

APPENDIX B

TELECOM NEW ZEALAND EFFICIENCY STUDY

**RESPONSE TO OXERA'S REPORT
'*EFFICIENCY ANALYSIS TO SUPPORT COST-
BENEFIT ANALYSIS*', SEPTEMBER 2003**

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IBM BCS

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1. Introduction

IBM Business Consulting Services are pleased to provide Telecom New Zealand (TCNZ) with a response to the paper written by Oxford Economic Research Associates (OXERA) on behalf of the Commerce Commission titled 'Efficiency analysis to support cost-benefit analysis'. OXERA's report was intended as a review of the work initially carried out by IBM BCS¹ which aimed to assess the relative efficiency of Telecom New Zealand (TCNZ).

OXERA state that TCNZ's inefficiency level requires an annual cost reduction of between 2.3% and 5.2% over a five year period to bring TCNZ's costs in line with best practice or full efficiency. This implies that, in effect, OXERA are stating the current inefficiency of TCNZ is between 10% and 23%. This result differs markedly from the inefficiency assessment provided by IBM which found TCNZ to be very efficient, with a level of inefficiency between 1.5% and 3% in comparison to the top decile.

This difference arises from a number of assumptions OXERA make about the treatment of TCNZ's costs and the econometric model used in the analysis.

In this document we explain why we believe that OXERA's results carry little weight since OXERA's analysis is based on a number of incorrect assumptions.

Section 2 provides an overview of our key points of disagreements with OXERA's critique, and section 3 then goes on to describe these points in further detail.

¹ Formerly known as PwC Consulting. At the time of conducting the original study the organisation was known as PwCC. Throughout this report we use the current name of IBM Business Consulting Services, or simply IBM.

2. *Overview of Key Points*

IBM believe that several of the criticisms OXERA have made of the initial study conducted by IBM are incorrect. The key points are summarized below:

- The cost of capital is an economic cost incurred by operators and should therefore be included in the analysis of a company's efficiency.
- The inclusion of cost of capital in the efficiency assessment does not provide incentives for underinvestment.
- Aggregating operating and capital costs is the correct method of assessing a firm's overall efficiency as it is total costs that are of interest.
- The marketing and billing international calls is carried out by the long distance operators in the US. These equivalent costs should therefore be excluded from TCNZ's cost base.
- To account accurately for the differences between TCNZ and the LECs in the provision of leased lines an adjustment needs to be made.
- Regarding the econometric model there are a number of alternative options with regard to the variable selection process and the specification of the functional form but these alternatives do not invalidate the approach originally adopted by IBM.
- Adjustments for differences in output levels can be made either through division of total costs by output levels or through adjustments based on the econometric model. Where the degree of homogeneity of the production function is close to 1 these approaches are close to equivalent.

These issues along with several other points raised by OXERA in their report are discussed in further detail in the section 3 of this report.

3. *Areas of disagreement*

The inclusion of the depreciation and cost of capital (p12, p13)

In their paper OXERA state²:

'It can be argued that this (a definition of capital cost to include depreciation and cost of capital) might be inappropriate in this case, since comparative efficiency requires economic data – i.e. data that reflects as accurately as possible the actual consumption and replacement of resources'

IBM disagrees with this statement. Both depreciation charges and cost of capital are true 'economic costs' since they reflect the cost that a company incurs in order to remain in business and as such should be included in the efficiency study. A company that is not able to meet the costs of servicing its debt will not remain in business. Further, companies need to be able to pay the cost of equity in order to attract capital from shareholders.

It is true, of course, that country specific differences in interest rates and in the cost of capital do not reflect the efficiency of operation. Therefore, a uniform rate of return on capital should be used across all operators and this approach was followed in our original analysis. However, the suggestion to ignore the costs of capital entirely is hardly conducive to increased accuracy and should be rejected.

We are not aware of any precedent where either cost of capital or depreciation has been excluded from an efficiency study. All previous studies including studies of both BT and Eircom used the same definition of total costs as that proposed by IBM:

Total costs = depreciation + cost of capital + operating costs

OXERA then go on to state that:

'Even when a robust standardization mechanism (for the adjustment of depreciation) is applied, this does not necessarily mean that the comparisons are like-for-like if the capabilities of the underlying assets in LECs and TCNZ differ markedly'

IBM agrees that such adjustment will not ensure that a truly 'like-for-like' comparison is made. However, the entire purpose of the efficiency study is not to make so many adjustments that all factors are 'like-for-like' as this will simply remove all ability to

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assess inefficiency. Differences in the capabilities of the underlying assets for should not be adjusted since they will form a key area reflecting the level of efficiency of the operator's operation. Over-investment would result in increased costs of capital whereas under-investment would lead to unacceptable QoS levels and/or increased OPEX. This tradeoff between OPEX and the size of the capital base is correctly reflected in the originally proposed and generally used cost measure which includes OPEX as well as both types of capital costs, namely depreciation and the cost of capital.

