Regulation of Electricity Lines Businesses, Analysis of Lines Business Performance – 1996–2003

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CONTENTS

EXECUTIVE SUMMARY

The Commerce Commission (2003) presented draft decisions on the form of price path thresholds to apply to electricity distribution lines businesses from 1 April 2004 and to Transpower from 1 July 2004. The Commission decided to retain the current CPI–X form of the price path threshold but proposed using a comparative approach to allocate distribution businesses to three groups, each of which would be assigned a different X factor. The X factors would comprise two components:

- a B factor, reflecting expected industry–wide improvements in efficiency, to be determined through total factor productivity (TFP) analysis; and
- a C factor, reflecting the relative performance of groups of distribution businesses, to be determined by a combination of comparative productivity analysis and comparative profitability analysis.

For Transpower, only the B factor would be applicable.

Meyrick and Associates has been engaged by the Commission to assist with developing the quantitative basis for implementing this comparative approach. Our initial report (Meyrick and Associates 2003) was released with the Commission's draft decision and presented the results of analysis based on the lines businesses' Disclosure Data for the period 1996 to 2002 with only those corrections to the data identified by the lines businesses up to that point.

Since the initial report was released in September 2003, an extra year's Disclosure Data has become available and the Commerce Commission has received submissions on its draft decisions. A conference was held in Wellington on 3–6 November 2003 where interested parties commented on the Commission's draft decisions and our initial report. This was followed by cross submissions from interested parties.

Changes since the initial report

As well as updating the database to include data for the 2003 financial year, we have made a number of changes to data for other years in response to more information that has become available. The analysis supporting the B factor now uses data covering the eight years 1996 to 2003 while the analysis supporting the C factors uses data covering the five years 1999 to 2003. The major changes include:

- Adjusting for reporting changes in 1999 – evidence presented in submissions and at the conference confirmed that the impacts of these accounting changes were confined to operating expenditure. In the current study we adjust for the 1999 accounting changes by applying the average change in the quantity of operating expenditure (ie in constant prices) observed in the two years on either side of the 1999 year to 1999.

- Adjusting for the 1999 Vector CBD outage – rather than attempting to exclude Vector, in the current study we assume that the indirect costs per connection figure reported by Vector for 1998 also applied in 1999 and 2000.
- MVA kilometre conversion factors – we incorporate revisions to the factors proposed by PBA (2003) to reflect specific New Zealand conditions and separate conversion factors for 11 kV, 22 kV and 33 kV high voltage distribution lines in place of the weighted average factor used in our initial report.
- Definition of deemed revenue – this now includes line charges ('RevLine2') plus revenue from 'other' business plus AC loss rental rebates less payment for transmission charges less avoided transmission charges less AC loss rental expense paid to customers. This removes double counting present in the initial report and excludes other operating revenue such as that from capital contributions.
- Data anomalies – a number of data anomalies have been identified and corrected in the database covering revenue, throughput, transformer capacity and operating expenditure.
- UnitedNetworks split up in 2003 – the assets of UnitedNetworks were acquired by Vector, Powerco and Unison in the second half of the 2003 disclosure year. Relevant data (for 2003 only) for these three distribution businesses have been scaled up to provide full year estimates incorporating their respective shares of UnitedNetworks.
- OtagoNet operations in 2003 – for the 2003 disclosure year, Marlborough Lines presented consolidated results for itself and OtagoNet (previously Otago Power), given its acquired 51 per cent share in OtagoNet. Because Marlborough Lines and OtagoNet are still distinct lines businesses for the purposes of the thresholds, disaggregated data for 2003 is included in the updated database.
- Definition of residual rate of return – as well as using the new definition of deemed revenue, we now deduct an estimate of tax equivalent payments so that the return is now tax adjusted in line with other regulatory measures. The tax equivalent payments deducted are actual taxes paid plus 33 per cent of subvention payments plus the interest tax shield.
- Transpower data – we have identified double counting of depreciation in the initial report but we have been unable to assemble reliable operating cost data.

B factor analysis

To capture the multiple dimensions of lines business output we measure distribution output in this study using three outputs: throughput, system line capacity and connection numbers. This has the advantage of incorporating the major density effects directly into the output measure.

Inputs are broken into five categories: operating expenses, overhead lines, underground cables, transformers and other capital. Transmission output is measured by throughput and system capacity and inputs by operating expenses, lines and transformer capital.

We use the Fisher total factor productivity (TFP) index method to calculate the productivity performance of distribution as a whole incorporating the data changes outlined above. For the period 1996 to 2002 aggregate distribution TFP increased at a trend annual rate of 2.1 per cent, 1.0 per cent above that for the economy as a whole. The trend incorporating the 2003 data is similar but as less confidence can be placed in the estimated operating expenditure data constructed for the full year equivalents of the three businesses which acquired UnitedNetworks half way through that year, we take the trend TFP growth rate up to 2002 as the most robust estimate.

There are several conflicting pieces of information on the movement of lines business input prices relative to those for the economy as a whole. Wage rates in the electricity, gas and water sector have increased by less than those for all industries in the nine years to March 2003 although the gap has narrowed somewhat in the last two years and anecdotal evidence points to a shortage of linesmen. Capital price indexes give conflicting information with one power line price index increasing faster than the capital price index for all sectors and the other major power line price index increasing less rapidly than the all sectors index. Producer price indexes, on the other hand, show that lines business input prices have increased less rapidly than input prices for all industries. The implicit total input price index derived from the distribution database increases at the same trend rate as economy–wide capital prices but substantially less than economy–wide wage rate and producer input price indexes. In light of the conflicting information coming through from the official statistics we recommend setting the price differential to zero.

Combining the 1.0 per cent productivity differential and the zero per cent price differential, we recommend a B factor of 1.0 per cent for distribution. At this time insufficient information is available to construct a robust TFP estimate for transmission over a long enough period for use in deriving a separate B factor for transmission. In light of this, and given that the Commission intends resetting Transpower's price path threshold for only one year, we recommend that the B factor derived for distribution also apply to transmission as an interim measure.

C factor analysis

The C factor analysis proceeds in two stages. The first stage allocates distributors to C factor groupings based on relative productivity performance while the second stage allocates them to groupings based on relative profitability. The sum of these components forms the C factor.

We use distributors' average multilateral TFP (MTFP) index scores for the five years 1999 to 2003 to form three productivity groups. A mixture of urban and rural based distributors with both high and low energy density is found to have the highest MTFP levels. Load growth and scale do not appear to be good indicators of a distributor's average MTFP level ranking with distributors with both high and low load growth being found near both the top and bottom of the rankings. Small and large distributors are also dispersed through the rankings.

We derive productivity based C factors (denoted by C_1) by dividing the distributors into groups of around one third each. These groupings generally coincide with step points in the average MTFP scores. We use groupings of 10, 12 and 7 distributors to define high, average and low levels of productivity, respectively, and allocate them initial C factors of –1, 0 and 1 per cent, respectively. These C factors are consistent with those required to bring the average distributor in the top and bottom groups to the same productivity level as the middle group average over 10 years and assuming the middle group's TFP increases annually at 1 per cent. A 10 year adjustment period is prudent for a capital intensive industry with long lived assets.

We derive profitability based C factors (denoted by C_2) by dividing the tax adjusted residual rate of return rankings into three groups based on distinct breakpoints between high, medium and low rates of return. This leads to groups of 10, 8 and 11 distributors being classed as earning high, average and low rates of return, respectively. These groups are allocated C_2 components of 1, 0 and –1 per cent, respectively. These components are designed to 'glide path' distributors earning high and low rates of return towards the average return deadband.

X factor recommendations

The X factors resulting from using aggregate distribution industry TFP and input price estimates relative to those for the economy as a whole to derive the B factor and the MTFP scores in conjunction with the tax adjusted residual rate of return estimates to derive C factors are presented in table A. For three distributors the C factor components sum to –2. Whereas these were capped at –1 in our initial report, we do not cap them in this report. When combined with the B factor of 1, this means these three distributors would be allowed to increase their real prices by 1 per cent per annum to restore their profitability levels.

There is a mixture of business types in each of the three broad X factor groups with urban and rural businesses appearing in each of the low, middle and high X factor groups. A total of eight distributors have changed groupings compared to our initial report. This is largely due to changes in profitability factors resulting from the move to tax adjusted residual rates of return and, in some cases, the correction of data inconsistencies in the Disclosure Data.

Table A: **X factor recommendations**

ELB	*B*	C_1	C_2	$C= C_1+C_2$	$X= B+C$	*ELB*	*B*	C_1	C_2	$C= C_1+C_2$	$X= B+C$
Centralines	1	0	1	1	2	Network Tasman	1	–1	1	0	1
Counties Power	1	0	1	1	2	Orion New Zealand	1	0	0	0	1
Eastland Network	1	1	0	1	2	UnitedNetworks[a]	1	–1	1	0	1
Electra	1	0	1	1	2	Westpower	1	1	–1	0	1
MainPower	1	1	0	1	2	Elec Invercargill	1	–1	0	–1	0
Marlborough Lines	1	1	0	1	2	Network Waitaki	1	0	–1	–1	0
Powerco	1	0	1	1	2	Scanpower	1	–1	0	–1	0
The Lines Company	1	0	1	1	2	The Power Company	1	0	–1	–1	0
WEL Networks	1	0	1	1	2	Top Energy	1	0	–1	–1	0
Alpine Energy	1	0	0	0	1	Unison	1	0	–1	–1	0
Aurora Energy	1	1	–1	0	1	Vector	1	–1	0	–1	0
Buller Electricity	1	1	–1	0	1	Northpower	1	–1	–1	–2	–1
Elec Ashburton	1	1	–1	0	1	OtagoNet	1	–1	–1	–2	–1
Horizon Energy	1	–1	1	0	1	Waipa Networks	1	–1	–1	–2	–1
Nelson Electricity	1	–1	1	0	1						

[a] UnitedNetworks included for information only.
Source: Meyrick and Associates estimates

Looking ahead to future regulatory resets, the priority for future work in this area is improving the quality and quantity of relevant data available. This involves requiring the disclosure of data on the price and quantity of all major outputs and inputs, including labour and broad asset categories. It also includes gaining more accurate information on the allocation of costs between the major output types. Much of the Disclosure Data currently required from businesses is not used for developing comparative performance measures that would be relevant for forming B and C factors. The usefulness of this data should be reviewed with a view to reducing the amount of data required and making its composition more relevant.

1 INTRODUCTION

Under subpart 1 of Part 4A of the Commerce Act, the Commerce Commission is required to set thresholds for the declaration of control in relation to New Zealand electricity distribution businesses and Transpower. The thresholds are, in effect, a screening mechanism to identify lines businesses whose performance may warrant further examination through a post–breach inquiry and, if required, control by the Commission.

The Commerce Commission (2003) presented draft decisions on the form of price path thresholds to apply to electricity distribution lines businesses from 1 April 2004 and to Transpower from 1 July 2004. The Commission decided to retain the current CPI–X form of the price path threshold but proposed using a comparative approach to allocate distribution businesses to three groups, each of which would be assigned a different X factor. The X factors would comprise two components:

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Meyrick and Associates has been engaged by the Commission to assist with developing the quantitative basis for implementing this comparative approach. Our initial report (Meyrick and Associates 2003) was released with the Commission's draft decisions and presented the results of analysis based on the lines businesses' Disclosure Data for the period 1996 to 2002. Using the Disclosure Data with only those corrections to the data identified by the lines businesses up to that point, aggregate distribution industry productivity was found to have increased at a trend rate of growth of 3.2 per cent per annum, 2.1 per cent per annum higher than the productivity growth rate for the New Zealand economy as a whole. Electricity, gas and water sector labour price indexes were taken as the most robust reflection of lines business input prices relative to those for the economy as a whole. This led to a price differential favouring distributors of 0.5 per cent per annum. Combining the productivity differential and the input price differential led to a B factor of 2.6 per cent per annum. The corresponding B factor for Transpower was 1.7 per cent per annum.

The initial report proceeded to form three C factor productivity groupings of distributors using multilateral total factor productivity (MTFP) indexes that allow productivity levels as well as growth rates to be compared. By using a three output specification covering throughput, system capacity and connections, the impact of the main density operating environment variables was included. The middle productivity group was allocated a C productivity factor of 0 while the above average group was allocated –1 and the below average group was allocated 1. Three C profitability factor groups were then formed using a pre–tax, residual rate of return derived from the productivity database. Those with average profitability levels were allocated a C profitability factor of 0 while the high profitability group was allocated 1 and the low profitability group –1. An overall C factor was derived for each distributor by summing its productivity and profitability factors but limiting the overall change to be no more than one in absolute value.

Since the initial report was released in September 2003, an extra year's Disclosure Data has become available and the Commerce Commission has received submissions on its draft decisions. A conference was held in Wellington on 3–6 November 2003 where interested parties commented on the Commission's draft decisions and our initial report. This was followed by cross submissions from interested parties.

The current report presents our updated and revised analysis taking in the 2003 Disclosure Data and additional information that have become available since our initial report.

The following section of the report reviews the rationale for using productivity results in forming the parameters of CPI–X regulation, the strengths and weaknesses of using measures of past industry TFP performance and overseas experience with using TFP in utility regulation. Section 3 examines the available estimates of New Zealand's economy–wide TFP performance and early estimates of lines business TFP. Section 4 reviews the data used in the current study and the main changes made since our initial report. In section 5 we present estimates of overall distribution industry TFP and separate transmission TFP estimates for Transpower. We also review input price changes for the electricity industry and the economy as a whole. Based on this information we then derive the implied B factors for distribution and transmission lines businesses. In section 6 we investigate the performance of the 28 distribution lines businesses existing in 2003 using multilateral TFP indexes. We then introduce a revised residual rate of return measure as a means of allocating the businesses to three profitability groupings before forming overall C factor estimates for each business. Finally, conclusions are drawn in section 7.

2 THE USE OF PRODUCTIVITY IN THRESHOLD SETTING

The principal objective of CPI–X thresholds is to mimic the outcomes that would be achieved in a competitive market. Competitive markets normally have a number of desirable properties. The process of competition leads to industry output prices reflecting industry unit costs, including a normal rate of return on the market value of assets. Because no individual firm can influence industry unit costs, each firm has a strong incentive to maximise its productivity performance to achieve lower unit costs than the rest of the industry. This will allow it to keep the benefit of new, more efficient processes that it may develop until such times as they are generally adopted by the industry. This process leads to the industry operating as efficiently as possible at any point in time and the benefits of productivity improvements being passed on to consumers relatively quickly.

Because infrastructure industries such as the provision of the electricity network are often subject to decreasing costs, competition is normally limited and incentives to minimise costs and provide the cheapest and best possible quality service to users are not strong. The use of CPI–X thresholds in such industries attempts to strengthen these incentives by imposing similar pressures on the network operator to the process of competition. It does this by constraining the operator's output price to track the level of estimated efficient unit costs for that industry. The change in output prices is 'capped' as follows:

(1) $$\Delta P_O = \Delta P - X \pm Z$$

where Δ is the mathematical symbol for 'proportional change in', P_O is the maximum allowed output price, P is a price index taken to approximate changes in the industry's input prices, X is the estimated productivity change for the industry and Z represents relevant changes in external circumstances beyond managers' control which the regulator may wish to allow for. There are several alternative ways of choosing the index P to reflect industry input prices. Perhaps the best way of doing this is to use a specially constructed index which weights together the prices of inputs by their shares in industry costs. However, this price information is often not readily or objectively available, particularly in regulatory regimes that have yet to fully mature. A commonly used alternative is to choose a generally available price index such as the consumer price index or GDP deflator.

In choosing a productivity growth rate to base X on, it is important that the productivity growth rate be external to the individual firm being regulated and instead reflect industry trends at a national or even international level. This way the regulated firm is given an incentive to match (or better) this productivity growth rate while having minimal opportunity to 'game' the regulator by acting strategically. External factors beyond management control that the regulator may wish to allow for in the Z factor include changes in government policy such as community service obligations and tax treatment.

Drawing on Kaufmann and Lowry (1997), the framework that underlies the CPI–X approach can be illustrated as follows. The objective is to have the proportional change in industry revenue (R) tracking the proportional change in industry costs (C):

$$(2) \qquad \Delta R = \Delta C.$$

But mathematically the proportional change in revenue is approximately equal to the sum of the proportional changes in its component parts, prices (P) and quantities (Q):

$$(3) \qquad \Delta R = \Delta P + \Delta Q.$$

Rearranging (3) we have:

$$\begin{aligned}(4) \qquad \Delta P &= \Delta R - \Delta Q \\ &= \Delta C - \Delta Q \qquad \text{using (2) above;} \\ &= \Delta UC\end{aligned}$$

where UC is the industry's unit cost.

By using an analogous result for costs to that used above for revenue, we can rewrite the above using proportional changes in input prices (W) and input quantities (X):

$$\begin{aligned}(5) \qquad \Delta UC &= (\Delta W + \Delta X) - \Delta Q \\ &= \Delta W - (\Delta Q - \Delta X) \\ &= \Delta W - \Delta TFP\end{aligned}$$

where ΔTFP is the industry's total factor productivity change, the difference between its proportional change in output and input quantities (the objective of productivity improvement being to produce a greater quantity of output from each unit of input).

The next issue to be considered in operationalising (5) is the choice of the price index to reflect changes in the industry's input prices, W. The most common choice for this index is the consumer price index (CPI). But this is actually an index of output prices for the economy rather than input prices. Normally we can expect the economy's input price growth to exceed its output price growth by the extent of economy–wide TFP growth (since labour and capital ultimately get the benefits from productivity growth):

$$(6) \qquad \Delta W_E = \Delta CPI + \Delta TFP_E$$

where the E subscript denotes the corresponding economy–wide variable.

We are now in a position to operationalise the CPI–X method to derive a price cap for the industry being regulated as follows:

(7) $$\Delta P_O = \Delta W - \Delta TFP$$
$$= \Delta CPI + \Delta TFP_E - \Delta TFP + [\Delta W - (\Delta CPI + \Delta TFP_E)]$$
$$= \Delta CPI - [(\Delta TFP - \Delta TFP_E) - (\Delta W - \Delta W_E)]$$
$$= \Delta CPI - X$$

where $X = [(\Delta TFP - \Delta TFP_E) - (\Delta W - \Delta W_E)]$ and the variables without E subscripts refer to the relevant industry level variable for the regulated industry.

What equation (7) tells us is that the X factor can effectively be decomposed into two differential terms. The first differential term takes the difference between the industry's TFP growth and that for the economy as a whole while the second differential term takes the difference between the firm's input prices and those for the economy as whole. Thus, if the regulated industry has the same TFP growth as the economy as a whole and the same rate of input price increase as the economy as a whole then the X factor in this case is zero. If the regulated industry has a higher TFP growth than the economy then X is positive, all else equal, and the rate of allowed price increase for the industry will be less than the CPI. Conversely, if the regulated industry has a higher rate of input price increase than the economy as a whole then X will be negative, all else equal, and the rate of allowed price increase will be higher than the CPI.

In the New Zealand thresholds setting context, setting the B factor involves a similar process to that for setting the general X described above. It requires information on the differences between the industry and economy TFP trends and input price trends. However, given the differing operating environments of the New Zealand lines businesses and the fact that the industry is still evolving and likely to have a wide range of productivity performance levels, there is a strong case for supplementing the underlying B factor by a C factor which takes account of the circumstances of each business or groups of similar businesses.

The differential productivity factor approach has usually been adopted where industry wide data are used to determine the productivity growth rate and input price growth rate in determining the X factor for a number of firms in the industry. The differential productivity factor is then used to tailor the regulatory regime to the circumstances of each particular firm. It distinguishes between productivity levels and productivity growth rates. Normally, firms which are at the forefront of industry performance have high productivity levels but low productivity growth rates. This is because they have removed almost all unnecessary slack from their operations and are only able to increase productivity at the rate of technological change for the industry.

Conversely, laggard firms normally have low productivity levels but are potentially capable of high productivity growth rates. This is because they can make some easy gains by removing the slack from their operations to mimic the operations of the industry's best performers. Consequently, they can achieve productivity growth far in excess of the rate of technological change for the industry for an interim period while they catch up to the productivity levels of the best performing firms. As a result of this catch up process, the best performing firms in the industry will, ironically, not be able to match the average productivity level growth rates for the industry (although they have superior productivity levels) while laggard firms will be able to outperform the industry average productivity growth rate.

In a regulatory context, if a firm is a long way from best practice (after allowing for operating environment and service quality differences) then a positive differential factor may be applied to allow for the fact that the firm should be able to make some easy 'catch up' gains and exceed the average industry productivity growth rate. This ensures the firm's consumers receive some of those initial catch up benefits. In subsequent regulatory periods we would expect the firm to move closer to the average industry productivity performance and so the size of the differential productivity factor would diminish. Conversely, for a firm that is already close to best practice, a negative differential factor may be set to allow for the fact that this firm is unlikely to be able to match industry average productivity growth performance as it cannot make easy catch up gains and is instead only able to grow its productivity at the rate of technological change. In the long run, as competition and the regulatory framework drive all firms towards best practice, the industry average productivity growth rate will draw close to the rate of technological change in the industry.

Provided the differential factor is set at the start of the regulatory period and not changed frequently, it is unlikely to have adverse incentive effects as the firm is unable to influence it within the regulatory period and still has a strong incentive to minimise costs and grow its business.

To operationalise equation (7) a few subtle measurement difficulties need to be recognised. The main difficulties are:

- The CPI is an index of after–tax commodity prices. It is the revenues actually received by the utility that are relevant for productivity analysis, ie before–tax prices.
- If a tax–adjusted CPI is chosen as the economy–wide output price index, then the corresponding input price index is not an index of primary input prices – it is equal to an

index of primary input prices plus import prices less export prices less investment prices less a price index for deliveries to government.

- If a tax–adjusted CPI is chosen, it follows that the usual TFP index – consumption plus government purchases plus investment plus exports minus imports divided by labour plus capital – will not be the correct one. The correct TFP index in this case is consumption divided by (labour plus capital plus imports minus exports minus investment minus government purchases). The corresponding rate of TFP growth will be larger than the traditional one because the denominator will be smaller. This could lead to unfair comparisons with the target utility if the TFP measure for the utility is equal to gross output divided by labour plus capital plus intermediate inputs. In theory, however, this last difficulty should not be a problem if TFP and the net input price measure for the economy are measured correctly.

In practice, analysts use the standard economy–wide TFP and input price index measures to operationalise the CPI–X formula (7). Like all approximations, this process may involve some degree of error. Consequently, when translating standard productivity and input price index measures into implemented price caps or thresholds, it is appropriate to adopt a conservative approach to allow for potential approximation errors.

Equations (5) and (7) can alternatively be derived starting with the index number definition of TFP growth:

(8) $$\Delta TFP \equiv [Y^1/Y^0]/[X^1/X^0] = \{[R^1/R^0]/[P^1/P^0]\}/\{[C^1/C^0]/[W^1/W^0]\} = \{[M^1/M^0][W^1/W^0]\}/[P^1/P^0]$$

where R^t (C^t) is revenue (cost) in period t, M^t is the period t markup and $R^t = M^t C^t$. Thus, rearranging the above equation gives:

(9) $$P^1/P^0 = \{[M^1/M^0][W^1/W^0]\}/\ \Delta TFP$$

where W^1/W^0 is the firm's input price index (which includes intermediate inputs). Equation (9) is approximately equal to:

(10) $$\Delta P = \Delta M + \Delta W - \Delta TFP.$$

This derivation produces equation (10) which is approximately equal to equation (5) but with the addition of a change in monopolistic markup term. Thus, if the regulator wants to keep the monopolistic markup constant (so that $\Delta M = 0$), then the admissible rate of output price increase ΔP is equal to the rate of increase of input prices ΔW less the rate of TFP growth. Similarly, this approach can be further extended to produce the equivalent of equation (7) but again with the additional change in monopolistic markup term. The markup growth term could be set equal to zero under normal circumstances but if the target firm was making an inadequate return on capital due to factors beyond its control, this term could be set equal to a positive number. On the other hand, if the target firm was making monopoly profits or excessive returns, then this term could be set negative. This effectively sets a ‘glide path’ to bring firms closer to earning a normal or average rate of return and is the theoretical basis for the C_2 component used in section 8 of the report.

2.1 Past productivity performance as a guide to the future

The rationale behind CPI–X threshold setting involves setting the B and C factors to reflect likely future productivity performance. However, we are only able to empirically observe past productivity performance and this is usually used as an indicator of possible future improvements by a process of extrapolation. The question then arises as to how reasonable a guide past productivity performance is likely to be for what will be achievable in the future.

There are two situations where past productivity performance may not be a good guide to future performance. The first of these is where there is a ‘regime change’ occurring in the form of regulation with the new regulatory regime offering more powerful incentives for the firm to improve performance. An example of this is the movement from traditional rate of return regulation or cost based regulation in the US to performance based regulation. In rate of return regulation firms have limited incentive to improve performance, as the benefits will be taken from them in the next annual review. With performance based regulation such as CPI–X price capping, firms have an incentive to outperform the targets set as they can keep the gains until at least the next regulatory reset and regulatory resets are usually several years apart. Changing from one regime to the other is likely to see a ‘step’ increase in productivity performance and this was the original rationale for using productivity ‘stretch’ factors in the US. However, since New Zealand lines businesses have been subject to ongoing reforms for the past several years, it is less likely there would be a step increase in average productivity performance going forward to the new thresholds but rather a continuation of higher productivity growth rates.

The other situation where past performance may not be a good guide to future performance is where the industry as a whole nears feasible best practice. After more rapid, catch–up productivity growth, future growth may slow to the rate of technological change in the industry once most avenues for catch–up have been exploited. This would lead to feasible future productivity growth being less than past performance. Given that the New Zealand lines businesses have only relatively recently acquired a separate identity and a more commercial focus, it is unlikely that many, if any, are sufficiently close to best practice that feasible future productivity growth will be significantly less than that achieved in the past.

Evidence from Australia where reform of the electricity industry has been underway since the early to mid 1980s also indicates that higher trend productivity growth rates have been sustained for long periods although this has been characterised by acceleration of TFP growth after the introduction of each round of reforms followed by a period of consolidation. Lawrence (2002) notes that 'this pattern of TFP moving in 'fits and starts' is common in infrastructure reform as the easy gains are made early on in the reform process and then productivity growth returns to a more 'normal' level until the next set of institutional roadblocks are removed'.

