATION

I, Denis Anthony Lawrence, Director of Meyrick and Associates, declare that I have read the Federal Court Guidelines for Expert Witnesses and that I have made all inquiries I believe are desirable and appropriate and that no matters of significance which I regard as relevant have, to the best of my knowledge, been withheld.



Denis Anthony Lawrence

26 March 2007

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