One should bear in mind that the efficiency studies are conducted to determine the level of cost based prices that should be paid by other operators to use the incumbent's network, e.g. interconnection, local loop unbundling, etc. These cost based tariffs always include a reasonable return on capital. All three components (opex, depreciation and cost of capital) form part of the interconnections charges payable. Hence, it is consistent to use the same measure of total costs as an efficiency benchmark. The exclusion of any of the three components appears highly arbitrary.

OXERA also state:

'there is a significant risk of double counting when depreciation is also included in the analysis...the inclusion of a cost of capital element in the analysis artificially increases the relative impact of the value of the asset base on the efficiency estimates'

While IBM agree that there is a high level of correlation between depreciation and cost of capital both are true economic costs and therefore have to be part of a valid efficiency analysis.

The argument that costs should be excluded simply on the basis that they are correlated with other costs is hardly tenable.

Incentives for under investment (p13)

OXERA state that the assessment of efficiency including the cost of capital provides incentives for under-investment: *"Lastly, the use of cost of capital in comparative efficiency analysis provides incentives for under-investment"*.

This claim may need some clarification. As a matter of fact, we struggled to make sense of the argument presented. OXERA seems to suggest that companies might defer investments because they understand that investments increase costs (through depreciation and cost of capital) and that high cost levels attract regulatory scrutiny of the operators' efficiency.

Whilst OXERA concedes that the same issue could be raised as an argument against the inclusion of depreciation they appear to suggest that excluding one of the two (i.e. cost of capital) solves at least part of the problem.

We have not been able to discover a valid argument here, for the following reasons:

- All firms considered in the study operate in a regulated environment where certain quality of service obligations must be met.
- The firms included in the analysis are all listed on the stock market and operate in a mix of competitive and non-competitive markets. As a result shareholders will drive for efficiencies and will be able to monitor the performance of the operators. The companies therefore have strong incentives to optimise their mix of capex and opex and to choose efficient investment levels (nor is there a risk of over-investment due to "gold plating" because regulated prices are likely to be based on bottom –up cost models, hence any costs of over-investment cannot be recouped).
- Profit maximizing firms have an incentive to reduce costs in order to improve profitability under regulatory constraints. Additional capital investment can be used to reduce operating costs (up to the point where the marginal rate of substitution is equal to one – see following point).
- It is highly unlikely that operators base their investment decisions on the inclusion of cost of capital in a regulatory efficiency study. Surely, profit maximizing firms limit their CAPEX to levels required to provide a level of service that meets regulatory requirements as well as customer expectations.

Marginal rates of substitution (p13-14)

In their report OXERA state:

*'Aggregating the various cost categories into a single measure by summing them is not necessarily optimal owing to the bias that could be introduced into the analysis as a result of assuming that the marginal rate of substitution between operating expenditure and CAPEX is equal to one'*³

We did not make any assumptions about the MRS between OPEX and CAPEX, and we do not believe that this point is valid.

In order to minimize costs each operator should ensure that it operates at the point where the marginal rate of substitution between operating costs and capital expenditure equals the relative price of these inputs as this point represents the lowest

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cost point of production. Otherwise, the operator acts inefficiently and the sum of capital costs and operating costs incurred exceeds the optimal level.

For these reasons, the straight (unweighted) sum of operating and capital costs is the correct measure to be used to assess the operators' levels of efficiency.

Use of DEA (p.9)

At several points in their paper OXERA advocate the use of data envelope analysis (DEA), a non parametric technique.

While IBM recognize that DEA does indeed have several advantage over parametric methods there are also a number of disadvantages:

- No framework to allow for data errors (or incompatibilities in the observed data which cannot be related to explanatory variables)
- Very sensitive to 'outliers'. The calculated frontier may be warped if the data are contaminated by statistical noise.
- Systematic over-estimation of inefficiency because the inclusion of outliers (where cost levels are low due to observation errors) would lead to a bias in that direction whereas the inclusion of outliers with observation errors that lead to an overestimation of costs would not impact on the analysis.

Although DEA can be a useful comparison tool to provide a cross check of results obtained from SFA or OLS analysis, it is generally not considered the optimal method. Indeed in previous studies (e.g. Eircom, BT) although DEA has often been carried out the focus has generally been placed on SFA results. As a result of this IBM concentrated on SFA in its paper on TCNZ's efficiency.