The alternative to using observed past productivity performance as a guide to future performance is to undertake engineering studies of the scope for future improvements. However, these studies face asymmetric information problems, may be relatively subjective between different assessors and are not as readily replicable or transparent as studies based on past performance.

Given these considerations it is our view that quantifying recent past productivity performance provides the best way of estimating likely future productivity performance for use in setting the thresholds.

2.2 TFP indexes as a means of calculating productivity

TFP indexes have been the most common technique used to derive estimates of past economy–wide and industry level productivity performance. A TFP index is generally defined as the ratio of an index of output growth divided by an index of input growth. Growth rates for individual outputs and inputs are weighted together using revenue and cost shares, respectively. In other words, the TFP index is essentially a weighted average of changes in output quantities relative to a weighted average of changes in input quantities. This is necessary because most economies have a diverse range of outputs (agricultural products, manufactures, services and exports) and an equally diverse range of inputs (eg labour, capital, land, inventories and natural resources). Calculating TFP requires a means of adding together these diverse output and input quantities into measures of total output and total input quantity. The different types of outputs and inputs cannot be simply added (eg it is not meaningful to add the number of employees to the number of petajoules of energy consumed). Changes in the TFP index tell us how the amount of total output that can be produced from a unit of total input has changed over time.

TFP indexes are a relatively simple and robust technique that have an interpretation consistent with the normal operation of competitive forces when used in setting X factors. They can be formed from a small number of observations whereas econometric cost and profit functions, on the other hand, require much longer time series to allow sufficient degrees of freedom to facilitate estimation. TFP indexes also provide maximum detail on year–to–year changes in performance but allow the flexibility to form smoothed trend rates of change over time.

The main advantage of the index number approach to the measurement of TFP is its reproducibility, ie different investigators will obtain the same productivity estimates (provided that they use the same data and use a 'superlative' or flexible index number formula to aggregate up the data). On the other hand, econometric estimates of TFP change will be much more open to challenge. Different econometricians will choose different functional forms for the production function or the dual unit profit function or the dual unit cost function; different econometricians will choose different break points for splines (differential time trend variables) and different econometricians will choose alternative stochastic specifications and methods of estimation. These differences will lead to different estimates of TFP.

TFP indexes have a rigorous grounding in economic theory. As noted in Diewert and Lawrence (1999), the two most commonly used approaches to the problem of finding the 'best' functional forms for the TFP index are the economic and the axiomatic approaches. The economic approach selects index number formulations on the basis of an assumed underlying production function and assuming price taking, profit maximising behaviour on the part of producers. For example, the Törnqvist index used extensively in past TFP studies can be derived assuming the underlying production function has the translog form (a flexible function with good ability to approximate production relationships) and assuming producers are price taking revenue maximisers and price taking cost minimisers.

The axiomatic approach to the selection of an appropriate index formulation specifies a number of desirable properties an index formulation should possess. Potential indexes are then evaluated against the specified properties and the index that passes the most tests would be preferred for the analysis. The tests used to evaluate the alternate indexes include:

- the constant quantities test: if quantities are the same in two periods, then the output index should be the same in both periods irrespective of the price of the goods in both periods;
- the constant basket test: if prices are constant over two periods, then the level of output in period 1 compared to period 0 is equal to the value of output in period 1 divided by the value of output in period 0;
- the proportional increase in outputs test: if all outputs in period *t* are multiplied by a

common factor, λ, then the output index in period *t* compared to period 0 should increase by λ also; and

- the time reversal test: if the prices and quantities in period 0 and *t* are interchanged, then the resulting output index should be the reciprocal of the original index.

When evaluated against the tests listed above, only the Fisher index method passes all four tests. The older Laspeyres and Paasche indexes which use constant weights fail the time reversal test while the Törnqvist index fails the constant basket test. On the basis of these tests the Fisher index is now the index of choice for time series TFP work although, in practice, the Törnqvist index can also be used as it closely approximates the Fisher index.

If applied properly, TFP indexes place a discipline on the analyst to ensure that the data used balances, ie that price times quantity equals the dollar value for each output and input and the sum of input costs equals total cost and the sum of output revenues equals total revenue. This discipline is absent with other techniques such as data envelopment analysis. TFP indexes are also more easily communicated to industry participants than most other techniques and appear as less of a 'black box'.

Like any quantitative method, TFP indexes have limitations as well as advantages. These include the fact that they are a non–parametric technique and, hence, cannot produce confidence intervals and other statistical information, the need to aggregate heterogeneous outputs and inputs and the need to estimate the annual physical input and cost of capital goods.

Aggregation is an inevitable part of making any modelling exercise tractable and TFP indexes provide a consistent framework within which this can be done. Also, to make sure that businesses' decisions are being accurately modelled it is necessary to calculate the annual physical input and cost of capital as these key input variables are a fundamental component of producers' decision–making processes, particularly in a capital intensive network industry.

While statistical methods provide useful information, they are best suited to larger data sets where the data errors and inconsistencies have largely been eliminated. In the early stages of developing regulatory databases and frameworks, particularly where there are a limited number of observations available, there is a strong case for using a non–parametric technique that enables the ready identification of likely data problems while not distorting the results for other observations. Plotting TFP index results provides a ready way of identifying unexpected results that may be less easy to identify in econometric approaches. Where only a limited number of observations are available the use of statistical methods may be problematic or limited to restrictive functional forms.

2.3 Overseas experience with using TFP in regulation

TFP analysis has been used extensively in the setting of price path parameters in the USA, Canada, the UK and Australia. In most cases TFP has been used to inform discretionary price cap decisions rather than forming the basis for mechanistic price caps. A selection of representative case studies of international experience in using TFP for regulatory purposes is reviewed in this section.

2.3.1 United States of America

The USA has made widespread use of TFP analysis in CPI–X ‘performance based’ regulation. TFP has been used as an input to setting X factors in the rail, telecommunications and electricity distribution industries.

Rail

The case for including TFP considerations in the setting of the maximum rail freight rates was first put to the Interstate Commerce Commission (ICC) in 1981. Initially the ICC rejected using an industry–wide productivity factor citing unstable earning levels in the industry and the risk that an inappropriate productivity factor would reduce incentives. This decision launched seven years of debate and analysis of the applicability of TFP measurement to the rail industry. This debate included a recommendation to utilise a five year moving average of TFP as the basis for the X factor culminating in the ICC’s 1989 determination that it was fair and reasonable for the price cap to reflect rail industry TFP and that the industry was then mature enough to have moved past its period of financial uncertainty.

The moving average industry–wide factor was chosen in order to smooth out year–to–year fluctuations and to provide strong performance incentives for each firm. This very light–handed regulatory stance has, in effect, no end to the regulatory period and the regulator does not examine the earnings performance of individual firms. The ICC’s decision to use an industry–wide TFP measure was justified because each firm’s returns would directly reflect its TFP performance relative to the industry average.

Telecommunications

TFP based performance regulation of telecommunication has a relatively long history in the United States. In approving the AT&T price plan in 1989 the Federal Communications Commission analysed industry–wide TFP estimates extensively and the subsequent plans reflect both a productivity factor and a consumer productivity dividend. In the market for interstate services by local exchange carriers price caps have been the form of regulation and the use of industry–wide TFP measurement is mandatory.

Electricity Distribution

The regulation of electricity distribution businesses in the US is undertaken by state Public Utility Commissions. Performance based regulation has been adopted by a number of states as an alternative to the long established cost of service regulation and TFP studies have been used in a number of these states as input to setting the X factor. The data used in these studies is generally sourced from data all US distribution companies provide to the Federal Energy Regulatory Commission. While the data are mostly accepted by all parties as being accurate at a firm level, there remains significant debate regarding the use of a nation–wide sample to calculate TFP given the variance in company structures and operating conditions.

The first CPI–X regulation plans for power distributors were in California. Southern California Edison Company conducted a TFP study of their business and submitted to the Californian Public Utilities Commission that their long run TFP growth trend was 0.9 per cent per annum. The Commission accepted this figure and set an X factor containing this productivity growth trend and a factor accounting for customer dividends rising from 0.3 to 0.7 per cent per annum over the regulatory period. While the Commission accepted the distributor's estimate, it noted that industry–wide TFP measurement would have been preferred to allow the regulation to more closely mimic an unregulated market.

Industry–wide TFP was subsequently used as the basis for regulating the San Diego Gas and Electric Company in a 1994 decision. The company commissioned studies of industry TFP trends and found that power distribution TFP was increasing at 0.92 per cent per annum. The Utilities Commission accepted this evidence and added an average consumer dividend of 0.55 per cent per annum.

2.3.2 Canada – Ontario

Electricity reform in Canada, as in the United States, has occurred at different paces in the different provinces. Ontario has led the way in utilising TFP studies in setting price caps in electricity distribution as well as other regulated industries.

The Ontario Energy Board (1999) undertook an electricity distribution TFP study prior to its first performance based regulation determination in 2000. The study found an average annual change in TFP across Ontario distribution utilities over the period 1988 to 1997 of 0.86 per cent with a median of 1.14 per cent. For the most recent five year period (1993 to 1997), the average annual change in TFP was 2.05 per cent, with a median of 1.97 per cent.

The Board took this analysis into account in making its decision but determined that, given the need for simplicity and the fact that distribution utilities required time to ease themselves into performance based regulation, it was most appropriate to specify a single productivity factor of 1.5 per cent for the first period of price regulation.

At the federal level in Canada, the Canadian Radio–Television and Communications Commission (1997) in developing the price cap plan for the Sentor telecommunication companies referred to the American experience with TFP based regulation. They noted the US approach was particularly strong in its ability to replicate the competitive market. In the Sentor price cap plan the Commission also noted the benefits of using data that was independent of the actions of one company when setting the X factor. The Commission further observed that the use of an industry wide X factor provided superior incentives and rewards for productivity gains.

2.3.3 United Kingdom

The UK began performance based regulation in the early 1990s using an RPI–X approach. In the first regulatory period different X factors were established for each distributor ranging from 0 per cent to –2.5 per cent. This led to favourable conditions for the companies and resulted in high levels of profitability. The price control regime was tightened considerably in the second determination of 1995.

In the 1995 review, the regulator used benchmarking studies in conjunction with assessment of best practice operations to estimate the efficient level of the distributors' capital and operation costs for the next period while allowing for operating conditions beyond management control. The outcome of this analysis was a common X factor of 2 per cent for the industry and reductions in the distribution price cap in the first year of between 11 and 17 per cent (OFFER 1995).

In a recent report Britain's National Audit Office (NAO 2002) undertook a review of performance–based regulation. The NAO concluded that, overall, RPI–X regulation had delivered significant benefits to consumers and noted that electricity prices had fallen on average by 24 percent in 2000–01. The NAO also found that power supply interruptions had been reduced. The report also noted some problems with RPI–X regulation creating incentives for firms to reduce costs declines towards the end of the regulatory period and the potential for biases in the treatment of operation and capital expenditure.

2.3.4 Australia

Indexing approaches have been utilised in the regulation of electricity distribution in most Australian states. In the case of Victoria, distribution related charges have been subject to CPI–X caps set using the 'building block' approach since 1995. In this approach the X factor is selected to ensure that the expected revenue over the regulated period covers each company's expected costs including a return on the depreciated optimised replacement cost of assets plus expected net investment, current cost accounting depreciation expenses and operation and maintenance costs. The overall cost expectations included expected productivity gains for each distributor leading to different X factors across firms. The expected productivity gains were largely determined using engineering analyses. In the most recent regulatory period the scheme was expanded to include an earnings sharing mechanism to counter the disincentive for firms to make productivity improvements towards the end of the regulatory period and a service quality incentive scheme to counter the incentive for firms to achieve productivity improvements by reducing service quality.

In 1999 the Independent Pricing and Regulatory Tribunal of New South Wales commissioned London Economics (1999) to assess the efficiency performance of the NSW distributors to inform its pricing determination. This study used a range of techniques including data envelopment analysis, stochastic frontier analysis and TFP indexes to compare the NSW distributors' efficiency with that of a sample of international distributors. The study found that the NSW distributors would have to reduce their input use by between 13 and 41 per cent to achieve best practice given comparable operating environments. Subsequent review of the study by the distributors found a number of data and measurement errors (Lawrence 1999).

In its 2000 electricity distribution price determination the Queensland Competition Authority used TFP index studies by Tasman Asia Pacific (2000a,b) and cost function studies by Pacific Economic Group (2000a,b) to inform its decision.

3 PAST TOTAL FACTOR PRODUCTIVITY STUDIES

As outlined in section 2, to form an estimate of the B factor we need estimates of the recent productivity performance of the economy as a whole and of lines businesses as a whole. We also need corresponding estimates of trend changes in input prices. In this section we review previous studies of New Zealand's economy–wide TFP performance and, given the lack of previous studies of New Zealand lines businesses' productivity, the productivity performance of the electricity supply industry in a range of countries.

3.1 New Zealand economy–wide TFP studies

Early New Zealand TFP studies

There were around a dozen studies of New Zealand's productivity and growth performance undertaken during the 1990s culminating in the detailed report by Diewert and Lawrence (1999). This interest in New Zealand's productivity performance was driven in part by the view that New Zealand had undertaken more radical economic reforms than other western countries during the mid to late 1980s and early 1990s. Diewert and Lawrence provide a detailed review of the earlier studies and Mawson, Carlaw and McLellan (2003) provide a brief review of earlier New Zealand TFP studies.

Most of the earlier studies used the standard Solow (1957) growth accounting approach to estimating productivity growth. In the growth accounting approach TFP is computed as a residual – the residual that results from separately evaluating the contributions of specified factors to output growth and then subtracting these measured contributions from the total growth of output. However, this method is based on the use of the relatively inflexible Cobb–Douglas (1928) production function and, hence, the results obtained with this methodology must be viewed with caution. Because of this and the earlier time period covered by these studies we will only briefly review a selection of their results.

Philpott (1995) used the Solow growth accounting method to examine New Zealand's performance between 1985 and 1994 and obtained a TFP growth rate of 1.5 per cent per annum for this period. Janssen (1996) used a similar methodology and obtained TFP growth rates of 0.9 per cent per annum for the longer period 1956 to 1996 and of 1.3 per cent per annum for the shorter period 1991 to 1996. Hall (1996) looked at peak–to–peak TFP growth rates and found a growth rate of 1.2 per cent per annum for the period 1978 to 1985 but only 0.4 per cent per annum for the period 1985 to 1993. The time periods examined by most of these studies finished before the period of more rapid economic growth observed in New Zealand in the second half of the 1990s.

One of the more unusual New Zealand TFP studies from the 1990s was that of Färe, Grosskopf and Margaritis (1996) who used the linear programming based Malmquist index and data for 20 New Zealand industries for the period 1972 to 1994. Diewert and Lawrence raise a number of interpretational issues with the approach used in this study and also question the way the overall productivity growth rate is reported. Färe, Grosskopf and Margaritis report the unweighted mean of their TFP indexes over 20 industries. However, taking an average of the industry TFP growth rates weighted by their average GDP shares for the period 1978 and 1997 produces a growth rate of only 0.4 per cent instead of the reported 1.46 per cent.

Diewert and Lawrence (1999)

In 1998 The Treasury, the Reserve Bank of New Zealand and the Department of Labour commissioned Diewert and Lawrence to review New Zealand’s recent TFP performance. This work culminated in the 1999 Treasury Working Paper looking at the productivity performance of the New Zealand economy up to 1998. The report contains two sets of economy–wide TFP estimates – one using an ‘official’ database supplied by Treasury and another using the Diewert–Lawrence database constructed from a wider range of sources – plus sectoral TFP estimates derived from the official database.

Diewert and Lawrence’s results for the New Zealand economy are summarised in table 1. For the 20 year period 1978 to 1998 the trend rates of TFP growth obtained were 1.09 per cent per annum for the official database and 1.26 per cent per annum for the Diewert–Lawrence database. For the more recent period 1993 to 1998 the trend TFP growth rates were around 1.5 per cent per annum for both databases. However, this more recent period covered the start of more rapid TFP growth that may not have been sustained subsequently.

Diewert and Lawrence also undertook extensive sensitivity analyses of alternative input and output specifications and data sources. New Zealand labour data was found to be unexpectedly variable between different official sources. The Diewert–Lawrence database used a combination of OECD data on labour numbers and Statistics New Zealand Census data on hours worked by occupation that produced the expected result of declining average hours per person over time. However, switching to the Statistics New Zealand Household Labour Force Survey (HLFS) data produced the counterintuitive result of increasing average hours per person and subsequently lower productivity growth. A range of output and capital specification options were also tried using the official database which produced trend TFP growth rate estimates ranging from 0.6 to 1.3 per cent per annum for the 20 year period to 1998 and from 1.5 to 1.6 per cent per annum for the 5 year period to 1998.

National Accounts based productivity estimates are often biased downwards because of outdated conventions used in the measurement of output in some service sectors where output is hard to measure. As a result some statistical agencies, including the Australian Bureau of Statistics (ABS), exclude the Finance and Community Services sectors from their official estimates. Diewert and Lawrence produced an 'ABS equivalent' estimate from the official database which showed stronger TFP growth trends of 1.56 per cent per annum for the 20 year period to 1998 and 2.38 per cent per annum for the 5 year period to 1998. The latter period was one of above longer–term trend growth rates and this growth rate is unlikely to have been sustained subsequently.

Table 1: **Diewert and Lawrence trend TFP growth rates (per cent per annum)**

	1972–84	*1978–84*	*1984–93*	*1993–98*	*1972–98*	*1978–98*
Official Database						
Base Case		1.19	0.76	1.46		1.09
Highest Estimate		1.28	1.00	1.48		1.25
Lowest Estimate		0.34	0.14	1.63		0.58
'ABS Equivalent' for NZ		1.12	1.35	2.38		1.56
Diewert–Lawrence Database						
Diewert–Lawrence	–0.35	1.80	0.07	1.47	0.81	1.26
Diewert–Lawrence with HLFS Hours	–1.19	1.18	–0.15	1.17	0.36	0.95

Source: Diewert and Lawrence (1999)

The Diewert and Lawrence report was the most comprehensive study of New Zealand's productivity undertaken up to 1999 and the extensive sensitivity analyses undertaken mean that considerable confidence can be placed in the preferred estimates from that study. The major development since the report was done has been the release of official capital stock estimates by Statistics New Zealand. These capital stock estimates should, in principle, be more robust than the estimates used by Diewert and Lawrence and are consistent with the approach now used by the ABS and a number of other statistical agencies. Statistics New Zealand has also made other improvements to its data over the last few years including the introduction of chained volume indexes for outputs. Some more recent studies have used these new data series.

International Monetary Fund (2002)

In February 2002 the International Monetary Fund produced a report on selected issues in the New Zealand economy as part of its 2002 Article IV Consultation with New Zealand (IMF 2002). Chapter 1 of this report deals with comparative productivity performance between New Zealand and Australia and explores reasons for the apparent divergence in performance.

The IMF study uses a relatively standard application of the Solow growth accounting framework extended to include changes in human capital and intercountry comparisons. While the main focus of the paper is on intercountry comparisons between New Zealand and

Australia, estimates of New Zealand's trend rate of productivity change for the period 1988 to 2000 can be derived from the database used in the study. The database is based on Statistics New Zealand's new chain volume output series and new capital stock estimates.

The trend rate of TFP growth for New Zealand obtained from the IMF study's database is 1.11 per cent per annum.

Shapiro (2003)

In recent work for the Reserve Bank of New Zealand, Shapiro (2003) has used The Treasury's update of the Diewert and Lawrence official database using the new Statistics New Zealand chain volume indexes and capital stocks to compare New Zealand's productivity performance to that of the US. Shapiro uses the traditional Solow growth accounting model although few details are given of either the methodology or data used. If, as appears to be the case, the study uses the traditional Cobb–Douglas functional form then some reservations have to be placed on the robustness of the results.

Shapiro presents TFP growth rate results for three different periods from 1992 onwards. For the decade from 1992 to 2002 Shapiro finds a trend TFP growth rate of 1.1 per cent per annum. For the period from 1992 to 1995 he finds a higher TFP growth rate of 1.5 per cent per annum but this falls to 0.8 per cent per annum for the period from 1996 to 2002.

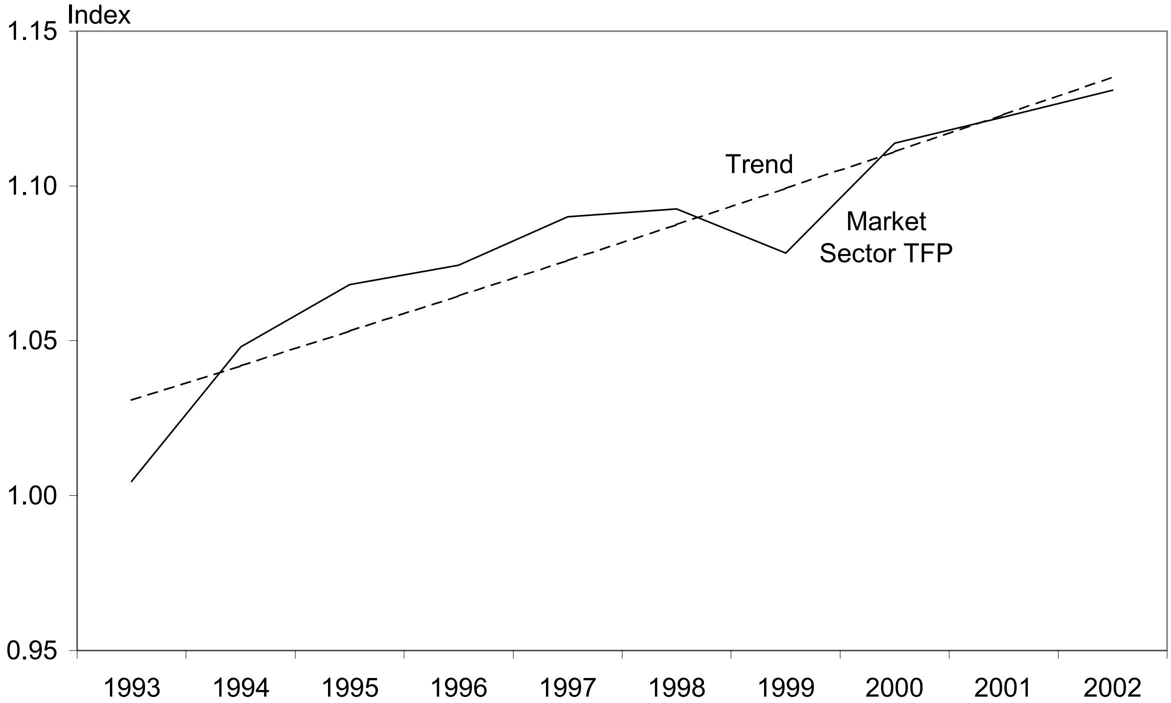
Black, Guy and McLellan (2003)

The Treasury has recently released a staff working paper updating the work of Diewert and Lawrence to 2002 (Black, Guy and McLellan 2003). As well as adding an extra four years to the time series, the paper incorporates Statistics New Zealand's new chain volume indexes and capital stock estimates. While some refinements remain to be made to the database used, the TFP estimates contained in this paper are the most recent available for New Zealand. One refinement remaining to be made is using annual user costs to weight the capital stock components together instead of simply adding up the constant dollar quantities. Some of the sectoral results presented in the paper also appear counterintuitive and warrant further investigation. Despite these outstanding refinements, the estimates presented are likely to be relatively robust.

The economy–wide TFP estimates presented are close to the official database estimates of Diewert and Lawrence for the overlapping period, 1988 to 1998. Capital productivity estimates diverge somewhat towards the end of this period reflecting the different sources of capital data used. The Treasury paper undertakes some of the same sensitivity analyses reported in Diewert and Lawrence with similar results.

Calculation of an 'ABS equivalent' TFP series excluding hard to measure service sectors again boosts New Zealand's observed TFP performance somewhat and leads to a similar pattern of productivity change to that reported by the ABS for Australia over this period.

Figure 1: **Treasury market sector TFP and trend, 1993 to 2002**



While there appear to be some inconsistencies in the TFP growth rates reported in the Treasury paper, calculation of the trend rate growth rate for the last decade, from 1993 to 2002, from the TFP index values reported yields a figure of 1.1 per cent per annum. This trend is plotted against the actual reported TFP series in figure 1.

The trend appears to be an accurate representation of economy–wide TFP performance over this period. The steep increase in TFP between 1993 and 1994 is discounted as a more steady increase between 1994 and 1998 takes place. The drop in TFP in 1999 associated with the 'Asian crisis' and the steep recovery in 2000 do not affect the trend and the increases observed in the last two years are very much in line with the trend. It appears, therefore, that a trend TFP increase of 1.1 per cent per annum for the economy as a whole is the most appropriate figure to use as input to determining the B factor. This is also consistent with the results of the IMF and Shapiro using the new data and with the longer term rates in Diewert and Lawrence.

3.2 Overseas lines business–related TFP studies

There has been little direct estimation of the TFP performance of New Zealand lines businesses undertaken previously. The main TFP estimates relevant to lines businesses are sectoral estimates derived by Diewert and Lawrence (1999) and Black, Guy and McLellan (2003) for the electricity, gas and water sector. These estimates are derived from relatively high level National Accounts data and due to the difficulty of accurately identifying flows of intermediate goods in the economy are far less robust than the corresponding economy–wide level measures. This sectoral level work is at best a very rough guide to the performance of lines businesses given the range of other activities included quite apart from likely data problems. Rather than dwell on these studies, in this section we review more specific electricity industry TFP studies that have been done in comparable countries such as Australia, Canada, the US and the UK.

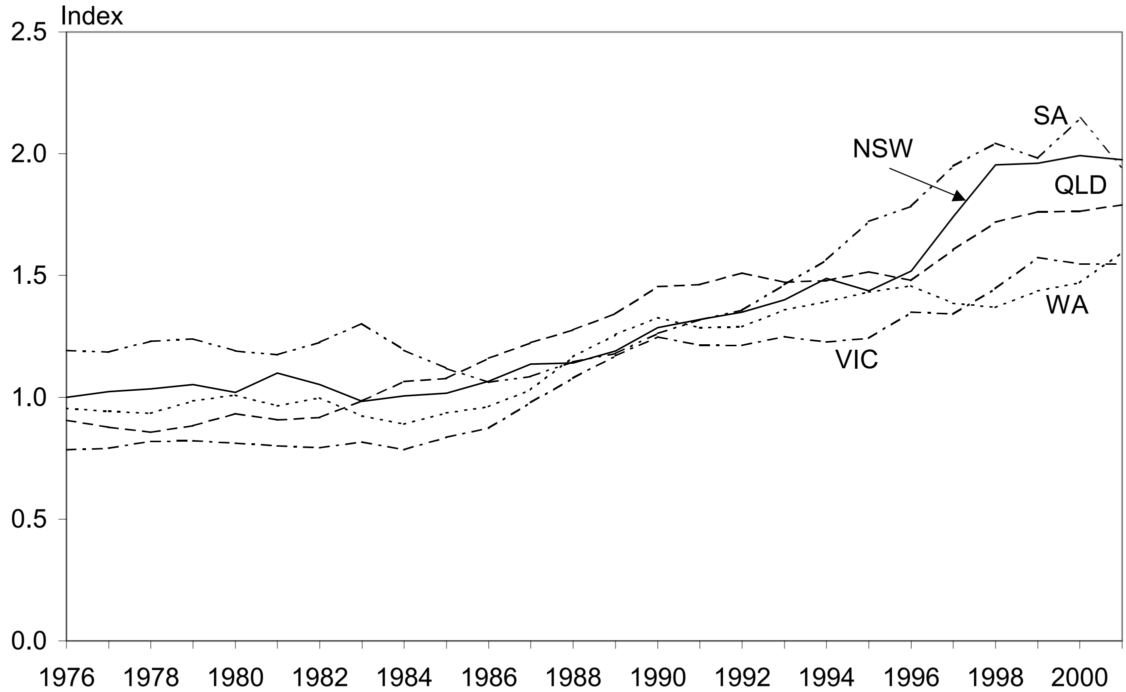
Australian electricity supply TFP studies

TFP measurement for the electricity supply industry has a much longer history in Australia with several major studies having been undertaken since 1991. The pioneering electricity industry TFP study in Australia was that of Lawrence, Swan and Zeitsch (1991). This was subsequently updated in Bureau of Industry Economics (1996) and, most recently, in Lawrence (2002). These studies looked at the TFP performance of each of the five mainland state electricity supply systems. They examined the combined performance of generation, transmission, distribution and retail within each state using consistent data that were collected and reported over a long period by the Electricity Supply Association of Australia (ESAA). The most recent study also drew on ABS data to supplement gaps in the ESAA data from 1993 onwards.

Lawrence (2002) covers the 26 year period from 1976 to 2001. The industry's total output is measured by the gigawatt hours of electricity consumed, which increased steadily over the entire period. Input use is measured as an aggregate of four broad input categories: labour, capital, fuel, and materials and services. TFP increased at a trend annual rate of 3 per cent for the entire period and at a trend rate of 3.3 per cent per annum since 1990. After remaining almost flat for the decade from 1976 as outputs and inputs moved in unison, it increased rapidly during the second half of the 1980s as reforms started to be implemented in the lead–up to corporatisation. The rate of TFP growth then slowed markedly during the first half of the 1990s before again growing strongly between 1995 and 1998 with the move to privatisation in some states and the introduction of a national electricity market. Multilateral TFP indexes for the individual state systems are presented in figure 2. Multilateral TFP indexes provide information of TFP levels as well as growth rates whereas the indexes discussed earlier only provide information on TFP growth rates.

Australian electricity industry labour productivity has increased rapidly since the mid–1980s, growing at a trend annual rate of 7.5 per cent over the 26 years and an even higher 9.5 per cent since 1990. Capital productivity has also grown relatively strongly in this capital–intensive industry with a trend annual increase of 3 per cent. Materials and services partial productivity has fluctuated but grown at a trend annual rate of 1.5 per cent reflecting a substitution between in–house labour and contracting out of a wider range of activities.

Figure 2: **Australian state electricity industry multilateral TFP indexes, 1976–2001**



Source: Lawrence (2002)

London Economics (1993) undertook a TFP study of the Australian state electricity supply systems using a similar approach and data to that used by Lawrence, Swan and Zeitsch (1991). They found that TFP had increased at a trend annual rate of 3.1 per cent for the system as a whole for the nine years up to 1991. Transmission and distribution TFP were found to have increased at 5.1 and 3.7 per cent per annum, respectively. This was more rapid than generation's trend annual increase of 2.9 per cent for the same period.

London Economics (1999) calculated TFP changes for the New South Wales distributors using very limited data for the three years to 1997 using the DEA–based Malmquist index method. They found average annual TFP changes ranging from 1.4 per cent for Integral Energy to 4.1 per cent for NorthPower.

Denis Lawrence has undertaken a series of TFP studies of Australian distributors including Tasman Asia Pacific (2000a,b). While this detailed database now contains 11 of the 16

Australian distributors, the focus to date has been on cross sectional rather than time series comparisons so no TFP growth rates have been derived.

Electricity supply TFP studies from the US, Canada and the UK

Kaufmann and Lowry (1999) estimated the TFP of the US electricity distribution industry using an index number approach for the period from 1985 to 1996. The sample included 124 businesses and data was assembled from detailed Federal Energy Regulatory Commission returns and information provided by the US Department of Commerce and Whitman, Requardt, and Associates.

Kaufmann and Lowry's outputs included the number of customers served, peak demands and volumes delivered to different customer groups. As revenue information on the different output components is not available for weighting purposes, Kaufmann and Lowry relied on an econometric approach to weighting where each output's cost elasticity was divided by the sum of all output–related cost elasticities to determine weights for the output quantity index.

The results suggest that TFP for the US distribution industry grew at a rate of 0.9 per cent per annum for the decade to 1996. This was almost 3 times the rate of TFP growth found for the US economy over the same period. The lower TFP growth rate for the US industry probably reflects its relative maturity and is consistent with earlier studies such as BIE (1996).

Cronin, King and Colleran (1999) calculated TFP for electricity distributors in Ontario for the Ontario Energy Board. They analysed 40 utilities (12 large, 15 medium and 13 small) to calculate TFP growth for the period 1988 to 1997. This study used capital, labour, materials, and line losses as inputs weighted by total cost attributable to each. The output measures used were a weighted average of customer numbers by class and kWh by class with quantity indexes weighted by their contribution to revenue.

The study found that the average growth in distribution TFP from 1988 to 1997 was 0.9 per cent per annum. However, for the more recent period 1993–97 the industry's annual TFP growth increased significantly rising to 2.1 per cent.

London Economics (1999) estimated the TFP of the distribution industry in England and Wales for the period 1991 to 1997 using linear programming based Malmquist indexing technique. They found average annual TFP growth over the period was in the order of 3.5 per cent. This increased to in excess of 7 per cent per annum in 1996 and 1997.

Another study completed over practically the same period (1991 to 1998) by Tilley and Weyman–Jones (1999) found a similar pattern of results with average annual TFP growth for the distribution industry of 6.3 per cent. This analysis was based on a sample size of 12 businesses. The inputs used were operating expenditure, total length of the distribution network in each of the business's areas and the transformer capacity of the business. The outputs used were electricity distributed across the network, the number of customers served by each business and the maximum demand for each network. Again TFP growth was found to have accelerated in the second half of the 1990s. The higher TFP growth rates found in the UK relative to the US probably reflect the fact that the UK industry was still undergoing regulatory reform.

4 DATA

The data source for this study is the official electricity lines business Disclosure Data required under the *Electricity (Information Disclosure) Regulations 1994 and 1999*. These data were first required for the 1995 March year and included physical, service quality and financial information. Legal (as opposed to reporting) separation of distribution and retail activities occurred during the 1999 financial year, and the disclosure data requirements were revised at this time.

Despite the wide range of items now reported in the Disclosure Data, the consistency and quality of the data is variable, particularly in the earlier years. A number of the key variables that would normally be required for productivity analyses are missing. For instance, there is effectively no useful labour data. There are some coverage gaps in years where distributors have amalgamated due to a requirement that data only has to be provided for entities existing at the end of the financial year. Despite these problems, given the short time we had to complete the initial report we adopted the policy of using the official data as it was presented rather than making ad hoc changes to correct apparent anomalies. Some corrections were made to reflect the businesses' responses to the opportunity to comment on the data set.

With the benefit of more information that has become available since the initial report, we have made several changes to improve the consistency and coverage of the database. These are outlined in section 6.3 below.

To provide an adequate basis for establishing trends we use the eight data years 1996–2003 to calculate trend rates of aggregate industry level productivity growth used to derive B factor estimates. The 1995 data year was discarded due to the apparent teething problems with providing Disclosure Data in the first year and the absence of ODV estimates. A number of assumptions are now made to address data problems surrounding the 1999 financial year. The changes introduced in 1999 have generally improved the quality of the data available. We now use the five data years 1999–2003 to derive multilateral TFP estimates used to derive C factor productivity groupings as this data has better consistency.

Extensive work has been required to assemble the database for the 28 distributors existing in 2003 for the eight year period. The procedures adopted to assemble the database are summarised in appendix A. The key variables for the eight year aggregate industry database and the five year individual distributor database are listed in appendix B.

4.1 Measurement issues

Measuring lines business outputs

The main challenge in calculating TFP for a lines business is the specification of exactly what a lines business's outputs are and how to measure the quantity and value of each of them. Distribution output can be measured from either a 'supply side' or a 'demand side' perspective. At the simplest level, the output would be the amount of energy 'throughput' and its value would be the distributor's total revenue. This approach essentially treats the distribution system in an analogous fashion to a pipeline and was a common approach of early studies of electricity distribution using TFP or other comprehensive indicators. It simply concentrates on the demand for the final product delivered by the distribution network. However, there are other important dimensions to a distributor's output that need to be taken into account. These include the reliability and quality as well as the quantity of the electricity supply and the coverage and capacity of the system (ie the fact that the system is there to meet the highest potential peak as well as actual day to day demand).

A number of distributor representatives in Australia have drawn the analogy between an electricity distribution system and a road network. The distributor has the responsibility of providing the 'road' and keeping it in good condition but it has little, if any, control over the amount of 'traffic' that goes down the road. Consequently, they argue it is inappropriate to measure the output of the distributor by a volume of sales or 'traffic' type measure. Rather, the distributor's output should be measured by the availability of the infrastructure it has provided and the condition in which it has maintained it – essentially a supply side measure.

This way of viewing the output of a network industry can be extended to a number of public utilities. For instance, a number of analysts have measured the output of public transport providers using both a 'supply side' and a 'demand side' measure of output. The supply side measure of a passenger train system, for instance, would be measured by the number of seat kilometres the system provides while the demand side output would be measured by the number of passenger kilometres. In the case of public transport this distinction is often drawn because suppliers are required to provide transport for community service obligation and other non–commercial reasons. Using the supply side measure looks at how efficient the supplier has been in providing the service required of it without disadvantaging the supplier as happens with the demand side measure because of low levels of patronage beyond its control.

In previous work on distribution efficiency we have estimated both supply side and demand side output models. In the Australian context, the demand side models tend to favour urban distributors with dense networks while the supply side models tend to favour rural distributors with sparse networks (but long line lengths). In Tasman Asia Pacific (2000a,b) and other recent work in Australia we have further advanced the output specification by combining the key elements of the demand and supply models to form a comprehensive output measure which contains three components – throughput, network line capacity and the number of connections. The connection component recognises that some distribution outputs are related to the very existence of customers rather than either throughput or system line capacity. This will include customer service functions such as call centres and, more importantly, connection related capacity (eg having more residential customers requires more small transformers and poles). This three output specification has the advantage of incorporating key features of the main density variables (customers per kilometre and sales per customer).

There is also a fourth dimension to a lines business's output. This is the quality of supply which encompasses reliability (the number and duration of interruptions), technical aspects such as voltage dips and surges and customer service (eg the time to answer calls and to connect or reconnect supply). Reliability is likely to be the most important of these service quality attributes and the one for which the most data is available. However, previous attempts to include reliability measures as a fourth output have proven unsuccessful due to the way output is measured. As both the frequency and duration of interruptions are measured by indexes where a decrease in the value of the index represents an improvement in service quality, it would be necessary to either include the indexes as 'negative' outputs (ie a decrease in the measure represents an increase in output) or else to convert them to measures where an increase in the converted measure represents an increase in output. Most indexing methods cannot readily incorporate negative outputs and inverting the measures to produce an increase in the measure equating to an increase in output leads to non–linear results. Measuring reliability by the time on supply each year rather than the time off supply effectively produces a constant as the time off supply is such a small proportion of the total time each year. Given these difficulties, we again omit service quality as an explicit output. As reliability has improved markedly over the last several years, this will understate output growth and, hence, TFP growth over this period.

Of the three outputs that can readily be included, energy throughput can be measured by the number of kWh of energy delivered. The line capacity of the system can be measured by the number of MVA–kilometres formed by summing the product of line length for each voltage capacity and a conversion factor based on the voltage of the line. This measures not only the length of line but also its overall capacity. Finally, the connections variable can be measured by the number of connections or customers.

To aggregate the three outputs into a total output index using indexing procedures, we have to allocate a weight to each output. For most industries which produce multiple outputs these output weights are taken to be the revenue shares. However, in this case we cannot observe separate amounts being paid for the different output components. In this case we can either make some arbitrary judgements about the relative importance of the output components or we can draw on econometric evidence. One way of doing this using econometrics is to use the relative shares of cost elasticities derived from an econometric cost function. The latter approach is often used in industries not subject to high levels of competition because the cost elasticity shares reflect the marginal cost of providing an output. In this report we have again estimated a Leontief cost function similar to that contained in our initial report. Given the splitup of UnitedNetworks in 2003, we are unable to include 2003 data in the estimation due to the 'unbalanced' nature of the panel and so use the seven years of revised panel data for the 29 distributors from 1996 to 2002. We find output cost shares for throughput of 22 per cent, for network line capacity of 32 per cent and for connections of 46 per cent. These compare with output cost shares of 18 per cent, 34 per cent and 48 per cent, respectively, obtained in the initial study.

Capital inputs and depreciation

There are a number of different approaches to measuring both the quantity and cost of capital inputs. The quantity of capital inputs can be measured either directly in quantity terms (eg using a measure of line length) or indirectly using a constant dollar measure of the value of assets. Similarly, the annual cost of using capital inputs can be measured either directly by applying the sum of an estimated depreciation rate and a rate reflecting the opportunity cost of capital to the optimised deprival value (ODV) of assets or indirectly as the residual of revenue less operating costs.

Some analysts have argued that measuring the quantity of capital by the deflated asset value method provides a better estimate of total input as it better reflects the quality of capital and can include all capital items, not just lines and transformers. There are two potential problems with this approach. Firstly, it is better suited to more mature systems where the asset valuations are very consistent over time and across organisations. If the asset valuation process is still being bedded down, as it is in New Zealand, then the estimated quantity of capital inputs in likely to be artificially variable using this approach. Secondly, approaches using the capital stock to reflect the quantity of inputs usually incorporate some variant of either the declining balance or straight line approaches to measuring depreciation. Electricity line business assets tend to be long lived and to produce a relatively constant flow of services over their lifetime. Consequently, their true depreciation profile is more likely to reflect the 'one hoss shay' or 'light bulb' assumption than that of a declining balance or straight line.

That is, they produce the same service each year of their life and until the end of their specified life rather than producing a given percentage less service every year. In these circumstances it is better to measure the quantity of capital input by the physical quantity of the principal assets. This approach is also invariant to different depreciation profiles that may have been used by different lines businesses. In this study we use direct physical asset measures to proxy the quantity of capital inputs wherever possible, ie we adopt the 'one hoss shay' assumption.

The direct approach to measuring capital costs involves applying a constant percentage reflecting depreciation and the opportunity cost of capital to the value of assets. Normally this asset value would be built up using investment data over a number of decades using the perpetual inventory approach (see Lawrence 2002). In the case of the New Zealand lines businesses, however, capital information is only available for a short number of years and even this has been subject to some major revaluations. Consequently, the way of implementing the direct approach that is most consistent with the perpetual inventory approach used in earlier studies is to multiply the ODV by a percentage reflecting depreciation and opportunity costs.

Following NZIER (2001) we assume a common depreciation rate of 4.5 per cent of ODV and an opportunity cost rate of 8 per cent of ODV in calculating the cost of capital inputs. This approach is consistent with a declining balance depreciation profile where 10 per cent of asset value is left after 50 years. It produces an estimate of depreciation costs which is somewhat higher than the current regulatory accounts figure based on optimised replacement cost for all but three of the distributors. Again, this approach abstracts from the different depreciation profiles that may have been used by individual distributors. The use of an 8 per cent opportunity cost rate is consistent with previous infrastructure TFP studies in Australia. It should be noted, however, that the opportunity cost concept used here is not comparable with either disclosed return on investment or weighted average cost of capital figures.

The indirect approach of allocating a residual or ex post cost to capital of the difference between revenue and operating costs has been favoured by some regulatory agencies such as the US Federal Communications Commission (1997). However, estimating productivity using a direct estimate of the cost of capital is more consistent with the underlying producer theory where an ex ante measure is required. The indirect approach may also be problematic where firms are earning a wide range of rates of return or where, as is the case with New Zealand lines businesses, some firms provide low prices to customer/owners as a form of dividend.

4.2 Output and input definitions

The distribution productivity analyses reported in sections 5 and 6 of the report contain three outputs and five inputs.

Output quantities

Throughput: The quantity of the distributor's throughput is measured by the number of kilowatt hours of electricity supplied. This is similar to the output measures used in most early TFP studies of distribution.

System line capacity: The quantity of the distributor's system capacity is measured by its total MVA kilometres. The MVA kilometres measure seeks to provide a more representative measure of system capacity than either line length alone or the simpler kilovolt kilometres measure. Low voltage distribution lines were converted to system capacity in MVA kilometres using a factor of 0.4, 6.6kV high voltage distribution lines using a factor of 2.4, 11kV high voltage distribution lines using a factor of 4, 22kV high voltage distribution lines using a factor of 8, 33kV high voltage distribution lines using a factor of 15, 66 kV lines using a factor of 35, and 110 kV lines using a factor of 80. These factors are based on a review of the factors used in our initial report by Parsons Brinckerhoff Associates (2003). They have been tailored specifically to reflect New Zealand operating conditions and the fact that the effective capacity of an individual line depends not only on the voltage of the line but also on a range of other factors, including the number, material and size of conductors used, the allowable temperature rise as well as limits through stability or voltage drop.

Connections: Connection dependent and customer service activities are proxied by the distributor's number of connections.

Output weights

To aggregate a diverse range of outputs into an aggregate output index using indexing procedures, we have to allocate a weight to each output. For most industries which produce multiple outputs these output weights are taken to be the revenue shares. However, in this case we cannot observe separate amounts being paid for the different output components. As discussed in the preceding section, in this case we can either make some arbitrary judgements about the relative importance of the output components in costs or we can use the estimated output cost shares derived from an econometric cost function. We have chosen to rely on New Zealand based empirical evidence wherever possible in this study and use the output cost shares derived from the econometric Leontief cost function presented in our initial report but using the revised data of the present study for the years 1996–2002. A weighted average of the output cost shares is formed using the share of each observation's estimated costs in the total estimated costs for all distributors and all time periods. This produces an output cost share for throughput of 22 per cent, for system line capacity of 32 per cent and for connections of 46 per cent.

Total distributor revenue is taken to be 'deemed' revenue comprising line charges ('RevLine2') plus revenue from 'other' business plus AC loss rental rebates less payment for transmission charges less avoided transmission charges less AC loss rental expense paid to customers.

Input quantities

Operating expenditure: The quantity of the distributor's operating expenses is derived by deflating the sum of the grossed up values of direct costs per kilometre and indirect costs per customer by the index of labour costs for the electricity, gas and water sector. The grossed up values of direct costs per kilometre and indirect costs per customer are used as the value of operating costs because these measures best reflect the purchases of actual labour, materials and services used in operating the lines business and exclude rebates. The index of labour costs for the electricity, gas and water sector is used as the price of operating expenditure as it directly measures the price of a major component of operating expenditure.

Overhead network: The quantity of poles and wires input in the overhead network is proxied by the distributor's overhead MVA kilometres calculated using the same factors as listed above. At this point in time there is inadequate information available to use the alternative indirect measure of a constant price ODV for poles and wires.

Underground network: The quantity of underground cables input is proxied by the distributor's underground MVA kilometres calculated using the same factors as listed above. Again, at this point in time there is inadequate information available to use the alternative indirect measure of a constant price ODV for underground cables.

Transformers: The quantity of transformer inputs is proxied by the KVA of the distributor's installed transformers.

Other assets: The quantity of other capital inputs such as computers and control systems, etc is proxied by their ODV where the share of total ODV attributable to these assets is estimated for the average of distributors having disaggregated ODV information in each of four groups (rural high density, rural low density, urban high density and urban low density). The shares of other assets in total ODV range from 2 to 4 per cent. The price of other assets is assumed to remain unchanged over the period.

Input weights

The value of total costs is formed by summing the estimated value of operating expenditure and 12.5 per cent of total ODV. As discussed in the preceding section, we follow NZIER

(2001) in assuming a common depreciation rate of 4.5 per cent and an opportunity cost rate of 8 per cent for capital assets. Disaggregated ODV data has been formed for all but three of the distributors although a number of allocation assumptions have had to be made and the quality of the data is very variable. To allocate ODV to the four asset classes used here we take the weighted average shares for the distributors that have this data in each of four groups (rural high density, rural low density, urban high density and urban low density) and apply these shares to all distributors in the respective group. This strategy was adopted to minimise risks as little confidence can be placed in the disaggregated asset data for several of the distributors. Input weights were then formed from the share of the cost of each of the five inputs in total cost.

Transpower data

Forming consistent time–series data for Transpower has proven to be particularly challenging given changes in reporting over time, particularly the different approach to reporting security product costs and associated changes in the reporting of wholesale market activity costs. The same basic approach to output and input specification used for the distributors has been followed. Two outputs are used: throughput measured by the number of kilowatt hours supplied and system capacity approximated by the number of MVA kilometres based on transformer capacity and line length. Throughput is allocated a weight of one third while system capacity is allocated a weight of two thirds. These ratios have been drawn from the distribution results excluding the connections component.

Three inputs are used: operating expenses, system capacity and transformer capacity. Operating expenses are taken directly from Transpower Annual Reports for the period from 1999 to 2003 and indexed back to 1996 using changes in the Gazetted Transpower Disclosure Information with adjustments to exclude the security product. It should be noted that the latter series was used for all years in our initial report but includes depreciation charges. System capacity is measured by MVA kilometres formed by extending the conversion factors reported above for higher voltages and transformer capacity is measured by the installed capacity in KVAs. Capital costs are again approximated by 12.5 per cent of the reported ODV and the ODV is allocated two thirds to lines and one third to transformers. These ratios are broadly in line with the available results for the distributors and are used in the absence of other information.

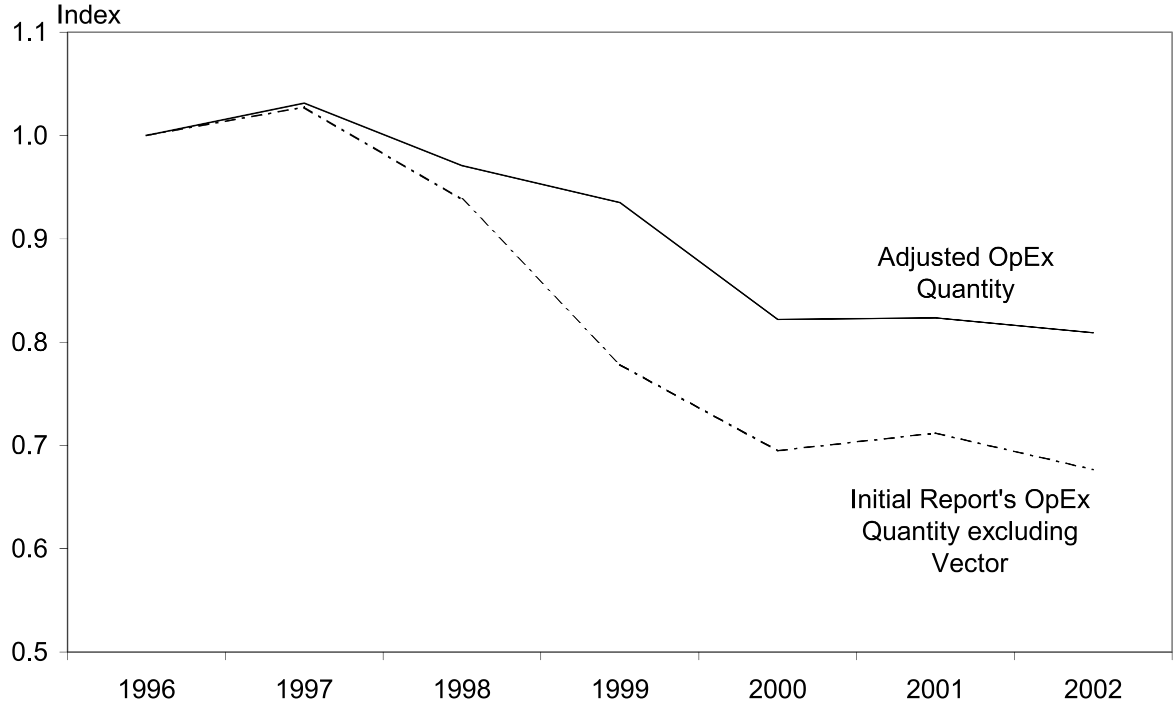
4.3 Data changes compared to the initial report

As well as updating the database to include data for the 2003 financial year, we have made a number of changes to data for other years in response to more information that has become available, including material presented in submissions and at the Commission's conference in November 2003. These changes cover six major areas that are outlined in this section.

Adjusting for reporting changes in 1999

During the 1999 financial year distribution and retail activities were separated into distinct legal entities and the Disclosure Data regulations were changed to require use of the avoidable cost allocation methodology. For some lines businesses this had little impact on reported distribution Disclosure Data but for a number of businesses that had previously been reporting some retail related activities in their distribution costs the changes were substantial. In our initial report we had insufficient information to adjust for the impacts of these changes which led to a substantial increase in apparent productivity in 1999 but undertook a sensitivity analysis on the assumption that productivity growth in 1998 could be projected forward to 1999. This analysis indicated that the trend growth rate of distribution TFP would be reduced from 3.2 per cent per annum to 2.6 per cent annum if this change was made. Further examination of the data has shown that output growth was substantially higher in 1998 than in 1999 which could lead to the method used in our initial report for adjusting for the accounting change overstating TFP growth in 1999.