Interestingly despite their numerous comments on the potential advantages of DEA OXERA do not present DEA results in their report.

Economies of scale and scope (p.14)

Regarding cost adjustments, OXERA states that

“simply deducting costs relating to services not offered by TCNZ or LECs, respectively, does not ensure comparability since any potential economies of scale and scope that may exist are not taken into account. It is also possible that there are cross-subsidies between functions within each operator, which are not accounted for by the approach adopted.”

Whilst this argument is true in principle it is unlikely to be significant. The data of all operators in the sample suggests that there are no positive returns to scale (the degree of homogeneity of the estimated production function was just below 1). If there were significant economies of scope one should see much more merger activity between various types of operators.

OXERA do not propose and do not seem to have followed an alternative approach in relation to the removal of costs relating to services not provided by other companies.

Regarding cross-subsidies we fail to see the relevance of this argument. A cross subsidy between two products exists when revenues from one product are used to cover the costs of another (which may be provided below costs). However, such cross subsidies do not affect the cost levels of either product.

General and telecoms specific inflation rates (p.15)

The formula used by IBM to convert historical cost data into current accounting costs uses, as OXERA correctly states, a general inflation rate as well as a telecoms specific inflation rate. OXERA points out that the telecoms specific inflation rate needs to reflect price changes of telecoms assets in real terms – otherwise the general inflation rate would be double counted. In other words, the 'real telecoms inflation' figures measure the deviation of the telecoms specific price trend from the general price trend (inflation).

IBM takes this opportunity to confirm that, in line with the above, the telecoms inflation rates used in their analysis reflected the real price change of telecoms assets and did not include a general inflation element. OXERA concede in their report that this matter had already been clarified by additional information we provided in the course of the process.

Treatment of leased lines

Information on the number of 64k equivalent leased lines for each of the US LECs is not available from the FCC. Therefore it is necessary to infer the number of leased lines from the revenue information available. OXERA agree that the Teligen leased line information is an appropriate source of leased line prices.

In including leased lines in the output equation IBM use a measure of leased line ends:

Total no. of 64k equiv LL= 2*national 64k equiv LL + 1*international 64k equiv LL

This approach is the standard approach used in efficiency studies and accounts for the fact that the operator will incur twice the amount of costs in providing national leased lines where both end of the leased line need to be provided as in providing an international leased line where one end is provided by another operator.

We fail to see why OXERA seems to view this method as inappropriate. If an international leased line (half of which is provided by each of the two operators) were counted in the same way as national leased lines one would, in effect, double count international leased lines because any one of them is provided (in part) by two operators. Therefore, the approach based on a weighting factor should be more accurate.

OXERA also state that the aggregation of access lines categories into one measure is not appropriate. Again, this is the standard approach used that has been used by various consultancies and regulators in carrying out efficiency studies in the past.

Call durations (p19)

The US LECs do not report the number of calls for local and intra-LATA calls. Therefore it is necessary to derive the number of calls using the reported minutes and an average call duration.

IBM used the average call duration for inter-LATA calls as a proxy for the local and intra-LATA calls. This is the general practice when conducting an efficiency study and has been used elsewhere, for example in the study of Eircom completed by NERA on behalf of the Irish regulator. NERA state:

'These figures provide a unique average call length (for answered calls) for each US LEC. We have applied these call durations to local and intra-LATA calls ... While this is an approximation we would not expect it to produce figures that differ radically from reality'⁴

OXERA have not followed this standard method and state that they used a common average call duration for all the US LECs '*informed by the aggregate call minutes by type of call measure*'.

OXERA have not provided detail of the specific source used here or how call durations were calculated or 'informed' by this information. We would be grateful if OXERA could provide clarification of this point.

⁴ The comparative efficiency of Eircom, A report for the ODTR, August 2002, National Economic Research Associates, section 3.3.5, p35

Functional forms (translog, Cobb Douglas, etc.) p.21)

The report produced by OXERA points out that IBM used a 'production function' of the 'Cobb-Douglas' type – which is true. It then goes on to criticize this approach on the basis that this function is homogeneous to the first degree (which is not true) and therefore assumes constant returns to scale. Cobb Douglas functions are only homogeneous to the first degree if a restriction is imposed (or holds) that the coefficients sum up to one.