Figure 3: **Adjusted and unadjusted operating expenditure quantity indexes for aggregate distribution, 1996–2002**



Charles Rivers Associates (2003) proposed an alternative method for adjusting for the changes by including a dummy variable for 1999 and later years in the regression that estimates the trend rate of TFP change. This produced a 'stepped' trend line and a trend rate of TFP growth of 1.8 per cent per annum. However, evidence presented in submissions and at the conference confirmed that the impacts of these accounting changes were confined to operating expenditure. Rather than adjusting the end TFP result for the accounting change, it is preferable to correct the component series involved seeing that it is only one of the components that is affected. This provides a more accurate correction for the accounting change as the impact of other changes on other components of TFP in 1999 is excluded. Consequently, in the current study we adjust for the 1999 accounting changes by applying the average change in the quantity of operating expenditure (ie in constant prices) observed in the two years on either side of the 1999 year to 1999.

The impact of this adjustment on the operating expenditure quantity index is shown in figure 3. The quantity of operating expenditure now decreases by only 3.7 per cent in 1999 compared to a 17 per cent decrease in 1999 in the series excluding Vector used in our initial report.

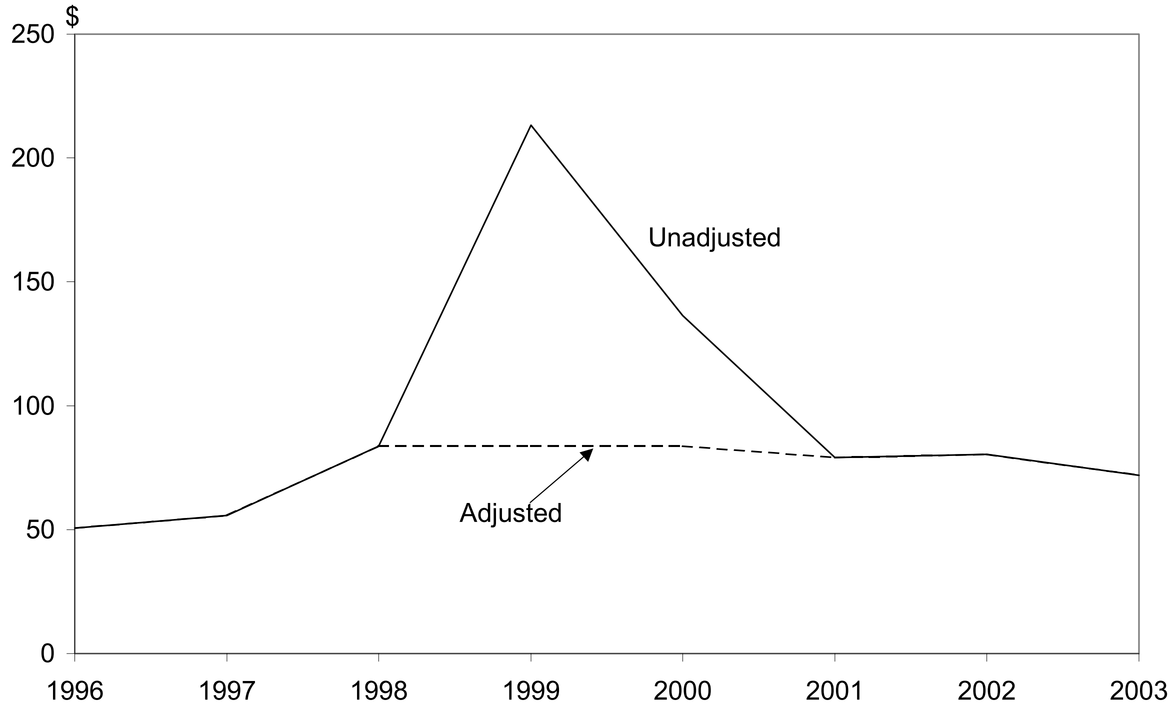
In its submission, Orion New Zealand (2003) presented a new operating expenditure series for the years 1996 to 1998 constructed using the accounting methods required from 1999 onwards. This data was endorsed by Audit New Zealand as being an accurate representation of a consistent operating expenditure series. As Orion New Zealand was one of the distributors most affected by the 1999 reporting requirement changes, we use this new series for Orion New Zealand in the Leontief cost function estimation used to derive output weights. For all other distributors in the Leontief cost function estimation we apply the same adjustment procedure to 1999 operating expenditure quantities as applied to the aggregate distribution data.

Adjusting for the 1999 Vector CBD outage

In our initial report we adjusted for the sizable and extraordinary impact of the 1999 Auckland CBD outage by excluding Vector from the aggregate distribution database for the purposes of calculating the industry TFP trend. However, this strategy becomes unusable with the inclusion of the 2003 data as Vector absorbed a large part of UnitedNetworks in that year and is thus not a comparable entity with earlier years. The impact of the CBD outage is confined to Vector's indirect costs per connection component of the productivity database for the years 1999 and 2000. Rather than attempting to exclude Vector (which accounts for a large proportion of the industry) it is preferable to adjust the indirect costs per connection series for these two anomalous years. Consequently, in the current study we assume that the indirect costs per connection figure reported by Vector for 1998 also applied in 1999 and 2000.

The impact of this on Vector's indirect costs per connection is illustrated in figure 4. Indirect costs per connection are reduced from the anomalous $213 in 1999 and $136 in 2000 to $84 in both years which is more consistent with Vector's indirect costs per connection for the other years in the series.

Figure 4: **Adjusted and unadjusted Vector indirect costs per connection, 1996–2003**



MVA kilometre conversion factors

A number of distributors questioned in their submissions whether the MVA kilometre conversion factors used in our initial report were sufficiently tailored to the specific operating conditions found in New Zealand and whether they were sufficiently disaggregated by voltage category. The Commerce Commission commissioned Parsons Brinckerhoff Associates (PBA 2003) to review the conversion factors. PBA proposed some revisions to the factors to reflect specific New Zealand conditions and separate conversion factors for 6.6 kV, 11 kV, 22 kV and 33 kV high voltage distribution lines in place of the weighted average factor used in our initial report. The conversion factors recommended by PBA are used in this report.

Definition of deemed revenue

A number of distributors noted in their submissions that the definition of deemed revenue used in our initial report included double counting of AC loss rental received and also included capital contributions which are not included as part of posted prices. These issues have been addressed by changing the definition of deemed revenue to include line charges

(‘RevLine2’) plus revenue from ‘other’ business plus AC loss rental rebates less payment for transmission charges less avoided transmission charges less AC loss rental expense paid to customers.

Data anomalies

A number of data anomalies have been identified and corrected in the database covering revenue, throughput, transformer capacity and operating expenditure including:

- The revenue figure used for Powerco in 2001 in the initial report only included revenue for 7 months due to merger activity. This has been corrected to reflect a 12 month figure.
- A change made by WEL Networks to its 2003 revenue to deduct discounts from lines charge revenue has been reversed.
- For the 2003 disclosure, Buller Electricity has removed a customer supplied directly from a Transpower grid exit point and which accounts for more than 50 per cent of total throughput. Buller has redisclosed throughput for 2000 to 2002, and we have estimated the values for the other years.
- In 2000, Orion New Zealand stopped disclosing privately owned transformers. To maintain continuity we have set the 1999 value to be the same as the 2000 value.
- In its submission on the Draft Decisions, Horizon Energy indicated that, up until the 2003 disclosure, it had included the competitive network stores function in its lines business accounts. This has now been removed from operating expenditure, consistent with the treatment of other distributors.
- Amortisation has been removed from Nelson Electricity’s operating expenditure.
- Top Energy included a benchmarked maintenance figure (a depreciation proxy) in its disclosed direct/indirect cost measures on top of actual maintenance. This double counting has been removed.
- Vector’s and Powerco’s reported costs for 2003 and Powerco’s reported costs for 2001 contain large non–recurring expenses associated with merger activity. As these non–recurring expenses are one–off, extraordinary items they are excluded from the analysis.

UnitedNetworks split up in 2003

The assets of UnitedNetworks were acquired by Vector, Powerco and Unison in the second half of the 2003 disclosure year. As a result, much of the 2003 Disclosure Data for Vector, Powerco and Unison are weighted averages, which do not fully reflect the pre–separation performance of UNL in 2003. Relevant data for these three distribution businesses have been scaled up to provide full year estimates incorporating their respective shares of

UnitedNetworks. It should be noted that the Vector, Powerco and Unison entities contained in the database for 2003 are very different to the corresponding entities in earlier years. Correspondingly, we do not include UnitedNetworks as a separate entity in the database in 2003 but it is included for earlier years.

Otago Power's operations in 2003

For the 2003 disclosure year, Marlborough Lines presented consolidated results for itself and OtagoNet (previously Otago Power), given its acquired 51 per cent share in OtagoNet. Because Marlborough Lines and OtagoNet are still distinct lines businesses for the purposes of the thresholds, the Commerce Commission requested Marlborough Lines to provide relevant disaggregated 2003 data for the two businesses. This disaggregated data for 2003 is included in the updated database so that these entities are consistent across all years.

Proposed changes rejected

In addition to the changes incorporated above, we have decided to reject two changes proposed in submissions. A number of submitters advocated the use of a constant price capital stock series (such as ODV) as the measure of capital input quantity in preference to the physical measures used in the initial report for the major capital components of overhead and underground lines and transformers. However, as noted in the preceding section, we believe the physical depreciation of these assets is best characterised by the 'one hoss shay' or 'light bulb' model which is reflected by the use of physical quantities rather than financial based measures which incorporate either straight line or declining balance depreciation assumptions. Several distributors, including Aurora Energy, supported this view at the conference. More importantly, submissions made by a number of distributors, such as Orion New Zealand (2003), highlighted the immature state of the current ODV estimates and the size of previous and proposed asset revaluations as better information comes to hand. Consequently, while it would be desirable to have even more differentiation between physical measures used on the output and input sides than those currently used, the current measures represent the best choices given the quality of available data.

Finally, some submitters such as Pacific Economics Group (2003) advocated the use of the logarithmic method of calculating the compound rate of change in key variables in preference to the regression based trend line fitted to series in our initial report. While there are several different ways of calculating trend or average growth rates, the New Zealand Disclosure Data still display a relatively high degree of variability. The logarithmic method places a lot of weight on the end points not being either outliers or unusual observations. PEG advocate choosing the end points on a peak–to–peak basis to ensure the end points are representative. However, given the relative shortness of the available time series and its variability, using the regression based trend minimises the sum of squares of residuals for all observations, including the end points and so is likely to be more representative of the underlying trend.

5 INDUSTRY PRODUCTIVITY AND THE B FACTOR

In this section we use the Fisher TFP index method to calculate the productivity performance of distribution as a whole and transmission for the eight years 1996 to 2003. We then examine evidence on input price changes before deriving implied B factors for distribution and transmission.

5.1 The Fisher TFP index

TFP is defined as the change in total output divided by the change in total inputs used between two periods. Mathematically, this is given by:

(11) $TFP = \Delta Q / \Delta I$

where ΔQ is the proportional change in the quantity of total output between the current period and the base period and ΔI is the corresponding proportional change in the quantity of total inputs.

To operationalise this concept we need a way to combine changes in diverse outputs and inputs into measures of change in total outputs and total inputs. To aggregate these changes in diverse components into a total change, index number methodology essentially takes a weighted average of the changes in the components. Different index number methods take this weighted average change in different ways. As indicated in section 2.2, alternative index number methods can be evaluated by examining their economic properties or by assessing their performance relative to a number of axiomatic tests. The index number which performs best against these tests and which is being increasingly favoured by statistical agencies is the Fisher ideal index.

Mathematically, the Fisher ideal output index is given by:

(12) $Q_F^t = [(\sum_{i=1}^{m} P_i^B Y_i^t / \sum_{j=1}^{m} P_j^B Y_j^B)(\sum_{i=1}^{m} P_i^t Y_i^t / \sum_{j=1}^{m} P_j^t Y_j^B)]^{0.5}$

where:

	Q_F^t	is the Fisher ideal output index for observation *t*;
	P_i^B	is the price of the *i*th output for the base observation;
	Y_i^t	is the quantity of the *i*th output for observation *t*;
	P_i^t	is the price of the *i*th output for observation *t*; and
	Y_j^B	is the quantity of the *j*th output for the base observation.

In this case we have three outputs (so *m* = 3) and seven years (so *t* = 1, …, 7).

Similarly, the Fisher ideal input index is given by:

(13) $I_F^t = [(\sum_{i=1}^n W_i^B X_i^t / \sum_{j=1}^n W_j^B X_j^B)(\sum_{i=1}^n W_i^t X_i^t / \sum_{j=1}^n W_j^t X_j^B)]^{0.5}$

where: I_F^t is the Fisher ideal input index for observation t;

W_i^B is the price of the ith input for the base observation;

X_i^t is the quantity of the ith input for observation t;

W_i^t is the price of the ith input for observation t; and

X_j^B is the quantity of the jth input for the base observation.

In this case we have five inputs (so $n = 5$) and seven years (so $t = 1, \ldots, 7$).

The Fisher ideal TFP index is then given by:

(14) $TFP_F^t = Q_F^t / I_F^t$.

The Fisher index can be used in either the unchained form denoted above or in the chained form used in this study where weights are more closely matched to pair–wise comparisons of observations. Denoting the Fisher output index between observations i and j by $Q_F^{i,j}$, the chained Fisher index between observations 1 and t is given by:

(15) $Q_F^{1,t} = 1 \times Q_F^{1,2} \times Q_F^{2,3} \times \ldots . \times Q_F^{t-1,t}$.

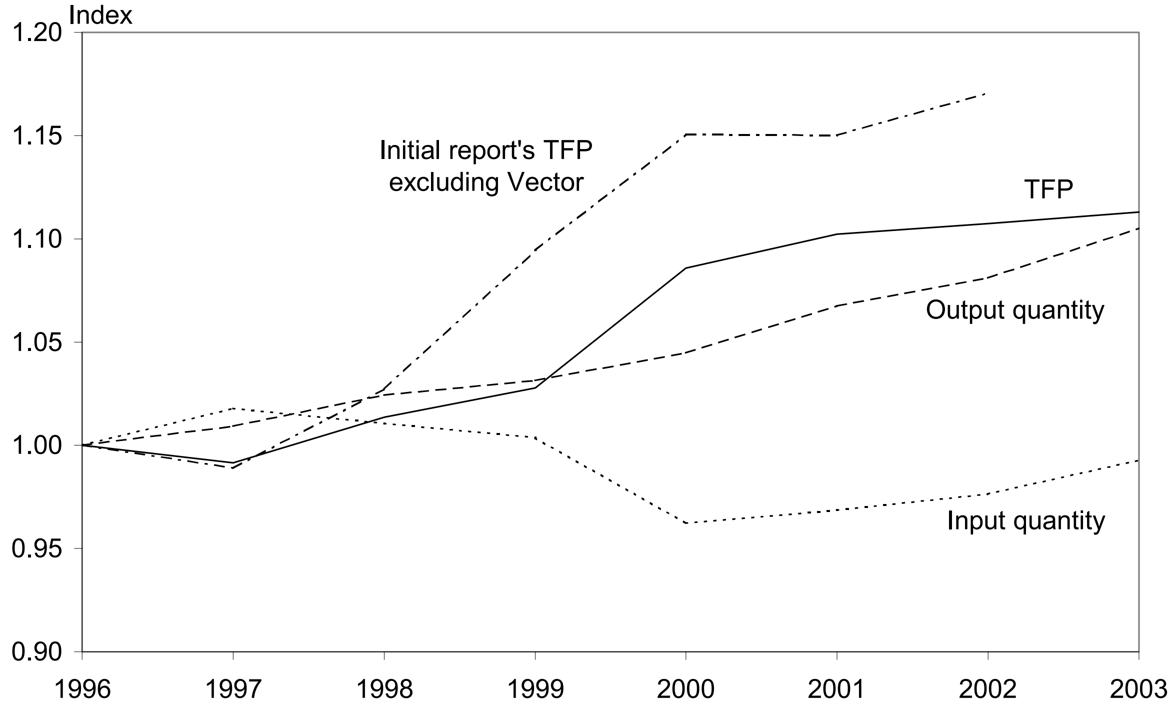
5.2 Aggregate distribution productivity

Our model of aggregate distribution TFP involves the three outputs and five inputs defined in section 4.2. The outputs are energy delivered in kilowatt hours, system line capacity in MVA kilometres and connection numbers. The five inputs are operating costs, overhead lines capital, underground lines capital, transformer capital and other capital items.

TFP results for the aggregate distribution industry are presented in figure 5 and table 2 using the chained Fisher indexing method and the eight years of available data from 1996 to 2003. As described in the preceding section, a number of revisions have been made to the database. The two most important of these are adjustment of operating expenditure for the 1999 accounting changes by applying the average change in the quantity of operating expenditure for the years 1997, 1998, 2000 and 2001 to 1999 and adjusting for the 1999 Auckland CBD outage by applying Vector's 1998 indirect cost per connection to 1999 and 2000. The TFP series excluding Vector from our initial report is also included in figure 5 for comparison.

Output quantity increases steadily over the period although somewhat more rapidly after 2000. Input quantities were initially relatively flat through to 1999 before falling somewhat in 2000 and again remaining relatively flat for the last three years. The TFP index increased by 3 per cent between 1996 and 1999. The TFP index then increased by 5.6 per cent in 2000 and by another 2.5 per cent through to 2003, the latter driven mainly by increased output quantities. For the 8 year period aggregate distribution TFP increased at a trend annual rate of 2 per cent.

Figure 5: Aggregate distribution output, input and TFP indexes, 1996–2003



Source: Meyrick and Associates estimates

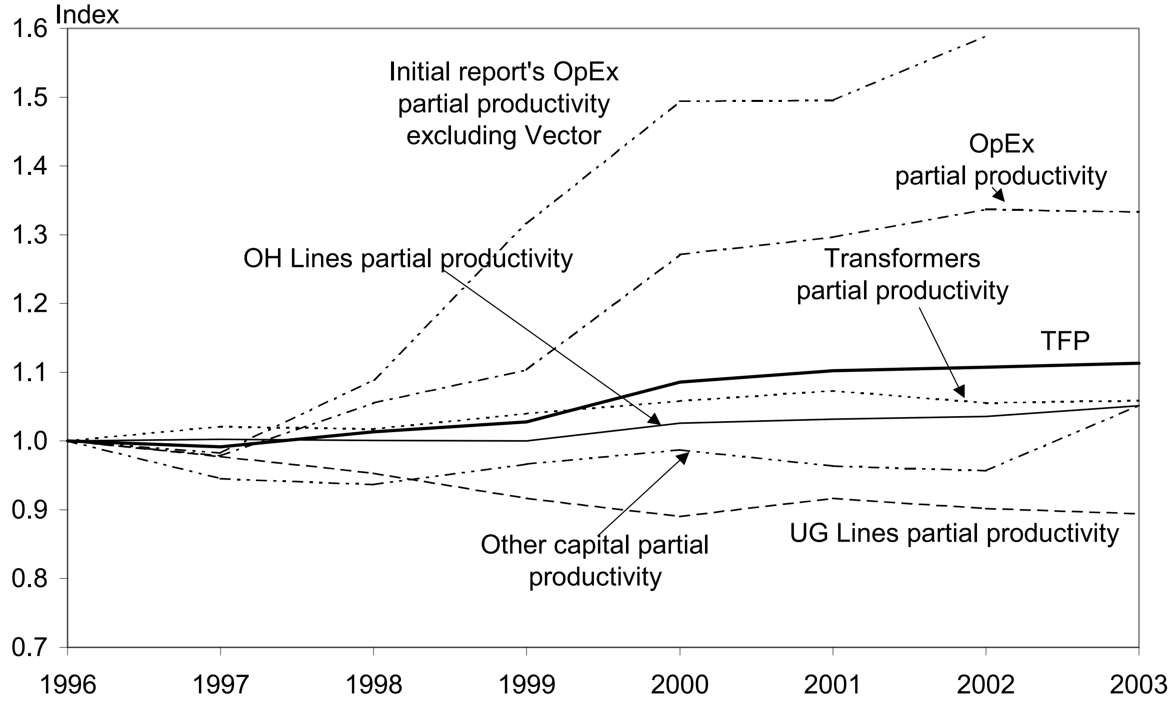
Table 2: **Aggregate distribution TFP and partial productivity indexes, 1996–2003**

	Quantity indexes			Partial productivities				
	Outputs	Inputs	TFP	OpEx	O/H lines	U/G lines	T'formers	Other
1996	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1997	1.009	1.018	0.992	0.979	1.003	0.977	1.021	0.945
1998	1.024	1.011	1.014	1.055	1.001	0.953	1.017	0.936
1999	1.031	1.004	1.028	1.103	1.000	0.916	1.040	0.967
2000	1.045	0.962	1.086	1.271	1.026	0.890	1.058	0.987
2001	1.067	0.969	1.102	1.296	1.032	0.916	1.073	0.963
2002	1.081	0.976	1.107	1.336	1.036	0.901	1.055	0.956
2003	1.105	0.993	1.113	1.333	1.051	0.894	1.059	1.052

Source: Meyrick and Associates estimates

The TFP index increased by only 0.5 per cent in 2003 despite an increase in output of over 2 per cent. This was due to an increase in estimated operating expenditure for the aggregate of the full year equivalents of Vector, Powerco and Unison of 7 per cent (despite the removal of one–off, non–recurring costs associated with the merger) due to assumptions made in scaling the data to full year equivalents. This led to operating expenditure for the industry as a whole increasing by 5.6 per cent in 2003. It is unlikely that this high estimated cost level is likely to be representative of the post–acquisition operating costs of the three distribution businesses involved in the UnitedNetworks acquisition and an analysis of distribution TFP which includes the 2003 data is likely to understate the long term TFP trend growth rate. Excluding the 2003 data leads to a trend growth rate in TFP of 2.1 per cent for the seven years 1996 to 2002. As less confidence can be placed in the estimated 2003 operating expenditure data constructed for the full year equivalents of the three businesses that acquired UnitedNetworks, we take the trend TFP growth rate up to 2002 as the most robust estimate.

Figure 6: Aggregate distribution partial productivity indexes, 1996–2003



Source: Meyrick and Associates estimates

In figure 6 and table 2 we present the five aggregate distribution partial productivities – the output quantity index divided by the relevant input quantity index – for the new database and the operating expenditure partial productivity index from our initial report for comparison. The partial productivity of operating costs has increased by around one third between 1996 and 2003 while the partial productivities of transformers, overhead lines and other capital have all increased by over 5 per cent. The increase in operating expenditure's partial productivity is now considerably less than that found in our initial report.

The partial productivity of underground lines has decreased by 10 per cent reflecting the increasing use of undergrounding. TFP is essentially a weighted average of these five partial productivities and lies above the four capital partial productivities but below operating expenditure partial productivity. TFP lies closer to the capital partial productivities reflecting the relative weights used in constructing the TFP index.

Given the assumptions that have had to be made to assemble 2003 data in the wake of the UnitedNetworks split, we take the trend annual TFP growth rate for all distributors of 2.1 per cent for the period 1996 to 2002 as our preferred estimate of distribution TFP performance.

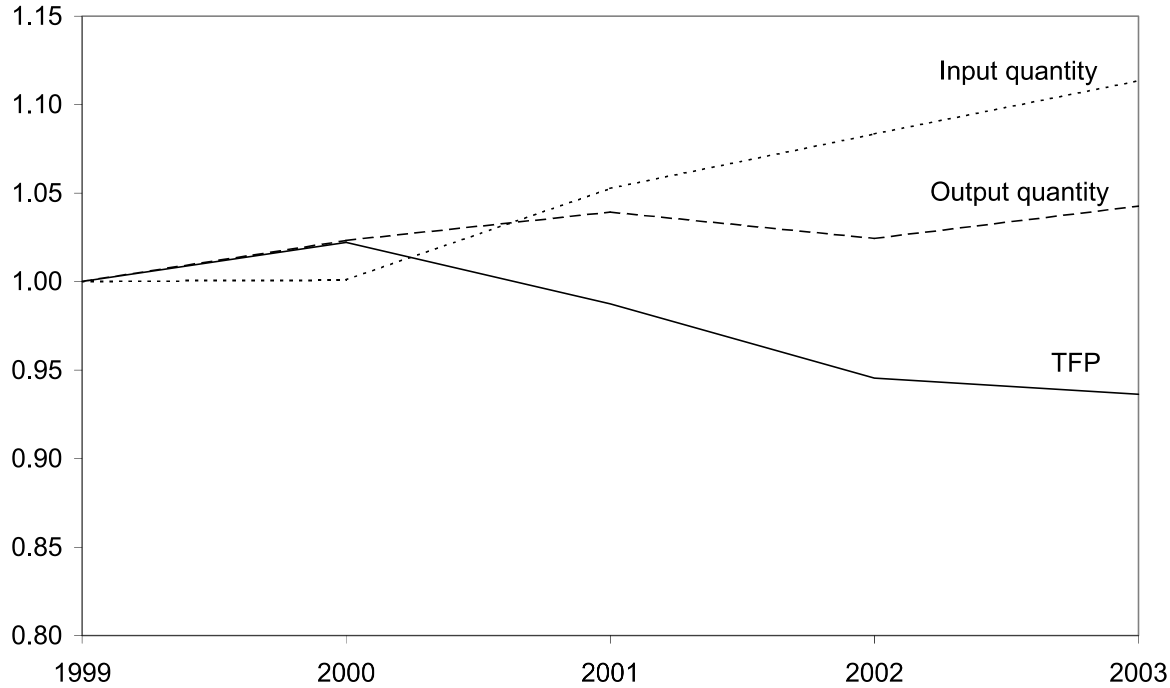
5.3 Transmission productivity performance

Obtaining consistent data for Transpower has proven to be particularly challenging with a number of changes in reporting methods, particularly the approach to reporting 'security' product costs, several major revaluations of ODV and the move to the avoided cost allocation methodology in 1999. We have constructed a model of transmission TFP that includes two outputs (throughput in kilowatt hours and a transformer capacity based estimate of MVA kilometres) and three inputs (operating costs, line capacity in MVA kilometres and transformer capacity in KVAs). As outlined in section 4.2, the throughput and system capacity outputs are allocated weights of one third and two thirds, respectively, broadly in line with the cost function distribution estimates excluding the connections output.

The operating expenditure series for Transpower used in our initial report was taken directly from the gazetted disclosures. However, subsequent investigation has revealed that this series includes depreciation and is, thus, inappropriate for a productivity study. A consistent time series of Transpower's net operating expenditure data prior to 1999 is not currently available. While the requirement to separate lines and retail functions was not relevant to Transpower, its disclosures were affected by the change in cost allocation requirements between the 1994 and 1999 Regulations. It has also been necessary to convert transformer capacity to a common reporting measure for the period.

TFP results for transmission are presented in figure 7 and table 3 using the chained Fisher indexing method. Output quantity increased steadily in 2000 and 2001 before falling marginally in 2002 due to reduced throughput associated with the drought and small reductions in the line length employed. In 2003 output was 4 per cent above its 1999 level. Input quantities remained flat in 2000 before increasing in markedly in the subsequent years. By 2003 input use was 11 per cent above its 1999 level. The TFP index increased by 2 per cent between 1999 and 2000 but then fell steadily to end up 6 per cent below its 1999 level in 2003. For the 5 year period transmission TFP decreased at a trend annual rate of 2.1 per cent. However, a decline in productivity of this magnitude is highly implausible and is most likely an artefact of the short time period available.

Figure 7: Transmission output, input and TFP indexes, 1999–2003



Source: Meyrick and Associates estimates

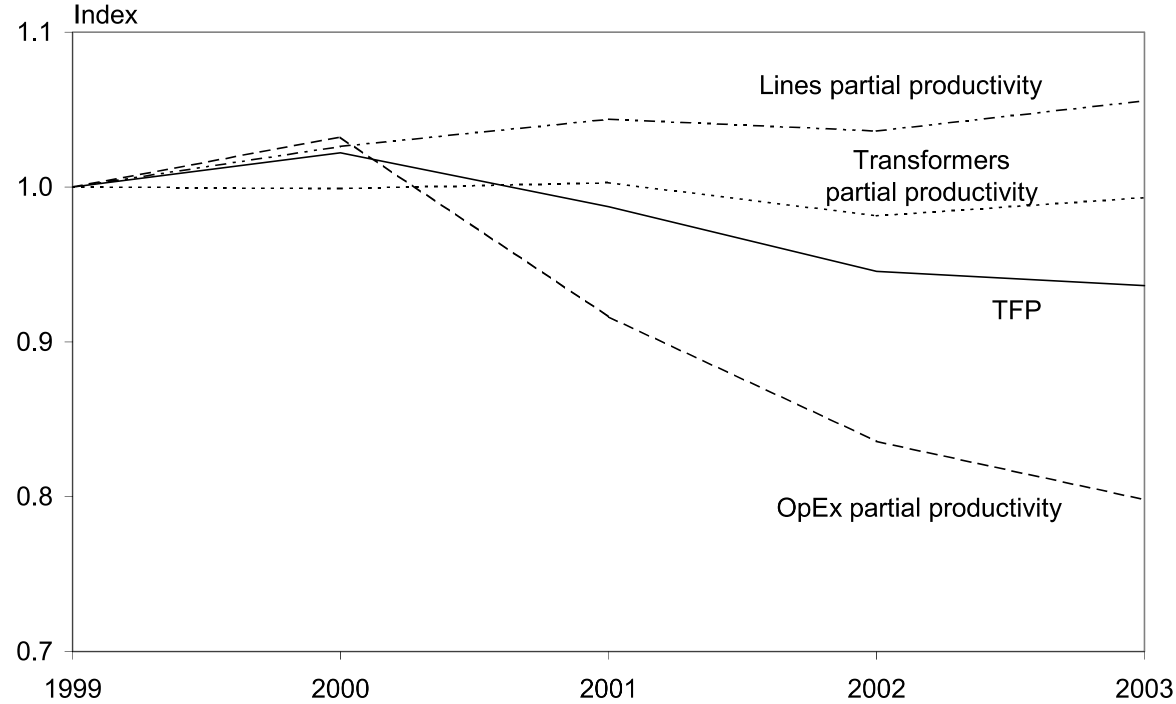
Table 3: **Transmission TFP and partial productivity indexes, 1999–2003**

	TFP	Quantity indexes		Partial productivity indexes		
	index	Outputs	Inputs	OpEx	Lines	Transformers
1999	1.000	1.000	1.000	1.000	1.000	1.000
2000	1.022	1.023	1.001	1.032	1.026	0.999
2001	0.987	1.039	1.053	0.916	1.044	1.003
2002	0.945	1.024	1.083	0.836	1.036	0.981
2003	0.936	1.043	1.114	0.798	1.056	0.993

Source: Meyrick and Associates estimates

In figure 8 and table 3 we present the three transmission partial productivity indexes. The partial productivity of operating costs increased by 3 per cent in 2000 before dropping away to finish up 20 per cent above its 1999 level in 2003. The partial productivity of lines has been more steady and increased by 6 per cent as output quantity has increased faster than the capacity of overhead lines over the 5 years. Transformer partial productivity has remained flat over the period. TFP is essentially a weighted average of these three partial productivities and lies below the two capital partial productivities but above the operating cost partial productivity. TFP again lies closer to the capital partial productivities reflecting the relative weights used in constructing the TFP index.

Figure 8: Transmission partial productivity indexes, 1999–2003



Source: Meyrick and Associates estimates

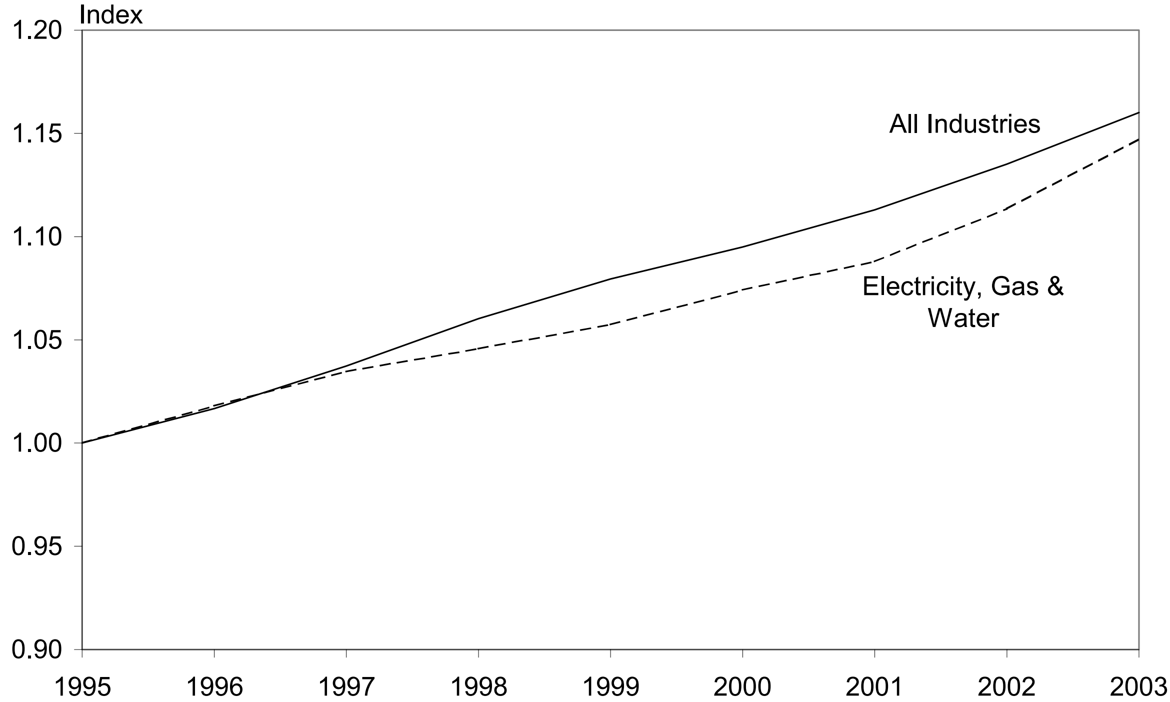
Given the short time period available, the TFP estimates presented for Transpower are not considered to be sufficiently robust for use in setting the B factor to apply to Transpower. Obtaining better quality transmission data and forming robust estimates of Transpower's productivity performance should be a priority for future work.

5.4 Input price changes

As well as information on the difference between the productivity performances of the electricity industry and the economy as a whole, we also require information on the difference between the electricity industry's and the economy's input price growth rates to derive the B factor. In our initial report we used the labour cost indexes for the electricity, gas and water sector and the market sector of the economy to represent input prices for lines businesses and the economy, respectively. While only covering part of overall input costs, these indexes were considered the most robust available. The trend rate of input price increase in the economy was found to be 0.5 per cent higher than in the electricity, gas and water sector.

A number of submitters advocated the use of a capital price index instead of the labour cost index given the capital intensity of lines businesses. Many lines businesses also noted they are experiencing a significant increase in the wages paid to linesmen in response to recruitment of local linesmen by overseas lines businesses, particularly from Ireland and Australia. In response to these submissions we have examined a broader range of input price indexes.

Figure 9: **All salaries and wages price indexes, 1995–2003**

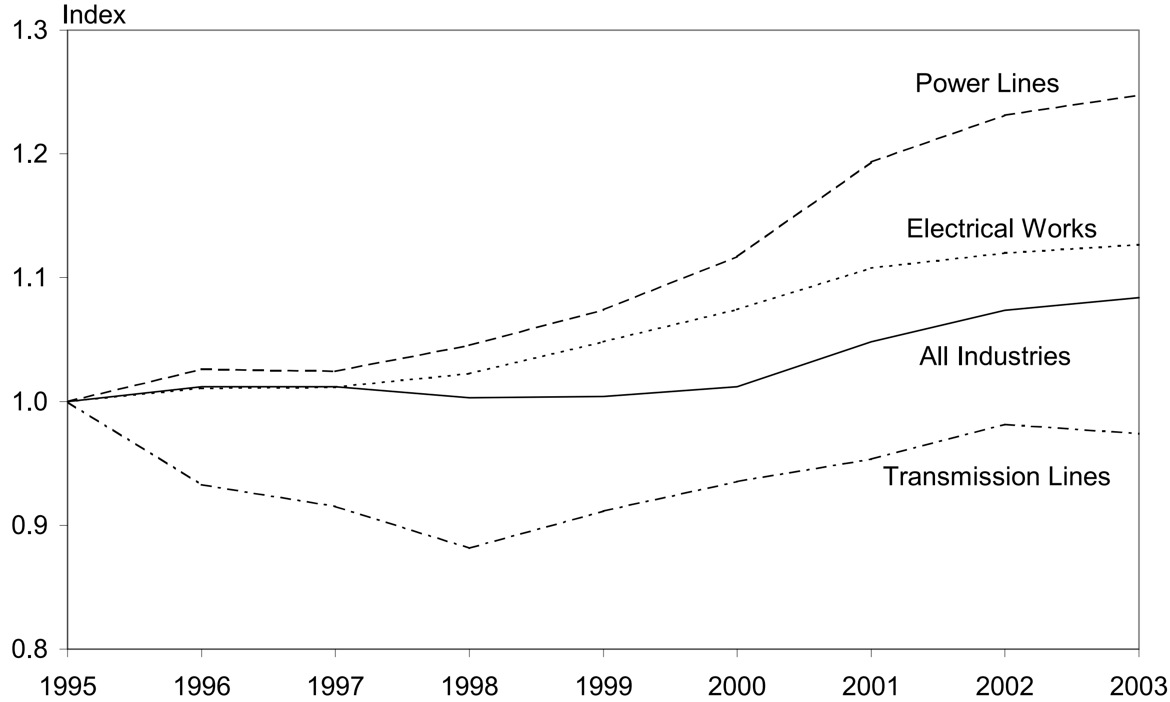


Source: Statistics New Zealand

Updating the labour cost comparison and changing to the 'all industries' price index for all wages and salaries given its better availability and the corresponding broader index for the electricity, gas and water sector failed to reveal a marked reversal in the pattern of electricity, gas and water sector labour costs relative to the economy up to the end of March 2003. These indexes are plotted in figure 9. There is some narrowing in the gap between the two indexes in 2002 and 2003, with the all industries index increasing at a trend growth rate of 1.83 per cent for the nine year period 1995 to 2003 and the electricity, gas and water sector index increasing at a trend rate of 1.58 per cent. This still leaves a price differential of 0.25 per cent. While the main impact of the reported shortage of linesmen may not have impacted until after March 2003, there is also increasing evidence of a general shortage of skilled labour in the economy (Watson 2003). This means that any upturn in the price of electricity, gas and water labour costs may be matched by increased wage rates in other parts of the economy.

Charles Rivers Associates (2003) advocated the use of Statistics New Zealand's distribution power line capital price index to represent lines businesses' input prices. This price index shows rapid increase between 1999 and 2001 with more modest increases on either side of this period. This period of rapid price increase produces a relatively high trend growth rate for this price index of 3 per cent between 1995 and 2003. This compares to a 1 per cent trend increase for the capital price index for all sectors over the same period. Examination of related capital price indexes does, however, produce a different picture. From figure 10 we see that the SNZ transmission power line price index for the same period behaves very differently and only increases by a trend rate of 0.3 per cent. Information supplied by SNZ shows that the two indexes have very similar regimen (31 per cent cable and wire, 20 per cent wages and salary, 12 per cent excavation, 9 per cent concrete and poles, 7 per cent nuts and bolts, 5 per cent machinery hire and 3 per cent transport and storage). This makes explanation of the differences in these indexes difficult.

Figure 10: **Capital price indexes, 1995–2003**



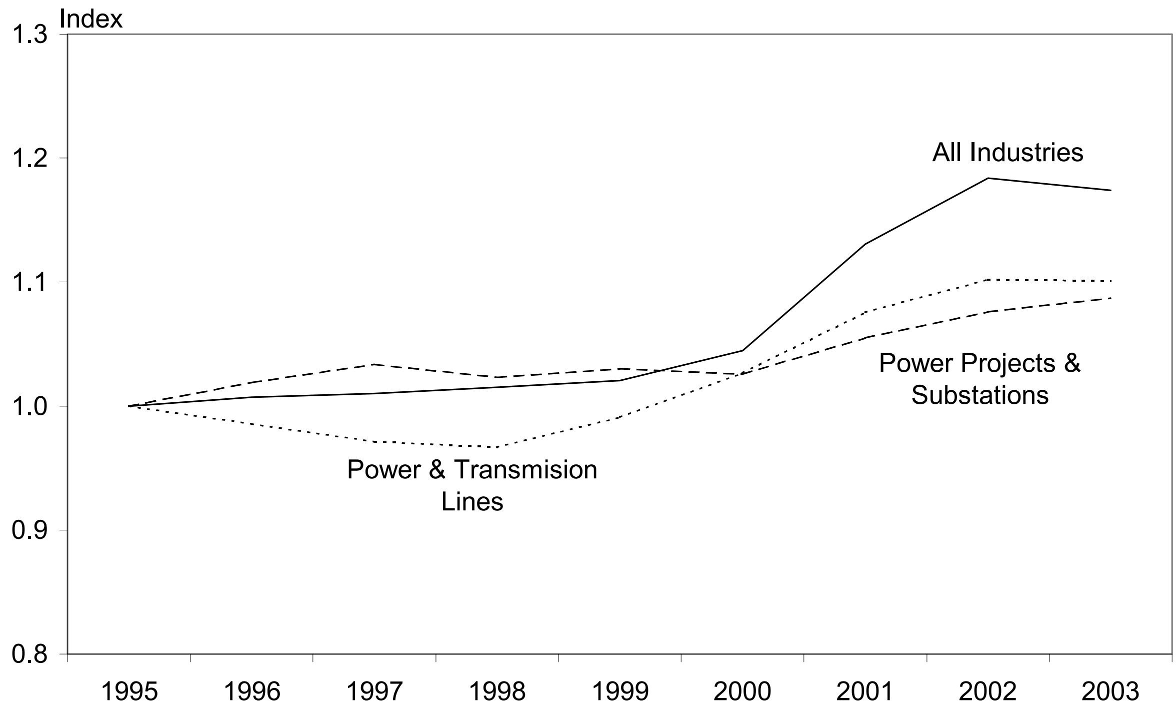
Source: Statistics New Zealand

A third capital price index in figure 10 shows the price of 'electrical works' increasing somewhat faster than the capital price index for all sectors at a trend rate of 1.7 per cent per annum. However, this price index covers a wide range of activities outside of lines businesses such as installing traffic lights and telecommunications facilities as well as power line construction.

Overall, little conclusive evidence can be drawn from the capital price indexes due to the conflicting nature of the information from different relevant indexes.

A third group of candidate input price indexes are shown in figure 11. These are producer price indexes which show movements in purchased or intermediate inputs, excluding capital goods. There are two relevant electricity producer price indexes – the power and transmission lines index and the power projects and substations index. In this case both these indexes show a lower trend increase than that for all industries. The power projects and substations producer price index increases by 0.9 per cent per annum, the power and transmission lines index by 1.6 per cent per annum and the all industries producer price index by 2.3 per cent per annum. Information on the regimen of the power and transmission lines producer price index supplied by SNZ is again very similar to that listed above for the distribution power lines capital price index but the trend rate of increase for the producer price index is only half that of the corresponding capital price index.

Figure 11: **Producer price indexes, 1995–2003**

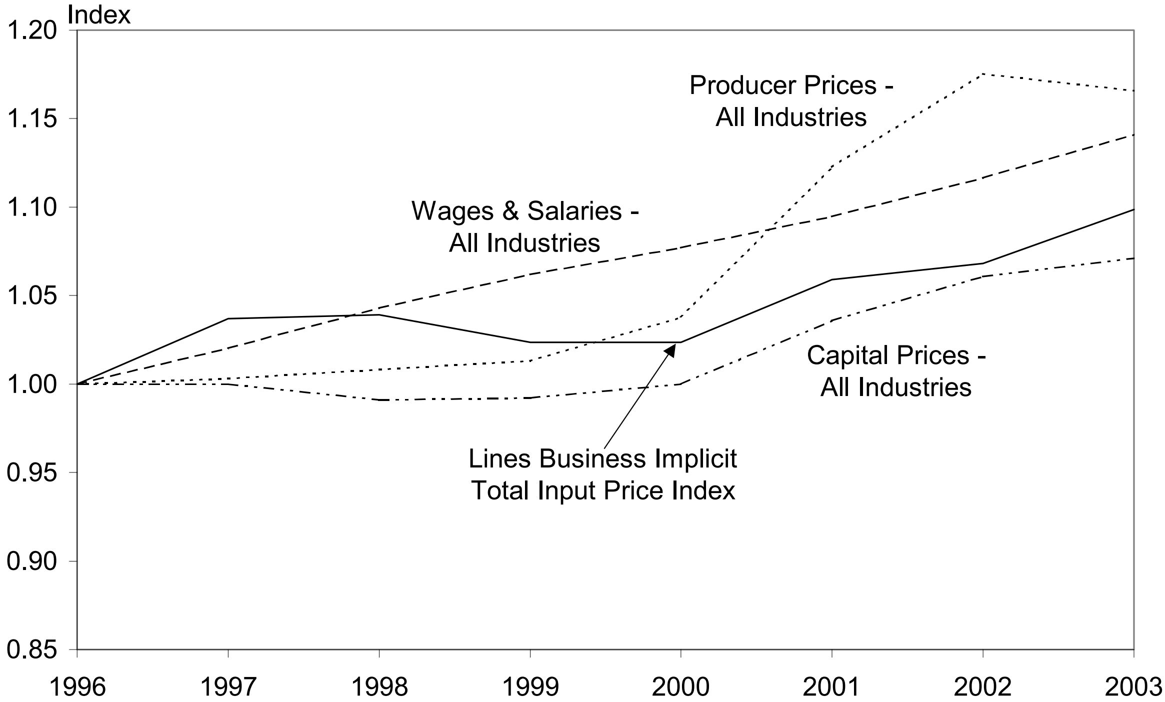


Source: Statistics New Zealand

Another way of measuring lines business input prices is to take the implicit total input price index derived from the distribution TFP database and analysis of the preceding section. This implicit price index is formed by dividing total distribution lines business costs by the total input quantity index. This price index has the advantage of being specific to lines businesses and is, by definition, completely consistent with the TFP analysis. However, its robustness will be dependent on the quality of the data in the TFP database. This index is plotted in figure 12 along with the SNZ wage, capital and producer price indexes for all industries. The lines business input price index increases at a trend annual rate of 1 per cent over the period

1996 to 2003. This is the same annual trend rate of increase as the capital price index for all industries but substantially less than the annual trend rates of increase in producer and labour prices for all industries (2.3 per cent and 1.9 per cent, respectively).

Figure 12: **Lines business and economy–wide price indexes, 1996–2003**



In conclusion, we have several conflicting pieces of information on the movement of lines business input prices relative to those for the economy as a whole. Wage rates in the electricity, gas and water sector have increased by less than those for all industries in the nine years to March 2003 although the gap has narrowed somewhat in the last two years and anecdotal evidence points to a shortage of linesmen. However, tightening labour market conditions in general are also likely to see an acceleration in wage increases for the economy as a whole. Capital price indexes give conflicting information with one power line price index increasing faster than the capital price index for all sectors and the other major power line price index increasing less rapidly than the all sectors index. Producer price indexes, on the other hand, show that lines business input prices have increased less rapidly than input prices for all industries.

One response to this would be to say that four of the five most relevant SNZ price indexes increase less rapidly for lines business than for the economy as a whole and hence there should be a positive price differential term in calculating the B factor as we had in the initial report. Similarly, the implicit total inputs price index derived from the distribution TFP database increases by substantially less than two of the three broad input price indexes for all industries.

An alternative argument advanced by Pacific Economics Group (2003) is that unless there is clear cut evidence of a statistically significant difference in rates of input price increase then the price differential term should be set at zero. In light of the conflicting information coming through from the official statistics and the fact that the implicit input price index derived from the database is close to the all industries capital price index (and this is a capital intensive industry), we adopt the Pacific Economics Group approach of minimising risks by setting the price differential to zero.

5.5 B factor conclusions

Based on the review of available information for the lines businesses in this section and for the economy in section 3, we can now draw conclusions on the appropriate size of the B factor for distribution. In both forming and using these conclusions we need to be cognizant of the less than perfect quality of the data they are based on.

In terms of the two productivity components, we have the preferred annual growth rate for TFP in the New Zealand economy of 1.1 per cent per annum using the trend rate derived from the indexes reported in the Treasury update of Diewert and Lawrence. For the distribution lines businesses we have derived a trend annual TFP growth rate of 2.1 per cent per annum from the adjusted Disclosure Data. While lower than the growth rate obtained in our initial report using the unadjusted Disclosure Data, the current database makes better allowance for the accounting changes introduced in 1999 and the extraordinary effects of the Auckland CBD outage. A number of anomalies and inconsistencies in the original Disclosure Data have also been detected and corrected in the current database. The estimate of a 2.1 per cent per annum TFP growth rate for the industry for the seven year period 1996 to 2002 is likely to be lower than that which could be expected over the next several years as economies from the recent split up of UnitedNetworks are realised. The 2003 year exhibited what are likely to be unusually large increases in aggregate operating expenditure as a result of this split up, as well as assumptions used in scaling operating expenditure data for the acquiring businesses to full year equivalents.

The annual input price trends observed in the preceding section produce no consistent pattern for an input price differential. Labour cost increases still appear higher for the economy as a whole than for lines businesses although some anecdotal evidence indicates that wage rates for linesmen are likely to increase further due to recruitment activities by overseas utilities. Capital price indexes produce mixed information with relevant power line construction price indexes increasing both faster and slower than capital price indexes for the economy as a whole. Producer price input indexes for power lines, power projects and substations have increased less rapidly than the producer price input index for all industries. Despite the fact that four of the most relevant five SNZ input price indexes increase less rapidly for lines businesses than for the economy as a whole, it is appropriate to adopt a zero price differential in constructing the B factor given the uncertainty involved.

Substituting these figures in equation (7) we obtain the following for distribution:

$$(16) \quad B = [(\Delta TFP - \Delta TFP_E) - (\Delta W - \Delta W_E)]$$

$$= [(2.1\% - 1.1\%) - (0\%)]$$

$$= [(1.0\%) - (0\%)]$$

$$= 1.0\%$$

We recommend, therefore, that a B factor of 1.0 per cent would be appropriate for distribution lines businesses.

At this time insufficient information is available to construct a robust TFP estimate for transmission over a long enough period for use in deriving a separate B factor for transmission. In light of this, and given that the Commission intends resetting Transpower's price path threshold for only one year, a reasonable proxy in the short term would be to also apply the B factor derived above for distribution to transmission.

6 DISTRIBUTOR PRODUCTIVITY AND C FACTORS

As well as the industry productivity growth related B factor, our initial report proposed using a number of additional considerations in setting distributors' X factors. These distributor–specific considerations were to be represented by a C factor for each distributor reflecting the distributor's comparative productivity performance (taking account of differences in distributors' operating environments to the maximum extent possible) and relative profitability. Those distributors performing better than the industry average on productivity levels and those earning low rates of return would be set less onerous overall X factors compared to those performing near the industry average. Those performing worse than the industry average on productivity levels and those earning high rates of return would be set more onerous overall X factors compared to those performing near the industry average.

The overall X factor for a given distributor is made up of an amalgam of its B and C factors. The B factor is common to all distributors and the C factors are to be determined for broad groups of distributors.

We again proceed with a two stage analysis. The first stage allocates distributors to three groupings based on relative productivity performance while the second stage allocates distributors to three groupings based on profitability considerations. We then form overall C factor groupings by summing the relative productivity and profitability components.

In this section we initially concentrate on the comparative productivity performance of the 28 distributors existing in 2003 (29 in earlier years) using an extension of the TFP index concept used in section 5 to enable 'multilateral' comparisons using combined time series, cross section or 'panel' data. We then examine profitability levels using an enhanced version of the residual rate of return analysis presented in the initial report before using all this information to allocate distributors to four broad C factor groups.