In our analysis we did not impose any condition on the powers or coefficients of the Cobb Douglas function but used the data to estimate these coefficients. Our estimated model has a R squared value⁵ of 98.7% indicating a good fit with the data. The coefficients resulting from our regression analysis sum up to 0.94. Hence the data suggests a slight variation from a constant returns scenario. The important issue is that the function used had the flexibility to deal effectively with returns to scale. The good fit suggests that the function used was sufficiently flexible. It should further be pointed out that Oftel repeatedly used this functional form in analysis the level of efficiency of BT's operations.

Variable selection mechanisms (p.21)

OXERA's report suggests that a 'general to specific' approach should be adopted in defining the econometric model and that a reverse process might be followed as cross check.

Under the general to specific approach all potential factors having an impact on an operator's cost level are included as regressors in the econometric model. In a series of regressions, the least significant regressors are successively removed.

The reverse of this process is sometimes carried out to cross check the results of the general-to-specific approach: each potential regressor is first tested individually and the most significant one is selected. Then the same process is followed with each of the remaining regressors, and so on until no further significant regressor is found.

The approach adopted by IBM comprised both versions. A general-to-specific approach was complemented by the reverse approach. The model with the best statistical properties was chosen.

The results from the two alternative approaches to variable selection coincide in many cases and we believe that they do so for the data set in question. We are in the process of verifying this issue.

⁵ Reflecting the fit of the model where 1 = perfect fit.

Multi-collinearity issue (p.21)

As OXERA point out multi-collinearity is introduced into the model if it contains the number of lines, the number of calls and the call minutes. OXERA further suggest that, in this case, multi-collinearity may not introduce significant inaccuracies into the model and therefore all three variables should be included purely on the basis of significance.

IBM believes that multi-collinearity in this case is very high because minutes are directly calculated from call numbers and, both numbers and minutes are strongly related to the number of access lines. However, IBM conducted the analysis for both cases, including and excluding call numbers and minutes. The inclusion led to higher efficiency levels and IBM decided to use the more conservative model that omits both of these regressors.

The claim that IBM's analysis is not based on traditional SFA approach (p.23)

OXERA suggest in their report that IBM did not follow a traditional SFA approach, on the basis that 'average costs' were used as opposed to 'minimum costs'. We would be grateful if OXERA could clarify what they mean by 'minimum cost' levels.

As a matter of fact, our analysis was not based on average costs. However, as companies differ considerably as to the size of their operations (output levels) an adjustment needs to be made to reflect this. There are two approaches that may be followed to achieve this and a number of precedents can be found for both.

The first approach (followed by IBM at the time) uses the total output level of each company as an adjustment factor, simply by multiplying each operator's cost level by an adjustment factor which, obviously, is given by the ratio of TCNZ's output level and the output level of the operator in question.

The second approach would simply include the output variables as exogenous factors in the regression analysis and the adjustment would be made based on the coefficients derived in the regression. Clearly, in the case of the study conducted by IBM the difference between the two approaches is unlikely to be significant because the production function is homogeneous to the degree 0.94 i.e. close to constant returns to scale. However, IBM is happy to rerun the analysis based on the other variant of the SFA analysis described above.

Alternative probability distributions for residuals (p23)

In considering the appropriate distribution for the residuals IBM considered a range of possible distributions including:

- Truncated normal distribution
- Half normal distribution
- Exponential distribution

The truncated normal distribution was used as it provided the best fit to the data.

Common ownership structure argument (p.10)

The OXERA report mentions that a number of the LECs are jointly owned and that this, arguably, might have some impact on their cost structure. OXERA continue to point out that this issue is unlikely to have a significant effect or to invalidate the analysis. On a theoretical level, this is borne out by much of the economic literature on horizontal integration (failing to show a clear cut case for or against integration based on arguments around cost savings). Further, this issue has never seemed to be viewed as a problem in other SFA studies in telecommunications which normally, if not always, rely on comparisons with the US LECs.

We therefore agree that the ownership structure does not introduce any significant or avoidable inaccuracies into the analysis.

Common frontier assumption (pp. 9 and 10)

OXERA point out that a comparative efficiency analysis requires the 'common frontier assumption' to hold. Under this assumptions all operators in the sample face the same operating conditions or production function, hence cost structures and levels are comparable. A number of factors are mentioned which, according to OXERA, might lead to deviations from the common frontier assumptions. The main ones are the length of time during which operators have been subject to regulation, the extent of competition, and privatization.

OXERA then concede that the differences between the LECs on the one hand and TCNZ on the other hand, if significant at all, would not invalidate the common frontier assumptions and rather manifest themselves as inefficiency.

We generally agree with this analysis and OXERA's conclusions, namely that (i) the analysis is not invalidated and (ii) no specific adjustments should be made for the

length of time during which operators have been subject to competition and/or regulation as these may act as a proxy for the extent to which efficiency improvement have already been realized in the past.