6.1 Multilateral TFP

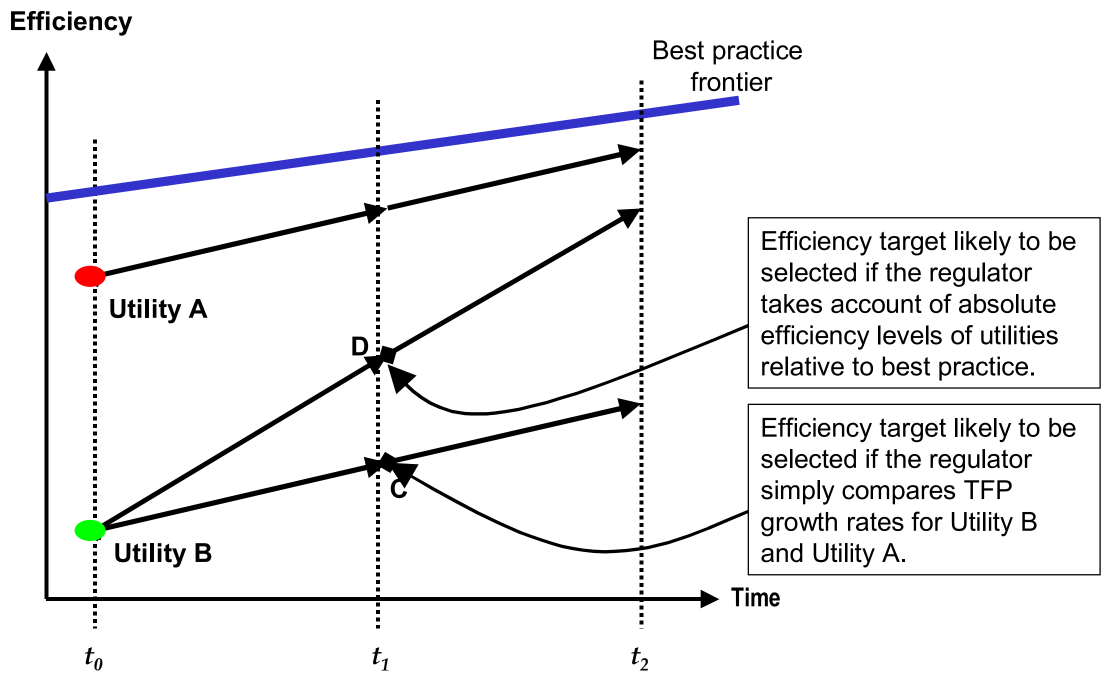
The advantages of the standard TFP indexes were outlined in section 2.2. These include the following:

- indexing procedures are simple and robust;
- they can be implemented when there are only a small number of observations;
- the results are readily reproducible;
- they have a rigorous grounding in economic theory;
- the procedure imposes good disciplines regarding data consistency; and

- they maximise transparency in the early stages of analysis by making data errors and inconsistencies easier to spot than using some of the alternative techniques.

For benchmarking purposes we need to extend the time series indexing methods discussed in the earlier sections to include analysis of productivity levels as well as growth rates. The reasons for this can be illustrated using figure 13 where the efficiency performance of two similar utilities is plotted relative to a best practice frontier. Utility A is initially performing at close to best practice efficiency as reflected by its closeness to the best practice frontier while Utility B is initially well below best practice efficiency. Say we are reviewing the utilities at time t_1 and setting price caps for the period through to t_2. Because Utility A is close to best practice initially it will have limited options for efficiency improvement and so its productivity growth rate will consist of small movements towards the frontier plus movement of the frontier due to technical change which will be relatively slow in industries like electricity distribution. Utility B, on the other hand, has the potential to make large catch–up changes to its operations and so could achieve a much higher productivity growth rate than Utility A although it is starting from a much lower productivity level.

Figure 13: Efficiency levels and growth rates



If Utility B had a low productivity growth rate in the period up to t_1 getting only to point C then in the absence of yardstick competition we would have no way of distinguishing Utilities A and B. Extrapolating the low productivity growth rate would be appropriate for Utility A but inappropriate for Utility B. Rather, Utility B should be set a higher X factor to provide it with an incentive to move closer to the frontier. If, on the other hand, Utility B had

had a higher growth rate in the period up to t_1 getting to point D then extrapolating this growth rate in setting the X factor would be appropriate. However, setting an X factor of that magnitude would be inappropriate and indeed unachievable for Utility A. Only by examining the utilities' productivity levels as well as their growth rates can we set appropriate X factors for them.

Traditional measures of TFP such as those discussed earlier in the report have enabled comparisons to be made of rates of change of productivity between organisations but have not enabled comparisons to be made of differences in the absolute levels of productivity in combined time series, cross section data. This is due to the failure of conventional TFP measures to satisfy the important technical property of transitivity. This property states that direct comparisons between observations *m* and *n* should be the same as indirect comparisons of *m* and *n* via any intermediate observation *k*.

Caves, Christensen and Diewert (1982) developed the multilateral translog TFP (MTFP) index measure to allow comparisons of the absolute levels as well as growth rates of productivity. It satisfies the technical properties of transitivity and characteristicity which are required to accurately compare TFP levels within panel data. Lawrence, Swan and Zeitsch (1991) and the Bureau of Industry Economics (BIE 1996) have used this index to compare the productivity levels and growth rates of the five major Australian state electricity systems and the United States investor–owned system. Zeitsch and Lawrence (1996) use the method to compare the efficiency of coal–fired electricity generation plants in the United States, Canada and Australia.

The Caves, Christensen and Diewert (CCD) multilateral translog index is given by:

$$(17) \qquad \log (TFP_m/TFP_n) = \sum_i (R_{im}+R_i^*) (\log Y_{im} - \log Y_i^*)/2 - \sum_i (R_{in}+R_i^*) (\log Y_{in} - \log Y_i^*)/2 - \sum_j (S_{jm}+S_j^*) (\log X_{jm} - \log X_j^*)/2 + \sum_j (S_{jn}+S_j^*) (\log X_{jn} - \log X_j^*)/2$$

where R_i^* (S_j^*) is the revenue (cost) share averaged over all utilities and time periods and $\log Y_i^*$ ($\log X_j^*$) is the average of the log of output *i* (input *j*). In the main application reported in the following section we have three outputs (throughput, system line capacity and connections) and, hence, *i* runs from 1 to 3. We have five inputs (operating expenses, overhead lines, underground cables, transformers and other capital) and, hence, *j* runs from 1 to 5. The Y_i and X_j terms are the output and input quantities, respectively, described in section 6.1. The R_i and S_j terms are the output and input weights, respectively, from section 4.2.

The formula in (17) gives the proportional change in MTFP between two adjacent observations (denoted *m* and *n*). An index is formed by setting some observation (usually the first in the database) equal to one and then multiplying through by the proportional changes between all subsequent observations in the database to form a full set of indexes. The index for any observation then expresses its productivity level relative to the observation that was set equal to one. However, this is merely an expositional convenience as, given the invariant nature of the comparisons, the result of a comparison between any two observations will be independent of which observation in the database was set equal to one.

This means that using equation (17) comparisons between any two observations *m* and *n* will be both base–distributor and base–year independent. Transitivity is satisfied since comparisons between the two distributors for 1999 will be the same regardless of whether they are compared directly or via, say, one of the distributors in 2002. An alternative interpretation of this index is that it compares each observation to a hypothetical average distributor with output vector $\log Y_i^*$, input vector $\log X_j^*$, revenue shares R_i^* and cost shares S_j^*.

With the index number MTFP approach there is scope to capture density related operating environment conditions by the specification of multiple outputs. For example, in previous studies, output specifications that focus on energy delivered have tended to favour dense urban distributors while output specifications that have focused on the network's capacity as measured by MVA–kilometres have tended to favour low density rural distributors (Tasman Asia Pacific 2000a,b). Incorporating both the energy delivered and network capacity measures of distribution output leads to a more even–handed treatment of urban and rural distributors. By choosing multiple outputs such as energy delivered, MVA–kilometres and connection numbers, it is possible to incorporate aspects of density such as customers per kilometre and energy delivered per customer into the MTFP measure directly in an analogous fashion to how this is captured in multiple output econometric cost functions (see Tasman Asia Pacific 2000a,b and Pacific Economics Group 2000a,b).

The multilateral TFP index has some important advantages. It is a robust technique which is relatively insensitive to data errors, does not require a large number of observations, provides information on productivity levels as well as growth rates and can be readily communicated to non–technical audiences. In the following section we present the results of the MTFP analysis.

6.2 MTFP results

The database we used in section 5 to calculate the overall distribution industry productivity performance was formed by aggregating the individual data for the 29 distributors for the years 1996 to 2002 and for the 28 full–year equivalent distributors in 2003. In this section we use the same data from the distributors but for the five years 1999 to 2003 and look at individual distributor results. We use the shorter time period in this analysis because it avoids problematic individual distributor data issues associated with the 1999 accounting changes and only recent information is used to determine distributor productivity rankings. A sensitivity analysis conducted on the database used in our initial report indicated there were no changes in allocation of distributors to productivity groupings in moving from a seven year analysis for the period 1996 to 2002 to a four year analysis for the period 1999 to 2002.

We again use three outputs (throughput in kilowatt hours, system line capacity in MVA kilometres and connection numbers) and five inputs (operating costs, overhead line capacity, underground line capacity, transformer capacity in KVAs and other capital). The main decision we have to make again relates to how to weight the three outputs together. Our preferred weighting method relies on New Zealand empirical evidence. As described in section 4.2, we use the weighted average estimated output cost shares derived from rerunning the econometric Leontief cost function presented in our initial report using the current eight year database. For the purposes of the cost function estimation the same adjustment for the 1999 accounting changes as used at the aggregate level in section 5 is applied to each distributor except Orion New Zealand where revised audited data is used. The weighted average output cost shares derived from the re–estimated Leontief cost function are 22 per cent for throughput, 32 per cent for system line capacity and 46 per cent for connections.

It is again important to stress that the three distributors which have acquired parts of the former UnitedNetworks operations – Vector, Powerco and Unison – are quite different entities in 2003 compared to 2002 and earlier years. The 2003 data for these three distributors has been scaled up to a full year equivalent of their new operations even though they acquired their shares of the former UnitedNetworks operations only half way through the 2003 financial year. Correspondingly, UnitedNetworks is assumed to cease to exist at the end of the 2002 financial year. Incorporation of the three new entities in the 2003 data and the departure of UnitedNetworks does not cause any consistency problems as far as the MTFP methodology is concerned as it does not require a ‘balanced’ panel but care is, of course, required in interpreting the results for 2003 compared to earlier years as the operational coverage of the three ongoing entities has changed. However, despite the need to scale operating expenditure data to full year equivalent levels for the new entities, the MTFP results of the three post–merger businesses are not inconsistent with the MTFP results of the four pre–merger businesses. We can, thus, have confidence in assigning the three new entities to productivity groups.

We present the MTFP results using the three outputs and weighted average cost function shares in table 4. Index values and ranks are shown for each of the five years 1999 to 2003 and for the average of the five years. The index values indicate the productivity level relative to the performance of Alpine Energy in 1999. The results are invariant to this choice of the 'base' observation. The distributors are listed by decreasing MTFP level for the average of the five years.

Table 4: **MTFP indexes using 3 outputs, average cost function weights, 1999–2003**

	1999	*Rk*	*2000*	*Rk*	*2001*	*Rk*	*2002*	*Rk*	*2003*	*Rk*[1]	*Mean*	*Rk*
Elec Invercargill	1.401	1	1.441	1	1.508	1	1.603	1	1.781	1	1.547	1
Nelson Electricity	1.262	2	1.363	2	1.318	2	1.404	2	1.201	4	1.309	2
Waipa Networks	1.227	3	1.221	3	1.296	3	1.296	3	1.239	3	1.256	3
Horizon Energy	0.987	16	1.143	6	1.257	4	1.201	6	1.254	2	1.168	4
Vector	1.093	5	1.168	4	1.165	6	1.251	4	1.104	9	1.156	5
Network Tasman	0.989	14	1.154	5	1.145	7	1.227	5	1.161	6	1.135	6
Northpower	1.105	4	1.111	8	1.171	5	1.126	7	1.159	7	1.134	7
Scanpower	1.038	9	1.136	7	1.106	9	1.123	8	1.100	10	1.100	8
UnitedNetworks	0.981	17	1.089	9	1.111	8	1.115	9			1.074[2]	9
OtagoNet	1.005	12	1.023	15	1.071	10	1.078	10	1.175	5	1.070	10
Orion NZ	1.065	7	1.032	13	1.059	11	1.047	11	1.050	14	1.051	11
Alpine Energy	1.000	13	1.033	12	1.037	13	1.040	12	1.067	13	1.035	12
Network Waitaki	1.077	6	1.040	11	1.041	12	1.013	16	1.001	17	1.034	13
Powerco	1.053	8	1.026	14	0.986	19	1.007	19	1.097	11	1.034	14
Electra	0.987	15	1.046	10	1.031	15	1.012	17	1.012	16	1.018	15
Unison	0.957	18	1.008	16	0.986	18	1.028	13	1.067	12	1.009	16
Counties Power	1.023	10	0.971	21	0.999	17	1.010	18	0.973	20	0.995	17
WEL Networks	0.926	20	0.987	19	1.008	16	1.016	15	1.000	18	0.987	18
Top Energy	1.011	11	0.991	18	0.970	21	0.987	20	0.977	19	0.987	19
The Power Co'y	0.937	19	0.954	22	0.983	20	0.966	21	0.946	24	0.957	20
The Lines Co'y	0.762	28	1.005	17	1.034	14	1.018	14	0.962	21	0.956	21
Centralines	0.827	24	0.974	20	0.950	23	0.950	22	1.047	15	0.950	22
Aurora Energy	0.912	21	0.954	23	0.959	22	0.946	23	0.952	23	0.944	23
MainPower	0.889	22	0.927	24	0.946	24	0.923	24	0.942	25	0.925	24
Marlborough	0.878	23	0.853	25	0.873	26	0.847	26	0.868	26	0.864	25
Westpower	0.791	26	0.784	28	0.875	25	0.824	27	0.842	27	0.823	26
Eastland Network	0.702	29	0.817	26	0.766	29	0.859	25	0.959	22	0.821	27
Elec Ashburton	0.778	27	0.789	27	0.812	28	0.797	28	0.765	28	0.788	28
Buller Electricity	0.817	25	0.734	29	0.834	27	0.712	29	0.674	29	0.754	29

[1] For 2003 rankings UnitedNetworks was assumed to have same MTFP as in 2002 to facilitate greater comparability of rankings of firms ranked below it. Hence, 2003 rankings go to 29, not 28.

[2] Four year average for UnitedNetworks.

Source: Meyrick and Associates estimates

A mixture of urban and rural based distributors with both high and low (energy) density are found to have the highest MTFP levels for the average of the five years. We define rural distributors as those having less than 13 connection points per kilometre while low density distributors have an average consumption of less than 16,000 kilowatt hours per customer. The urban low density distributor Electricity Invercargill has the highest productivity level in each of the five years. This is followed by the urban high density distributor Nelson Electricity, the rural low density Waipa Networks and the rural high density Horizon Energy. The two large urban distributors, Vector and UnitedNetworks, also have MTFP levels in the top third of the sample.

The distributors with the lowest average MTFP levels over the five years also reflect a mixture of distributor types. The rural high density distributors, Electricity Ashburton and Buller Electricity, have the lowest MTFP levels followed by four rural low density distributors (Eastland Network, Westpower, Marlborough Lines and MainPower) and the urban high density Aurora Energy (formerly Dunedin Electricity).

Load growth does not appear to be a good indicator of a distributor's average MTFP level ranking with Electricity Invercargill, the distributor with the highest MTFP level, having one of the lowest increases in energy throughput between 1996 and 2003. Conversely, Electricity Ashburton, the distributor with the second lowest average MTFP level, had the highest increase in electricity throughput over the same period. The two large urban distributors, Vector and UnitedNetworks, have only had mid–range increases in throughput over the period up to 2002 although they had among the highest increases in customer numbers. Generally, rural high density networks have achieved the highest increases in throughput. With the exception of Westpower, the rural low density distributors that have lower average MTFP levels do not appear to have had unusually low load growth over the period.

Scale of operations also does not appear to be a major determinant of average MTFP levels with the smallest distributor in terms of throughput (Scanpower) appearing near the top of the list and the second smallest distributor (Buller Electricity) appearing near the bottom. The five largest distributors (UnitedNetworks, Vector, Orion, Powerco and Aurora Energy) are spread across the top, middle and bottom thirds of the sample.

The average MTFP rankings reported here are generally consistent with those contained in out initial report despite a number of significant changes. Apart from moving to the five year average as the basis for ranking rather than the last year's MTFP level, the present analysis uses more detailed and somewhat different MVA–kilometre conversion factors and a number of data anomalies and reporting inconsistencies have been removed. The major changes in ranking occur for Horizon Energy which moves from the middle third of the table to the top third and for Top Energy which moves from the bottom third into the middle third. Horizon Energy's position improves because of a correction to operating expenditure to remove the stores function and Top Energy's position improves because of a correction to operating expenditure to remove double counting of elements of depreciation. Importantly, the three entities affected by the major change in 2003 resulting from the split up of UnitedNetworks maintain their relative positions in 2003 compared to earlier years despite the change in the nature and scale of their operations and the need to form estimates of full year equivalent operating expenditure. Vector just remains in the top third of productivity levels while Powerco and Unison remain in the middle third of productivity levels.

6.3 Profitability considerations

In our initial report we allocated distribution businesses a second C factor component based on their profitability. The rationale for this is that if a business is currently earning 'high' profits, it can sustain a higher level of real price reduction than that indicated solely by its relative productivity performance, all else equal. Conversely, if a business is currently earning a 'low' return then there is an arguable case for easing the tightness of its threshold based purely on productivity considerations to allow it to return to earning normal rates of return. While it would be desirable to also include a service quality component in the C factor, more work is required on better understanding the complex relationship between observed service quality levels and current input levels.

Profitability issues are often addressed separately from productivity issues by the setting of a 'P_0' factor separately from the X factor. While the X factor is based on relative productivity considerations as usual, the P_0 adjustment is applied as an additional adjustment in the first year of the regulatory period to bring the business's profitability back to 'normal' levels. P_0 adjustments have been the subject of much controversy in other countries. By sometimes placing a large adjustment burden on the distributor in a short space of time there is a risk that this process can place undue financial distress on the lines business and endanger the ongoing security of supply. They also assume that the regulator has full information which is rarely the case.

A more reasonable approach to addressing the profitability problem is setting a 'glide path' where prices are adjusted over a period of several years to bring the business to a position of earning a normal return. The overall X factor that a business is set will then consist of two components: the usual productivity–based component plus an additional component aimed at gradually eliminating excess profits or restoring normal returns, as the case may be. This concept is illustrated diagrammatically in Hawke's Bay Network/NECG (2003, p.7).

The range of ownership types and associated objectives complicates assessing the profitability of New Zealand lines businesses. The businesses can be broadly divided into three groups: commercial businesses that issue dividends to shareholders in the normal way; trusts which offer 'dividends' to their consumers/owners in the form of explicit rebates which may take the form of line charge holidays; and, trusts which provide a 'return' to their consumers/owners implicitly in the form of lower prices. This makes assessing profitability against normal commercial criteria such as the rate of return difficult. However, we do not have enough information to attempt to adjust for ownership influences. Instead we assess businesses on the basis of pre–rebate prices. This is equivalent to treating the explicit trust rebates as a form of dividend to 'shareholders'.

In our initial report we assessed distributor profitability on the basis of a relatively simple residual rate of return measure. This was derived by subtracting operating expenses (derived by grossing up direct line costs per kilometre and indirect costs per customer) and estimated depreciation (calculated as 4.5 per cent of ODV) from 'deemed' revenue (comprising total operating revenue plus AC loss rental revenue received less payment for transmission charges less AC loss rental expense paid to customers). Submissions received by the Commerce Commission criticised this approach on a number of grounds including:

- the analysis was conducted on a pre–tax basis whereas other regulatory analysis is conducted on a tax adjusted basis;
- there was double counting of AC loss rental revenue received given the definition of deemed revenue; and
- capital contributions are not part of posted prices.

In addition, a number of inconsistencies in the way lines businesses reported direct and indirect operating expenditures tended to distort the analysis.

In response to the submissions received and data issues identified we have revised the residual rate of return analysis. Firstly, the definition of deemed revenue has been changed to remove the double counting contained in the initial report and to narrow down the range of revenue items included to more closely reflect lines business operations and exclude capital contributions. Consequently, deemed revenue now includes lines charges ('RevLine2' in the Disclosure Data) plus revenue from 'other' business plus AC loss rental rebates less payment for transmission charges less avoided transmission charges less AC loss rental expense paid to customers.

The second major change made to the residual rate of return analysis is to deduct an estimate of tax equivalent payments so that the return is now tax adjusted in line with other regulatory measures. The tax equivalent payments deducted are actual taxes paid plus 33 per cent of subvention payments plus the interest tax shield. Subvention payments are payments from one business entity to another in the same tax group (eg subsidiary to parent company) while the interest tax shield is an adjustment to correct for the tax implications of debt rather than equity funding. Adopting this approach to tax equivalent payments puts the measure on the same basis as other aspects of the Disclosure Data regulations and requirements.

The residual rate of return is then derived by deducting tax equivalent payments plus the new operating expenditure series plus estimated depreciation (calculated as 4.5 per cent of ODV) from the new measure of deemed revenue and dividing the resulting figure by the ODV. The revised treatment puts the residual rate of return analysis on a similar basis to other commonly used regulatory measures while retaining its links to and consistency with the MTFP database and analysis.

The tax adjusted residual rates of return derived from our database are presented in table 5 for the years 2000 to 2003 and the average of these four years. With the exception of Powerco, Unison and Vector, for which 2003 deemed revenue data are neither available nor readily able to be estimated, distribution businesses have been ranked on their average tax adjusted residual rates of return for the average of the four year period. The three business involved in the acquisition of UnitedNetworks have been ranked on their average tax adjusted residual rates of return for the three year period from 2000 to 2002 instead.

We divide the businesses into three groups – high, medium and low rates of return – with approximately one third of the businesses in each group. This also corresponds with breakpoints in the list of tax adjusted residual rates of return. This leads to businesses with low rates of return being those with a tax adjusted residual rate of return of less than 6 per cent and those with high rates having tax adjusted residual rates of return in excess of 8.1 per cent.

The distributors earning the highest residual rates of return include a mixture of listed businesses, trusts, consumer trusts and council owned entities. Nelson Electricity has the highest residual rate of return. UnitedNetworks, Counties Power, The Lines Company and Powerco have the next highest tax adjusted residual rates of return. The businesses in the low rate of return group are all trusts plus the former consumer cooperative OtagoNet. The Power Company, Waipa Networks (which ranked highly in the MTFP rankings), Buller Electricity and OtagoNet have the lowest residual rates of return followed by Northpower. Moving to the tax adjusted basis for comparison changes the ranking of some businesses substantially, as the relative level of subvention payments and interest tax shields varies considerably between businesses.

Table 5: **Tax adjusted residual rate of return estimates, 2000–2003**

	2000	*2001*	*2002*	*2003*	*4 yr average*
High return					
Nelson Electricity	13.90%	15.53%	18.20%	13.23%	15.2%
UnitedNetworks	11.68%	11.84%	12.95%		12.2% [a]
Counties Power	6.41%	10.61%	13.45%	9.92%	10.1%
The Lines Company	9.01%	9.31%	11.72%	9.81%	10.0%
Powerco	8.00%	10.79%	10.19%		9.7% [a]
WEL Networks	9.19%	8.86%	9.22%	11.30%	9.6%
Network Tasman	6.01%	10.02%	10.96%	9.87%	9.2%
Centralines	2.17%	14.38%	10.13%	9.86%	9.1%
Horizon Energy	7.66%	9.39%	10.40%	8.36%	9.0%
Electra	9.58%	8.49%	9.05%	7.70%	8.7%
Medium return					
Alpine Energy	5.57%	7.31%	9.30%	10.23%	8.1%
Scanpower	7.84%	7.25%	7.54%	8.98%	7.9%
Marlborough Lines	9.01%	10.44%	5.63%	5.95%	7.8%
Electricity Invercargill	5.93%	7.05%	8.33%	9.30%	7.7%
MainPower	6.25%	7.32%	7.18%	8.97%	7.4%
Orion New Zealand	8.45%	7.24%	6.40%	6.33%	7.1%
Eastland Network	6.80%	5.30%	6.60%	6.49%	6.3%
Vector	8.79%	4.61%	5.21%		6.2% [a]
Low return					
Unison	5.56%	4.02%	6.31%		5.3% [a]
Aurora Energy	4.80%	4.97%	4.95%	5.13%	5.0%
Top Energy	3.90%	4.16%	5.35%	5.23%	4.7%
Network Waitaki	3.46%	5.75%	4.29%	2.34%	4.0%
Westpower	1.77%	4.29%	4.96%	4.57%	3.9%
Electricity Ashburton	3.55%	4.48%	4.34%	3.04%	3.9%
Northpower	4.31%	1.89%	2.54%	3.03%	2.9%
OtagoNet	1.55%	3.22%	1.88%	3.25%	2.5%
Buller Electricity	2.31%	4.47%	0.90%	1.56%	2.3%
Waipa Networks	3.27%	3.74%	0.30%	-0.14%	1.8%
The Power Company	0.29%	1.35%	1.12%	2.33%	1.3%

[a] Three year average

Source: Meyrick and Associates estimates

The tax adjusted residual rates of return generally correspond well with average disclosed return on investment figures when the latter are adjusted for rebates and revaluations. However, some lines businesses have inflated disclosed return on investment figures as their disclosed depreciation is artificially low. In some cases this is a carry–over from infrastructure accounting that has yet to be fully removed from the average.

6.4 C factor recommendations

We are now in a position to assemble the information presented in the preceding sections on productivity levels and profitability to form recommendations for C factors. In doing this, we have adopted targets that minimise likely risks in light of the relatively small amount of information we have to work with.

Given the capital intensive nature of electricity lines businesses and the long lived nature of the assets involved, it is unrealistic to expect lines businesses to be able to remove large productivity gaps in a short space of time. Rather, a timeframe of a decade, or two five–year regulatory periods, is likely to be necessary for businesses performing near the bottom of the range to lift themselves into the middle of the pack. This timeframe would allow sufficient time for asset bases to be adjusted significantly, new work practices to be adopted and bedded down and for amalgamations and rationalisations to be implemented and consolidated. It is, however, reasonable to expect profitability levels to be adjusted over a shorter period, say one regulatory period of five years. This should allow sufficient time for adjustment in a sustainable fashion without incurring the risk of financial stress or failure resulting from large P_0 adjustments.

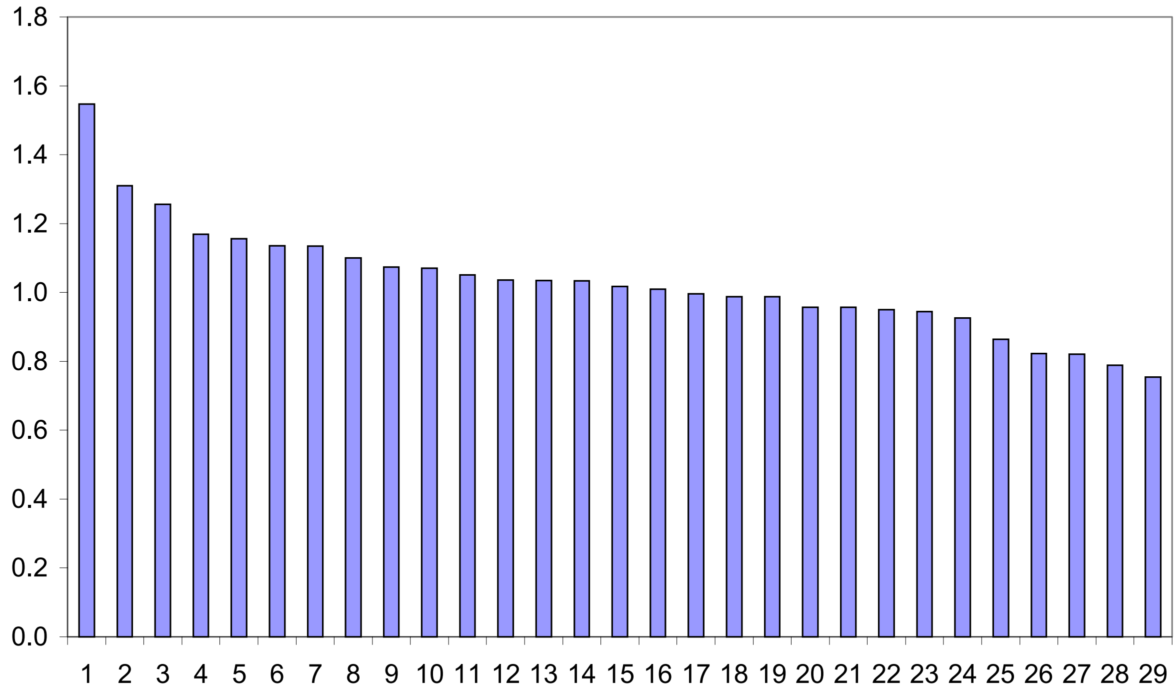
For productivity adjustments we form the distributors into three groups with high, medium and low productivity levels. In 2003 the high productivity group (excluding Electricity Invercargill) was 15 per cent more productive on average than the middle productivity group which was in turn around 15 per cent more productive than the low productivity group. Using the distribution B factor of 1 per cent derived in section 5 for the middle group and a 10 year timeframe, the average productivity of the bottom group would have to increase by 2.5 per cent annually to reach the same average productivity level as the middle group after 10 years. Conversely, the high productivity group would have to change its average TFP by –0.5 per cent annually to reach the same average productivity level as the middle group after 10 years. This implies overall X factors of –0.5, 1 and 2.5 per cent per annum for the three groups or C factors of –1.5, 0 and 1.5 per cent per annum, respectively. Given the need to minimise risks given the variable quality of the available data and residual uncertainties, we reduce the range of C factors to –1, 0 and 1 per cent. This range also allows the high productivity group to maintain its absolute productivity levels while the other groups catch up.

For a similar spread of tax adjusted residual rates of return, the same range of C factors (–1, 0 and 1 per cent) would imply adjustment of average residual returns for the low and high return groups, respectively, to the average of the medium return group over less than 10 years. This is because the rate of return component will usually make up less than half of total annual costs. Therefore a 1 per cent change in total revenue has a magnified effect on the residual rate of return.

To recap, distributors performing near the industry average on all counts would receive a C factor of zero while those achieving high productivity levels (taking their density characteristics into account) and low rates of return would be set the less onerous C factor components of –1 per cent. Distributors achieving low productivity levels taking their density characteristics into account and high rates of return would be set the higher C factor components of 1 per cent. Those achieving, say, high productivity and high profitability would receive offsetting C factor components of –1 and 1 per cent, respectively, leading to an overall C factor of zero.

We use the information from the multilateral TFP indexes using three outputs and the cost function based output cost shares to allocate initial C factors based on the average productivity levels estimated for the five years 1999 to 2003. For clarity, we will refer to these as C_1 components. We then proceed to derive C_2 components based on relative profitability by using the tax adjusted residual rate of return information

Figure 14: **MTFP indexes using 3 outputs, average cost function weights**, average of 1999–2003



Source: Meyrick and Associates estimates

We proceed by generally dividing the distributors into groups of around one third each. These groupings generally coincide with step points in the MTFP and tax adjusted residual rate of return results. In any exercise of this nature there will be boundary issues where discrete changes are made in the factors between the three groups. Making the change in the

C_1 or C_2 components more graduated can reduce these boundary issues. For instance, the top and bottom groups could be each divided into another three groups each receiving a change of one third of one per cent instead of the group as a whole receiving a change of 1 per cent. However, this comes at the expense of simplicity and requires further allocation decisions to be made within these two larger groups. We retain the step changes of 1 per cent for the top and bottom one third groupings used in our initial report.

Turning to the C_1 components, we present the MTFP efficiency scores for the average of the five years to 2003 in figure 14 in decreasing order. The indexes decrease steadily down to distributor 10 and then flatten out somewhat. The break point is less distinct between the medium and low productivity groups but we make the break after distributor 22. We use these groupings of 10, 12 and 7 distributors to define high, average and low levels of productivity, respectively, and allocate them C_1 components of –1, 0 and 1 per cent, respectively.

As noted above, to determine the C_2 component groupings we divide the tax adjusted residual rate of return rankings using breakpoints of 8.1 per cent and 6 per cent. This leads to groups of 10, 8 and 11 distributors being classed as earning high, average and low rates of return, respectively. These groups are allocated C_2 components of 1, 0 and –1 per cent, respectively. These components are designed to 'glide path' distributors earning high and low rates of return towards the average return deadband. Again, these components have been set cautiously as the spread of tax adjusted residual rates of return is wider than is the case for productivity levels but they are considered appropriate given the quality of relevant information available.

The C factors resulting from using the five year average MTFP scores to derive the C_1 components and the average tax adjusted residual rate of return estimates for 2000–2003 to derive the C_2 components are presented in table 6. There are a mixture of business types in each of the three broad C factor groups with urban and rural businesses appearing in each of the low, middle and high C factor groups.

For three distributors the C factor components sum to –2. Whereas these were capped at –1 in our initial report, we do not cap them in this report.

A total of eight distributors have changed groupings compared to our initial report. In most cases this is due to changes in profitability factors resulting from the move to tax adjusted residual rates of return and the correction of data inconsistencies in the Disclosure Data. As noted earlier, relative subvention payments and interest tax shields vary considerably across distributors leading to differences in pre–tax and post–tax profitability rankings. Three distributors – Electra, Powerco and The Lines Company – move from the middle C factor group to the high group as they now fall in the high profitability group.

Table 6: **C factor recommendations**

ELB	C_1	C_2	C	*ELB*	C_1	C_2	C
Centralines	0	1	1	Network Tasman	–1	1	0
Counties Power	0	1	1	Orion New Zealand	0	0	0
Eastland Network	1	0	1	UnitedNetworks[a]	–1	1	0
Electra	0	1	1	Westpower	1	–1	0
MainPower	1	0	1	Electricity Invercargill	–1	0	–1
Marlborough Lines	1	0	1	Network Waitaki	0	–1	–1
Powerco	0	1	1	Scanpower	–1	0	–1
The Lines Company	0	1	1	The Power Company	0	–1	–1
WEL Networks	0	1	1	Top Energy	0	–1	–1
Alpine Energy	0	0	0	Unison	0	–1	–1
Aurora Energy	1	–1	0	Vector	–1	0	–1
Buller Electricity	1	–1	0	Northpower	–1	–1	–2
Electricity Ashburton	1	–1	0	OtagoNet	–1	–1	–2
Horizon Energy	–1	1	0	Waipa Networks	–1	–1	–2
Nelson Electricity	–1	1	0				

[a] UnitedNetworks included for information only.

Source: Meyrick and Associates estimates

Four distributors – Alpine Energy, Aurora Energy, Horizon Energy and Orion New Zealand – move from the high C factor group back to the middle C factor group. In the case of Horizon Energy this is due to the exclusion of stores related operating expenditure previously included which improves Horizon's productivity grouping. Finally, Top Energy moves from the middle C factor group to the low C factor group as its productivity grouping improves with the exclusion of depreciation from its reported operating expenditure.

Three distributors – Northpower, OtagoNet and Waipa Networks – are found to have both high productivity and low profitability leading to C factors of –2. To allow these distributors the opportunity to return to acceptable levels of profitability in a reasonable timeframe, we do not cap the resulting C factors. No distributors have both low productivity and high profitability groupings leading to one being the largest C factor recommended.

7 CONCLUSIONS

In this report we have used the Disclosure Data for New Zealand's electricity distribution and transmission lines businesses to form estimates of threshold B and C factors. These factors relate to industry productivity trends, and individual business productivity performance and profitability considerations, respectively. As noted in our initial report, the data and our understanding of the complex relationship between quality and costs are insufficient to support inclusion of a C factor component based on price/quality trade–offs at this point in time. Further research on the relationship between service quality, costs and prices is a priority for work during the regulatory period relating to the next reset.

Important changes have been made to the database used in our initial report to better allow for the accounting changes that took place in 1999, the effects of the Auckland CBD outage and to correct anomalies and inconsistencies in previously supplied data. To minimise the impact of data irregularities in the early years we now conduct the productivity analysis of the individual businesses using only data from 1999 onwards. We have also made important changes to the methodology used to assess profitability levels to include taxation effects, remove double counting and exclude non–operational revenue. We find that applying the standard productivity and input price differential formula leads to a distribution B factor of 1 per cent. C factors range from –2 per cent to 1 per cent. The length of data currently available for Transpower is insufficient to support robust productivity analysis. We propose that the distribution B factor of 1 per cent also be applied to Transpower as an interim measure.

With respect to future regulatory resets, the priority for work in this area is improving the quality and quantity of relevant data available. This involves requiring the disclosure of data on the price and quantity of all major outputs and inputs, including labour and broad asset categories. It also includes gaining more accurate information on the allocation of costs between the major output types. Greater effort will be required to ensure businesses report data in a consistent manner both across businesses and over time. Much of the Disclosure Data currently required from businesses is not used for developing comparative performance measures that would be relevant for forming B and C factors. The usefulness of this data should be reviewed with a view to reducing the amount of data required but making its composition more relevant. The addition of more years and better price and quantity data will allow the estimation of more sophisticated econometric cost functions in future.

APPENDIX A: DATA SOURCES AND MANIPULATION

This appendix outlines the sources of data used in the analysis and the combination from the various sources into a collated data set.

Reporting requirements

Data has been collected from the published data according to the various Electricity (Information Disclosure) Regulations in force with amendments and revisions since 1995. The various amendments and refinements to the Regulations aim to improve the quality of the data collected, but come at the cost of some discontinuities in extent or definition as discussed below. The base files of financial and system data for the Electricity Lines Businesses (ELBs) have been collated and entered within the Ministry of Economic Development (MED) while the data for Transpower has been collated and entered by this consultancy.

Segregation of system data into voltage classes etc has also been collated as part of this consultancy from the reporting data. Asset valuation by asset class has also been extracted from hard–copy Asset Register reporting, but the detail available varied between ELBs.

Details of the reporting data Field Name, Broad Description and Specific Description are included below.

ELB data files

Early data comes as a combination of financial data in a separate data collation from the MED while the system data had been included in the general MED data summary. The various items have been ‘aligned and combined’ to form the fuller data set used here. Data relating to system elements by voltage class has been added as has some limited data relating to residential customer numbers although the latter was not used in the final analysis.

Where ELBs have amalgamated, data for previous years of the subsumed ELB has been combined with the persisting ELB below the table proper and reproduced as a single entry for the current ELB. As mentioned below, there may be some deficiencies due to reporting of only a part year for the combining ELB.

These data files have been extended to allow extraction of normalised data and data items for use in the analysis.

The tabulations of ODV by asset class and Line Length by voltage class and being overhead or underground are presented in separate source files, and have been combined into the general data file.

Some irregularities

Over the period since data has been collected, certain of the ELBs have combined, but data requirements apply only to entities relevant at the end of the (March) financial year reporting period, and the Regulations contain methodologies for 'pro–rata' reporting where assets, income etc have been within the reporting entity for only part of the year.

This has resulted in presentation of 'partial period' data for absorbed ELBs in the enduring ELB and apparent loss of data for the subsumed ELB for the combining year.

Some definitional changes have occurred, such as that in the 2001 Amendment which required energy throughput to be reported as energy entering the network (ie before losses) rather than energy leaving the network to the ELB customer. This has required adjustment (by the MED) for data consistency.

Asset valuation is required according to the Valuation Handbook under an Optimised Deprival Value (ODV) methodology, with regular revaluations. Thus, a series of asset values can show little change for the several years following a valuation, with a sharp change after the revaluation. The base rates used in the valuations may also not properly reflect changing replacement costs.

Asset recording has itself been refined over the period, resulting in some differences in line lengths, etc as deficiencies in previous data recording are rectified.

ELB alterations

With the exception of pre–1999 financial data, the Commerce Commission has advised ELBs of the collated data, and invited each to examine its data, and to highlight any alterations required for a correct representation of their situation.

Any alterations submitted by ELBs have been taken at face value and incorporated by this consultancy.

Transpower data

This consultancy has collated data for Transpower from the *Information for Disclosure* supplements to the New Zealand Gazette and Transpower Annual Reports.

Data Reporting Categories

The following indicates the categories of data collected by the Information Disclosure Regulations. This is the format following the revised 1999 Regulations but earlier data was available separately for financial items and for performance items.

This table shows data Field Names with the MED descriptive columns. The Col Ref item indicates the Field location on the data spreadsheets.

Col Ref	Field Name	Broad Description	Specific Description
A	LineOwner	Name of line company	Line Company name as at year of disclosure
B	AssignedTo	Name of relevant line company owner	The line company that purchased the company subsequent to year of disclosure
C	Year	Year of disclosure	Disclosure for the year ended 31 March
D	CABank	Current Asset	Cash and bank balances
E	CASTInvest	Current Asset	Short term investments
F	CAInvent	Current Asset	Inventories
G	CATrade	Current Asset	Accounts receivable
H	CAOther	Current Asset	Other current assets
I	CATotal	Subtotal	Total current assets
J	FASystem	Fixed Asset	System fixed assets
K	FABilling	Fixed Asset	Consumer billing and information systems assets
L	FAMotor	Fixed Asset	Motor vehicles
M	FAOffice	Fixed Asset	Office equipment
N	FALand	Fixed Asset	Land and buildings
O	FACapex	Fixed Asset	Capital works under construction
P	FAOther	Fixed Asset	Other fixed assets
Q	FATotal	Subtotal	Total fixed assets
R	TAOther	Subtotal	Other tangible assets
S	TangibleTotal	Subtotal	Total tangible assets
T	IAGoodwill	Intangible Asset	Goodwill assets
U	IAOther	Intangible Asset	Other intangible assets
V	IATotal	Subtotal	Total intangible assets
W	TotalAssets	Total	Total assets
X	CLOD	Current Liability	Bank overdraft
Y	CLBorrow	Current Liability	Borrowings
Z	CLPayable	Current Liability	Payables and accruals
AA	CLDividend	Current Liability	Dividends payable
AB	CLTax	Current Liability	Income tax
AC	CLOther	Current Liability	Other current liabilities
AD	CLTotal	Subtotal	Total current liabilities
AE	NCLPayable	Non Current Liability	Payables and accruals
AF	NCLBorrow	Non Current Liability	Borrowings
AG	NCLDefTax	Non Current Liability	Deferred tax
AH	NCLOther	Non Current Liability	Other non-current liabilities
AI	NCLTotal	Subtotal	Total non-current liabilities
AJ	EShareCap	Equity	Share capital
AK	ERetained	Equity	Retained earnings
AL	EReserves	Equity	Reserves
AM	ETotalSH	Equity	Total shareholders' equity
AN	EMinority	Equity	Minority interests in subsidiaries
AO	ETotal	Subtotal	Total equity
AP	ECapNotes	Equity	Capital notes
AQ	ETotalCap	Subtotal	Total capital funds
AR	TotalLiabilities	Total	Total equity and liabilities

Col Ref	Field Name	Broad Description	Specific Description
AS	RevLine2	Revenue	Revenue from line/access charges
AT	RevOthServices	Revenue	Revenue from "Other" business for services carried out by the line business (transfer payment)
AU	RevShortTerm	Revenue	Interest on case, bank balances, and short-term investments
AV	RevRebates	Revenue	AC loss-rental rebates
AW	RevOther	Revenue	Other operating revenue
AX	RevTotal	Total	Total operating revenue
AY	ExpTrans	Expenses	Payment for transmission charges
AZ	ExpMaint	Expenses - transfer	Transfer payments to the "Other" business for asset maintenance
BA	ExpConnect	Expenses - transfer	Transfer payments to the "Other" business for consumer disconnection/reconnection services
BB	ExpMeter	Expenses - transfer	Transfer payments to the "Other" business for meter data
BC	ExpCtrl	Expenses - transfer	Transfer payments to the "Other" business for consumer-based load control services
BD	ExpRoyalty	Expenses - transfer	Transfer payments to the "Other" business for royalty and patent expenses
BE	ExpAvoidTrans	Expenses - transfer	Transfer payments to the "Other" business for avoided transmission charges on account of own generation
BF	ExpOthBusServices	Expenses - transfer	Transfer payments to the "Other" business for other goods and services
BG	ExpTotalOther	Subtotal	Total transfer payments to the "Other" business
BH	ExpExtMaint	Expenses to non-related parties	Expenses to entities that are not related parties for asset maintenance
BI	ExpExtConnect	Expenses to non-related parties	Expenses to entities that are not related parties for disconnection/reconnection services
BJ	ExpExtMeter	Expenses to non-related parties	Expenses to entities that are not related parties for meter data
BK	ExpExtCtrl	Expenses to non-related parties	Expenses to entities that are not related parties for consumer-based load control services
BL	ExpExtRoyalty	Expenses to non-related parties	Expenses to entities that are not related parties for royalty and patent expenses
BM	ExpExtTotal	Subtotal	Total of specified expenses to non-related parties
BN	ExpPayroll	Expenses	Employee salaries, wages and redundancies
BO	ExpBilling	Expenses	Customer billing and information system expenses
BP	ExpDepnFA	Expenses	Depreciation expense on system fixed assets
BQ	ExpDepnCapWorks	Expenses	Depreciation expense on assets other than system fixed assets
BR	ExpDepnTotal	Subtotal	Total depreciation
BS	ExpGoodwill	Expenses	Amortisation of goodwill
BT	ExpAmortIA	Expenses	Amortisation of other intangibles
BU	ExpAmortIATotal	Subtotal	Total amortisation of intangibles
BV	ExpAdmin	Expenses	Corporate and administration
BW	ExpHR	Expenses	Human resource expenses
BX	ExpMarketing	Expenses	Marketing/advertising
BY	ExpMerger	Expenses	Merger and acquisition expenses
BZ	ExpTakeoverDef	Expenses	Take-over defence expenses
CA	ExpRD	Expenses	Research and development expenses
CB	ExpConsult	Expenses	Consultancy and legal expenses
CC	ExpDonations	Expenses	Donations
CD	ExpDirFees	Expenses	Directors' fees

Col Ref	Field Name	Broad Description	Specific Description
CE	ExpAuditTotal	Subtotal	Total auditors' fees
CF	ExpCostofCredit	Subtotal	Total cost of offering credit (bad debts written off and increase in estimated doubtful debts)
CG	ExpRates	Expenses	Local authority rates expense
CH	ACRebateExp	Expenses	AC loss-rental rebates (distribution to retailers/customers) expense
CI	RebateExp	Expenses	Rebates to consumers due to ownership interest
CJ	ExpSubvention	Expenses	Subvention payments
CK	ExpUnusual	Expenses	Unusual expenses
CL	ExpOther	Expenses	Other expenditure
CM	ExpTotal	Total	Total operating expenditure
CN	OSBIIT	Earnings	Operating surplus before interest and income tax
CO	OSBIITAdj	Derivation	Operating surplus before interest and income tax adjusted pursuant to regulation 18
CP	ExpIntBorrow	Interest expense	Interest expense on borrowings
CQ	ExpIntLease	Interest expense	Finance charges related to finance leases
CR	ExpIntOther	Interest expense	Other interest expense
CS	ExpInterest	Total	Total interest expense
CT	OSBT	Earnings	Operating surplus before income tax
CU	ExpTax	Expenses	Income tax
CV	NetProfit	Earnings	Net surplus after tax from financial statements
CW	NetSurplusAdj	Derivation	Net surplus after tax adjusted pursuant to regulation 18
CX	SFADepnBV	Derivation	Depreciation of system fixed assets at book value
CY	SFADepnODV	Derivation	Depreciation of system fixed assets at ODV
CZ	SubTaxAdj	Derivation	Subvention payment for tax adjustment
DA	IntTaxShield	Derivation	Interest tax shield
DB	Revaluations	Derivation	Revaluations
DC	NumROF	Derivation	Numerator ROF
DD	NumROE	Derivation	Numerator ROE
DE	NumROI	Derivation	Numerator ROI
DF	AvgFunds	Derivation	Average total funds employed
DG	AvgEquity	Derivation	Average total equity
DH	AvgUnderCons	Derivation	Average total works under construction
DI	AvgGoodwill	Derivation	Average total intangible asset
DJ	AvgSubvention	Derivation	Average subvention payment and related tax adjustment
DK	AvgFABook	Derivation	Average value of system fixed assets at book value
DL	AvgFAODV	Derivation	Average value of system fixed assets at ODV
DM	DenROF	Derivation	Denominator ROF
DN	DenROE	Derivation	Denominator ROE
DO	DenROI	Derivation	Denominator ROI
DP	ROF	Financial performance measure	Return on funds
DQ	ROE	Financial performance measure	Return on equity
DR	ROI	Financial performance measure	Return on investment
DS	RC	Valuation	Replacement cost
DT	DRC	Valuation	Depreciated replacement cost
DU	ODRC	Valuation	Optimised depreciated replacement cost
DV	ODV	Valuation	Optimised deprival valuation of system fixed assets
DW	LineValue	Valuation	Valuation of the line business
DX	DirLineKm	Efficiency performance	Direct line costs per kilometre

Col Ref	Field Name	Broad Description	Specific Description
		measures	
DY	IndirLineCust	Efficiency performance measures	Indirect line costs per customer
DZ	LoadFactor	Energy delivery efficiency performance measures	Load factor
EA	LossRatio	Energy delivery efficiency performance measures	Loss factor
EB	CapUtil	Energy delivery efficiency performance measures	Capacity utilisation
EC	KmSystem	Statistics	Total system length
ED	KmOH	Statistics	Total overhead length
EE	kmUnder	Statistics	Total underground length
EF	TransCap	Statistics	Transformer capacity
EG	MaxDemand	Statistics	Maximum demand
EH	TotElecSupplied	Statistics	Total electricity supplied from the system (before losses)
EI	TotCustomers	Statistics	Total consumers
EJ	ClassA	Reliability performance measure	Total interruptions, Class A
EK	ClassB	Reliability performance measure	Total interruptions, Class B - planned by lines business
EL	ClassC	Reliability performance measure	Total interruptions, Class C - unplanned within lines business
EM	ClassD	Reliability performance measure	Total interruptions, Class D
EN	ClassE	Reliability performance measure	Total interruptions, Class E
EO	ClassF	Reliability performance measure	Total interruptions, Class F
EP	ClassG	Reliability performance measure	Total interruptions, Class G
EQ	ClassH	Reliability performance measure	Total interruptions, Class H
ER	ClassI	Reliability performance measure	Total interruptions, Class I
ES	TotInt	Reliability performance measure	Total interruptions
ET	PlannedInt	Reliability performance measure	Target planned interruptions for next year
EU	UnplanInt	Reliability performance measure	Target unplanned interruptions for next year
EV	PlannedInt4	Reliability performance measure	Target planned interruptions for next 5 years
EW	UnplanInt4	Reliability performance measure	Target unplanned interruptions for next 5 years
EX	NotRestoredIn3	Reliability performance measure	Portion of interruptions not restored within 3 hours
EY	NotRestoredIn24	Reliability performance measure	Portion of interruptions not restored within 24 hours
EZ	SAIDITot	Reliability performance measure	SAIDI for the total interruptions
FA	SAIDIPlanInt	Reliability performance measure	SAIDI target for planned interruptions for the following year
FB	SAIDIUnplanInt	Reliability performance	SAIDI target for unplanned interruptions for the