We would add that, as the US LECs have been subject to regulation and competition for a relatively long time and have been run as privatized and shareholder value maximizing companies our analysis compares TCNZ to what are likely to be some of the world's most efficient companies. Hence, any potential deviation from the common frontier assumption would only contribute to more conservative efficiency estimates of TCNZ.

Marketing and billing for national calls (p.16)

In the US national calls sales and marketing is carried out by the long distance carriers rather than by the US LECs. Therefore, while national minutes are included in the LEC minute and call volume, all the associated costs are not. In order to make sure that this fundamental difference between the US and New Zealand is taken into account it necessary to exclude TCNZ's national calls sales and marketing costs. This is standard practice and these costs have been excluded in other studies. For example:

*'For national RSB (Retail System Business), the incremental costs of retail activities ...were removed. This was done to reflect that fact that in the US these services are performed by AT&T and other IXCs for most national calls.'*⁶

We have only excluded marketing and billing for national calls rather than local calls as OXERA appear to believe. This is consistent with standard methods.

OXERA presents four sets of results, the final two differing only on the inclusion or exclusion of all sales and marketing costs. In model 3 OXERA include all sales and marketing costs for all operators. Here TCNZ is reported to be ranked 30th with inefficiency of 23%. This model is incorrect since the cost used for TCNZ includes costs the costs of sales and marketing for national calls whereas the cost for the US LECs does not.

OXERA's model 4 avoids this mistake by excluding marketing, customer service and billing expenses from the OPEX of every company. On this basis this is likely to be more accurate although it does then avoid assessing the efficiency of marketing, customer service and billing functions. TCNZ appears much more efficient using this method moving to rank 5 with inefficiency of 11% in OXERA's study.

⁶ The comparative efficiency of BT, prepared for Oftel, July 2000, National Economic Research Associates, section 4.2.2.3, p14

It is highly unlikely that differences in inefficiency of TCNZ's marketing, customer service and billing costs account for such a large overall efficiency difference. This supports the view that OXERA's decision to include national calls sales and marketing cost in model 3 is flawed.

Efficiency should be compared to the top decile

OXERA estimate that an efficiency improvement of 2.3-5.2% per annum over 5 years is required to make TCNZ efficient.

It is unclear what efficiency level OXERA are using as a base for this comparison. It is unrealistic to compare TCNZ to the efficiency frontier (i.e. the theoretical 100% efficiency level) as no operator has been able to achieve this level. In the past regulators have tended to compare the operator under consideration to the top decile of operators.

It would appear that OXERA have compared TCNZ to the best in class or the theoretical 100% efficiency level. IBM believes this is unrealistic as it may be influenced by errors in the results and will therefore overstate TCNZ's inefficiency. A comparison to the top decile of operators, in line with international best practice would be more appropriate.

Further, it should be noted that Telecom has a high ranking (1st, 3rd, 5th in three of the OXERA models, but 30th in one model that IBM notes is quite unreasonable). Therefore, the most reasonable conclusion to make (if the Commission/OXERA wishes to rely on the analysis conducted so far) would be that Telecom is operating at or near the efficiency frontier and, as a working assumption, there should be no scope for Telecom to make further efficiency gains.

4. Conclusion

IBM have reviewed the critique provided by OXERA in relation to IBM's original assessment of TCNZ's level of efficiency. This report sets out IBM's comments on the various issues raised by OXERA.

In a number of areas, in particular in relation to the precise specification of the econometric model there are a number of alternative options, e.g. with regard to the variable selection process, the way of adjusting for different output levels, and the specification of the functional form – but these alternatives do not invalidate the approach originally adopted by IBM and are likely to have a very limited impact on the results.

Other issues raised by OXERA are fundamentally flawed. OXERA has made a number of errors in its assessment, in particular in relation to the following points:

- Exclusion of the cost of capital from their analysis
- Lack of any adjustment to account for the difference between single end and double end leased lines
- The inclusion of the cost of marketing and billing international calls (this is carried out by the long distance operators in the US, not by the LECs).
- The comparison of TCNZ's efficiency level to a theoretical benchmark of 100% efficiency as opposed to the more realistic yardstick of the top decile.

We believe that these errors explain a significant proportion of the difference between OXERA's and IBM's results. Further, a number of issues raised by OXERA are either not relevant or not significant. At times this is conceded in OXERA's report (e.g. the matter of inflation rates, the ownership structure of the LECs, etc.).

In the light of these findings OXERA should revise its analysis – which would have the added advantage that the more precise costing information now available could be taken as a basis for this revised study.