Col Ref	Field Name	Broad Description	Specific Description
		measure	following year
FC	SAIDIPlanInt4	Reliability performance measure	Average SAIDI target for planned interruptions for the next 5 years
FD	SAIDIUnplanInt4	Reliability performance measure	Average SAIDI target for unplanned interruptions for the next 5 years
FE	SAIDIA	Reliability performance measure	SAIDI for class A
FF	SAIDIB	Reliability performance measure	SAIDI for class B - planned by lines business
FG	SAIDIC	Reliability performance measure	SAIDI for class C - unplanned within lines business
FH	SAIDID	Reliability performance measure	SAIDI for class D
FI	SAIDIE	Reliability performance measure	SAIDI for class E
FJ	SAIDIF	Reliability performance measure	SAIDI for class F
FK	SAIDIG	Reliability performance measure	SAIDI for class G
FL	SAIDIH	Reliability performance measure	SAIDI for class H
FM	SAIDII	Reliability performance measure	SAIDI for class I
FN	SAIFITot	Reliability performance measure	SAIFI for the total interruptions
FO	SAIFIPlanInt	Reliability performance measure	SAIFI target for planned interruptions for the following year
FP	SAIFIUnplanInt	Reliability performance measure	SAIFI target for unplanned interruptions for the following year
FQ	SAIFIPlanInt4	Reliability performance measure	Average SAIFI target for planned interruptions for the next 5 years
FR	SAIFIUnplanInt4	Reliability performance measure	Average SAIFI target for unplanned interruptions for the next 5 years
FS	SAIFIA	Reliability performance measure	SAIFI for class A
FT	SAIFIB	Reliability performance measure	SAIFI for class B - planned by lines business
FU	SAIFIC	Reliability performance measure	SAIFI for class C - unplanned within lines business
FV	SAIFID	Reliability performance measure	SAIFI for class D
FW	SAIFIE	Reliability performance measure	SAIFI for class E
FX	SAIFIF	Reliability performance measure	SAIFI for class F
FY	SAIFIG	Reliability performance measure	SAIFI for class G
FZ	SAIFIH	Reliability performance measure	SAIFI for class H
GA	SAIFII	Reliability performance measure	SAIFI for class I
GB	CAIDITot	Reliability performance measure	CAIDI for the total interruptions
GC	CAIDIPlanInt	Reliability performance measure	CAIDI target for planned interruptions for the following year
GD	SAIDIUnplanInt	Reliability performance	CAIDI target for unplanned interruptions for the

Col Ref	Field Name	Broad Description	Specific Description
		measure	following year
GE	CAIDIPlanInt	Reliability performance measure	Average CAIDI target for planned interruptions for the next 5 years
GF	SAIDIUnplanInt4	Reliability performance measure	Average CAIDI target for unplanned interruptions for the next 5 years
GG	CAIDI	Reliability performance measure	CAIDI for class A
GH	CAIDI	Reliability performance measure	CAIDI for class B - planned by lines business
GI	ACIDIC	Reliability performance measure	CAIDI for class C - unplanned within lines business
GJ	CAIDID	Reliability performance measure	CAIDI for class D
GK	CAIDIE	Reliability performance measure	CAIDI for class E
GL	CAIDIF	Reliability performance measure	CAIDI for class F
GM	CAIDIG	Reliability performance measure	CAIDI for class G
GN	CAIDIH	Reliability performance measure	CAIDI for class H
GO	CAIDII	Reliability performance measure	CAIDI for class I

APPENDIX B: THE DATABASE USED

Table B1: **Aggregate distribution industry database, 1996–2003**

Variable	*Unit*	*1996*	*1997*	*1998*	*1999*
Deemed revenue	$m	771.86	866.49	913.50	788.64
Energy throughput	GWh	24,595.06	25,308.01	25,787.65	25,603.68
Customers	No	1,651,217	1,653,818	1,670,658	1,684,466
Unadjusted operating expenditure	$m	323.68	339.22	322.84	289.24
Adjusted operating expenditure	$m	297.81	312.10	297.04	289.24
Operating expenditure price	Index	1.000	1.016	1.027	1.039
Overhead MVA–kilometres	No	438,533.12	441,349.44	448,868.23	452,309.92
Underground MVA–kilometres	No	58,850.63	60,777.70	63,240.96	66,243.41
Transformer capacity	MVA	14,636.86	14,468.60	14,739.92	14,520.44
Annual user cost of overhead lines	$m	221.97	235.35	244.54	240.67
Annual user cost of underground cables	$m	124.36	132.35	132.33	128.39
Annual user cost of transformers	$m	137.26	144.65	146.01	143.77
Annual user cost of other capital	$m	16.08	17.17	17.60	17.16

Variable	*Unit*	*2000*	*2001*	*2002*	*2003*
Deemed revenue	$m	928.85	976.76	1,014.24	1,014.24[a]
Energy throughput	GWh	26,530.92	27,724.93	27,758.85	28,784.11
Customers	No	1,713,772	1,747,382	1,778,455	1,823,113
Unadjusted operating expenditure	$m	258.32	262.03	263.54	278.19[a]
Adjusted operating expenditure	$m	258.32	262.03	263.54	278.19[a]
Operating expenditure price	Index	1.055	1.069	1.094	1.127
Overhead MVA–kilometres	No	446,616.93	453,662.87	457,834.80	461,070.73
Underground MVA–kilometres	No	69,066.43	68,561.59	70,580.53	72,736.06
Transformer capacity	MVA	14,451.16	14,559.87	14,997.50	15,276.73
Annual user cost of overhead lines	$m	240.13	248.46	254.11	261.10
Annual user cost of underground cables	$m	126.83	136.82	139.41	137.40
Annual user cost of transformers	$m	143.14	152.90	156.33	176.28
Annual user cost of other capital	$m	17.02	17.82	18.18	16.90

[a] Estimate only due to UnitedNetworks split up.

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B2: **Transpower data, 1999–2003**

Variable	*1999*	*2000*	*2001*	*2002*	*2003*
Revenue ($m)	494.93	483.88	437.42	468.34	439.62
Throughput (GWh)	34,170	35,280	36,420	35,700	37,280
Operating expenses ($m)	130.86	131.76	152.74	168.90	185.54
Price of Opex (index)	1.000	1.016	1.029	1.053	1.085
MVA kilometres ('000)	2,556	2,549	2,546	2,527	2,525
Transformers (MVA)	8,230	8,430	8,530	8,590	8,640
Lines user cost ($m)	174.95	175.04	165.74	167.08	164.65
Transformer user cost ($m)	86.17	86.21	81.63	82.29	81.10
Transformer KVA kms ('000)	144,881	147,576	148,721	146,975	147,727

Source: Meyrick and Associates database formed from Disclosure Data and Annual Reports

Table B3: **Total deemed revenue ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	12.662	13.247	15.819	16.919	17.728
Buller Electricity	2.598	2.598	2.846	2.662	3.088
Centralines	2.821	3.680	6.631	5.282	5.812
Counties Power	16.001	17.472	19.129	19.885	19.827
Aurora Energy	30.450	31.944	33.284	36.177	37.276
Eastland N/W	14.364	14.582	14.840	15.300	14.180
Electra	15.632	13.635	14.530	15.712	15.588
Electricity Ashburton	8.566	9.309	10.458	11.197	11.873
Electricity Invercargill	6.748	6.838	7.798	8.845	9.012
Horizon Energy	14.215	15.201	15.559	17.513	14.799
MainPower	15.188	13.939	15.703	15.756	17.969
Marlborough Lines	7.896	15.477	16.348	12.144	13.090
Nelson Electricity	1.467	4.749	4.996	5.513	4.989
Network Tasman	14.661	15.153	17.362	17.485	18.031
Network Waitaki	4.045	6.192	6.391	5.769	5.285
Northpower	12.227	16.598	15.932	17.948	18.148
Orion New Zealand	94.582	95.382	95.260	92.969	98.853
Otago Power	6.933	6.886	7.998	8.435	8.215
Powerco	80.346	89.648	94.961	101.019	n.a.
Scanpower	3.208	3.297	3.369	3.461	3.531
The Lines Company	11.526	13.025	12.644	14.389	15.389
The Power Company	13.803	14.157	16.099	15.516	18.392
Top Energy	11.076	11.025	12.466	13.629	14.052
Unison	18.441	18.389	19.528	20.046	n.a.
UnitedNetworks	153.573	272.183	277.633	299.425	
Vector	162.585	154.297	165.670	170.022	n.a.
Waipa Network	6.336	7.170	7.575	5.296	5.534
WEL Networks	40.579	38.369	40.758	41.966	45.581
Westpower	8.908	8.025	8.630	9.562	9.974

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B4: **Tax adjustment ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	1.916	2.101	3.459	3.248	3.523
Buller Electricity	0.256	–0.059	0.332	0.120	0.207
Centralines	–0.969	0.437	0.367	0.073	0.642
Counties Power	1.199	2.490	1.070	–1.452	0.504
Aurora Energy	5.357	6.880	7.405	9.317	9.661
Eastland N/W	1.371	2.182	1.689	2.451	2.451
Electra	0.186	0.206	0.224	0.198	0.307
Electricity Ashburton	1.094	1.203	1.414	1.023	1.373
Electricity Invercargill	1.106	1.176	1.410	1.721	1.842
Horizon Energy	3.092	3.451	3.905	4.700	3.864
MainPower	1.012	0.663	0.900	0.760	1.227
Marlborough Lines	0.593	1.172	1.094	–0.255	0.340
Nelson Electricity	0.389	1.308	1.250	1.517	1.173
Network Tasman	3.045	1.679	2.251	2.301	2.171
Network Waitaki	0.707	1.295	0.945	0.770	0.837
Northpower	1.361	–0.972	2.190	2.405	2.277
Orion New Zealand	20.994	21.222	22.916	21.671	25.589
Otago Power	0.000	–0.188	0.424	1.415	0.713
Powerco	13.437	15.922	15.306	18.255	n.a.
Scanpower	0.096	0.141	0.087	0.207	0.071
The Lines Company	0.651	0.702	0.442	0.114	0.263
The Power Company	1.634	1.538	2.091	1.046	1.116
Top Energy	0.633	0.817	1.646	1.758	1.672
Unison	3.021	0.040	0.984	–0.649	n.a.
UnitedNetworks	53.455	50.065	49.331	59.203	
Vector	19.610	21.507	45.779	43.011	n.a.
Waipa Network	0.962	1.216	1.403	0.569	0.487
WEL Networks	9.455	7.801	9.127	9.177	7.991
Westpower	0.692	0.712	1.302	1.207	1.347

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B5: **Energy throughput (GWh), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	507.68	523.75	563.55	565.29	624.18
Buller Electricity	40.53	43.67	45.44	44.53	42.76
Centralines	89.55	93.37	111.17	111.12	117.71
Counties Power	382.60	397.74	409.30	418.09	441.12
Aurora Energy	1,152.38	1,189.99	1,233.77	1,240.26	1,300.09
Eastland N/W	274.30	281.93	289.56	290.31	296.91
Electra	358.64	365.73	378.70	383.91	395.69
Electricity Ashburton	327.77	292.31	348.95	342.70	408.50
Electricity Invercargill	267.37	256.56	261.65	264.56	284.54
Horizon Energy	551.38	580.95	586.63	594.50	601.86
MainPower	339.83	353.20	406.68	382.19	421.31
Marlborough Lines	285.58	290.48	308.09	303.56	321.70
Nelson Electricity	145.42	147.15	148.10	146.92	150.53
Network Tasman	586.50	626.41	674.18	684.84	730.40
Network Waitaki	177.93	174.42	179.02	175.81	194.54
Northpower	809.07	828.62	839.89	852.23	891.82
Orion New Zealand	2,692.69	2,735.27	2,821.60	2,901.02	3,064.40
Otago Power	273.63	311.66	338.97	348.37	368.01
Powerco	2,080.62	2,032.13	2,083.15	2,077.34	4,041.22
Scanpower	80.85	85.28	87.73	88.47	93.11
The Lines Company	269.62	285.97	283.82	286.25	296.73
The Power Company	558.91	557.82	591.69	608.06	662.48
Top Energy	280.19	284.03	305.51	316.15	326.43
Unison	797.13	828.81	848.45	867.33	1,559.91
UnitedNetworks	6,317.63	6,864.05	7,120.43	6,873.04	
Vector	4,568.06	4,632.09	4,990.01	5,115.12	9,607.69
Waipa Network	289.06	295.53	301.14	316.48	323.00
WEL Networks	901.26	975.85	965.82	962.39	1,006.22
Westpower	197.51	196.17	201.94	197.99	211.26

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B6: **Connection numbers, 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	27,486	27,829	27,806	28,376	28,248
Buller Electricity	4,243	4,241	4,258	4,108	4,187
Centralines	7,432	7,454	7,432	7,431	7,442
Counties Power	30,859	30,470	30,546	30,817	31,214
Aurora Energy	69,131	69,494	70,208	71,431	72,794
Eastland N/W	25,232	25,680	26,128	25,552	25,264
Electra	36,338	36,651	37,302	38,292	39,015
Electricity Ashburton	13,564	13,843	14,285	14,558	14,789
Electricity Invercargill	16,856	16,733	16,701	16,847	16,961
Horizon Energy	22,931	23,061	23,046	23,092	23,304
MainPower	22,859	24,140	25,638	25,047	25,997
Marlborough Lines	20,025	20,572	20,805	21,038	21,417
Nelson Electricity	8,461	8,476	8,579	8,575	8,614
Network Tasman	29,750	30,246	30,790	31,293	32,205
Network Waitaki	11,385	11,409	11,372	11,341	11,400
Northpower	44,158	44,674	45,589	46,712	47,785
Orion New Zealand	158,673	162,543	166,556	168,455	170,490
Otago Power	14,861	14,231	14,297	14,434	14,498
Powerco	153,305	156,220	157,120	157,451	293,479
Scanpower	6,626	6,675	6,707	6,615	6,638
The Lines Company	24,199	25,259	25,846	25,712	25,045
The Power Company	30,204	30,273	31,005	31,800	31,944
Top Energy	24,779	25,700	26,234	27,044	27,590
Unison	56,000	56,594	57,331	58,070	102,492
UnitedNetworks	469,953	479,972	492,387	505,057	
Vector	255,010	259,577	265,895	274,000	633,755
Waipa Network	19,612	19,824	20,050	20,293	20,510
WEL Networks	68,580	70,202	71,473	72,942	73,959
Westpower	11,954	11,729	11,996	12,072	12,077

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B7: **Operating expenditure ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	4.515	4.262	4.470	4.565	4.491
Buller Electricity	1.438	1.782	1.355	1.830	2.057
Centralines	2.217	1.379	1.683	1.648	1.588
Counties Power	5.642	6.329	5.369	5.231	5.975
Aurora Energy	13.192	11.125	11.355	12.276	12.739
Eastland N/W	8.389	6.383	7.858	5.516	4.121
Electra	5.367	4.750	4.894	5.554	5.706
Electricity Ashburton	3.682	3.021	2.875	2.775	3.667
Electricity Invercargill	2.286	2.250	2.335	2.280	1.959
Horizon Energy	5.386	3.787	2.646	3.281	2.970
MainPower	4.518	4.177	4.480	4.360	4.670
Marlborough Lines	4.340	4.946	5.026	5.224	4.702
Nelson Electricity	0.997	0.826	0.909	0.855	1.417
Network Tasman	5.945	4.332	4.888	4.105	5.247
Network Waitaki	1.459	1.694	1.530	1.627	1.896
Northpower	7.760	7.499	6.649	7.674	7.469
Orion New Zealand	17.429	21.605	21.203	23.042	24.167
Otago Power	3.801	3.722	3.507	3.612	2.333
Powerco	23.066	25.202	28.538	27.368	41.500 [a]
Scanpower	1.528	1.285	1.417	1.352	1.317
The Lines Company	6.433	3.505	3.215	3.658	4.091
The Power Company	6.142	5.722	5.238	5.905	6.860
Top Energy	3.703	4.098	4.620	4.609	4.975
Unison	9.157	8.150	8.628	7.834	13.080 [a]
UnitedNetworks	75.376	59.430	58.825	58.566	
Vector	46.107	38.731	42.236	41.683	90.466 [a]
Waipa Network	2.507	2.618	2.470	2.544	3.035
WEL Networks	12.596	11.492	10.713	10.804	12.038
Westpower	4.266	4.217	3.098	3.764	3.658

[a] Estimate only due to UnitedNetworks split up.

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B8: **Optimised deprival value of assets ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	69.724	68.367	66.783	65.996	65.958
Buller Electricity	13.204	12.845	12.925	13.182	13.593
Centralines	27.847	27.924	24.257	24.345	24.953
Counties Power	74.871	79.301	83.967	89.721	92.553
Aurora Energy	145.278	149.867	153.360	154.403	154.399
Eastland N/W	63.130	53.251	54.017	66.049	69.200
Electra	60.969	61.644	72.452	73.515	78.511
Electricity Ashburton	58.296	63.181	68.663	83.707	90.624
Electricity Invercargill	32.539	32.719	35.095	37.750	37.760
Horizon Energy	64.473	65.474	64.843	63.994	61.962
MainPower	82.219	84.674	87.361	91.038	89.626
Marlborough Lines	70.119	69.291	68.464	70.828	76.992
Nelson Electricity	14.541	14.215	14.167	13.837	13.531
Network Tasman	86.917	86.988	70.418	71.654	73.858
Network Waitaki	39.822	40.231	38.208	38.367	37.303
Northpower	113.903	114.366	110.934	111.840	111.626
Orion New Zealand	448.457	405.978	435.510	442.840	453.382
Otago Power	53.368	55.382	52.703	53.440	66.708
Powerco	376.889	388.179	376.105	377.156	703.269
Scanpower	15.118	15.154	15.871	15.806	15.900
The Lines Company	57.956	65.293	65.063	65.456	77.123
The Power Company	142.913	143.941	149.913	152.422	152.433
Top Energy	70.836	72.732	71.563	73.705	76.065
Unison	100.583	101.434	116.348	118.983	223.393
UnitedNetworks	1,018.300	1,005.300	1,037.001	1,040.859	
Vector	710.139	707.582	852.331	879.060	1,609.940
Waipa Network	43.290	42.920	44.944	45.472	46.178
WEL Networks	133.917	139.370	156.547	160.261	161.763
Westpower	50.332	49.370	48.127	48.545	54.799

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B9: **Overhead MVA kilometres, 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	14,261	14,161	14,243	14,302	14,378
Buller Electricity	3,038	3,049	3,102	3,117	3,116
Centralines	6,805	6,813	7,089	7,077	7,027
Counties Power	10,121	10,163	11,245	11,429	11,750
Aurora Energy	16,209	15,811	16,073	16,263	16,384
Eastland N/W	22,161	20,536	19,507	19,942	19,703
Electra	5,798	5,802	6,120	5,907	5,927
Electricity Ashburton	11,974	12,507	13,237	14,276	16,819
Electricity Invercargill	315	282	235	210	198
Horizon Energy	10,596	8,315	8,798	8,850	8,871
MainPower	16,393	16,622	16,842	16,895	16,943
Marlborough Lines	12,225	12,298	12,177	12,243	14,857
Nelson Electricity	214	207	211	166	151
Network Tasman	9,593	9,604	9,598	9,593	9,625
Network Waitaki	8,185	8,217	8,205	8,236	8,290
Northpower	15,909	16,622	15,864	16,081	16,276
Orion New Zealand	20,062	19,839	19,765	20,471	21,320
Otago Power	22,382	22,648	24,207	24,316	24,425
Powerco	55,971	54,161	53,852	55,482	81,030
Scanpower	3,130	3,134	3,133	3,062	3,049
The Lines Company	22,260	21,144	20,645	20,147	21,535
The Power Company	40,513	39,768	40,276	42,421	42,531
Top Energy	16,137	16,290	16,389	16,425	16,481
Unison	11,028	11,608	11,645	11,676	21,417
UnitedNetworks	63,272	62,931	65,939	65,507	
Vector	7,042	7,322	7,281	5,619	30,510
Waipa Network	5,376	5,397	5,276	5,300	5,308
WEL Networks	10,984	11,006	11,748	11,836	11,850
Westpower	10,356	10,360	10,960	10,984	11,299

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B10: **Underground MVA kilometres, 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	874	928	956	969	1,020
Buller Electricity	15	20	25	26	28
Centralines	44	45	45	50	26
Counties Power	407	448	715	761	821
Aurora Energy	2,421	2,998	2,932	2,924	3,130
Eastland N/W	503	451	449	481	548
Electra	934	945	1,080	1,058	1,171
Electricity Ashburton	339	421	517	550	581
Electricity Invercargill	859	901	984	1,046	1,071
Horizon Energy	576	632	688	700	705
MainPower	476	502	542	571	570
Marlborough Lines	326	346	300	374	453
Nelson Electricity	458	462	470	470	475
Network Tasman	629	651	690	717	765
Network Waitaki	94	94	129	141	154
Northpower	465	564	601	699	759
Orion New Zealand	10,296	10,417	10,413	10,456	10,761
Otago Power	35	33	32	31	36
Powerco	2,776	3,141	3,242	3,278	8,034
Scanpower	14	15	16	16	29
The Lines Company	355	452	410	367	412
The Power Company	236	244	268	284	317
Top Energy	382	423	455	490	529
Unison	1,852	1,966	2,180	2,226	3,711
UnitedNetworks	16,894	19,042	19,826	20,248	
Vector	20,877	19,651	17,071	17,969	32,863
Waipa Network	218	228	154	172	172
WEL Networks	2,756	2,907	3,219	3,346	3,436
Westpower	132	140	152	160	160

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B11: **Transformer capacity (MVA), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	259	259	262	275	283
Buller Electricity	27	27	27	28	29
Centralines	64	65	70	71	71
Counties Power	218	231	230	238	258
Aurora Energy	668	687	708	726	740
Eastland N/W	220	215	210	225	188
Electra	266	267	271	274	279
Electricity Ashburton	235	239	254	263	271
Electricity Invercargill	138	138	139	141	142
Horizon Energy	178	187	187	186	188
MainPower	215	229	247	257	275
Marlborough Lines	201	204	212	222	232
Nelson Electricity	72	72	77	78	79
Network Tasman	315	271	273	276	292
Network Waitaki	117	118	121	125	127
Northpower	376	386	393	397	407
Orion New Zealand	1,505	1,505	1,488	1,495	1,526
Otago Power	125	128	128	131	136
Powerco	1,268	1,257	1,320	1,312	2,508
Scanpower	55	55	53	56	57
The Lines Company	277	168	185	189	192
The Power Company	283	286	292	298	309
Top Energy	161	166	176	181	187
Unison	531	536	539	557	946
UnitedNetworks	3,739	3,735	3,706	3,888	
Vector	2,275	2,277	2,240	2,349	4,780
Waipa Network	148	150	156	160	165
WEL Networks	488	492	490	495	503
Westpower	97	100	107	104	109

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B12: **Annual user cost of overhead lines ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	5.352	5.248	5.127	5.066	5.063
Buller Electricity	1.014	0.986	0.992	1.012	1.043
Centralines	2.176	2.182	1.895	1.902	1.950
Counties Power	5.850	6.196	6.561	7.010	7.232
Aurora Energy	4.711	4.860	4.974	5.007	5.007
Eastland N/W	4.933	4.161	4.221	5.161	5.407
Electra	3.064	3.098	3.641	3.695	3.946
Electricity Ashburton	4.475	4.850	5.271	6.426	6.957
Electricity Invercargill	1.635	1.644	1.764	1.897	1.898
Horizon Energy	4.949	5.026	4.978	4.912	4.756
MainPower	6.424	6.616	6.826	7.113	7.003
Marlborough Lines	5.479	5.414	5.350	5.534	6.016
Nelson Electricity	0.472	0.461	0.459	0.449	0.439
Network Tasman	6.672	6.678	5.406	5.501	5.670
Network Waitaki	3.112	3.144	2.985	2.998	2.915
Northpower	8.744	8.779	8.516	8.585	8.569
Orion New Zealand	22.539	20.404	21.888	22.257	22.786
Otago Power	4.097	4.251	4.046	4.102	5.121
Powerco	29.449	30.331	29.387	29.469	54.951
Scanpower	1.181	1.184	1.240	1.235	1.242
The Lines Company	4.528	5.102	5.084	5.115	6.026
The Power Company	10.971	11.049	11.508	11.701	11.701
Top Energy	5.535	5.683	5.592	5.759	5.943
Unison	5.055	5.098	5.848	5.980	11.227
UnitedNetworks	51.178	50.525	52.118	52.312	
Vector	23.030	22.947	27.641	28.508	52.211
Waipa Network	3.383	3.354	3.512	3.553	3.608
WEL Networks	6.731	7.005	7.868	8.055	8.130
Westpower	3.933	3.858	3.760	3.793	4.282

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B13: **Annual user cost of underground cables ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	0.800	0.785	0.767	0.758	0.757
Buller Electricity	0.152	0.148	0.148	0.151	0.156
Centralines	0.402	0.403	0.350	0.351	0.360
Counties Power	1.081	1.145	1.212	1.295	1.336
Aurora Energy	5.883	6.069	6.210	6.252	6.252
Eastland N/W	0.911	0.769	0.780	0.953	0.999
Electra	2.453	2.480	2.915	2.958	3.159
Electricity Ashburton	0.669	0.725	0.788	0.961	1.040
Electricity Invercargill	1.309	1.316	1.412	1.519	1.519
Horizon Energy	0.740	0.752	0.744	0.735	0.711
MainPower	1.187	1.222	1.261	1.314	1.294
Marlborough Lines	1.012	1.000	0.988	1.022	1.111
Nelson Electricity	0.589	0.576	0.574	0.560	0.548
Network Tasman	0.998	0.999	0.808	0.823	0.848
Network Waitaki	0.575	0.581	0.551	0.554	0.538
Northpower	1.308	1.313	1.274	1.284	1.282
Orion New Zealand	18.042	16.333	17.521	17.816	18.240
Otago Power	0.613	0.636	0.605	0.614	0.766
Powerco	5.440	5.602	5.428	5.443	10.150
Scanpower	0.218	0.219	0.229	0.228	0.230
The Lines Company	0.837	0.942	0.939	0.945	1.113
The Power Company	1.641	1.653	1.721	1.750	1.750
Top Energy	1.022	1.050	1.033	1.064	1.098
Unison	4.047	4.081	4.681	4.787	8.988
UnitedNetworks	40.968	40.445	41.720	41.876	
Vector	28.756	28.653	34.514	35.596	65.192
Waipa Network	0.625	0.619	0.649	0.656	0.667
WEL Networks	5.388	5.607	6.298	6.448	6.508
Westpower	0.726	0.713	0.695	0.701	0.791

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B14: **Annual user cost of transformers ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	2.282	2.237	2.186	2.160	2.159
Buller Electricity	0.432	0.420	0.423	0.431	0.445
Centralines	0.797	0.800	0.695	0.697	0.715
Counties Power	2.144	2.271	2.405	2.569	2.650
Aurora Energy	7.203	7.431	7.604	7.656	7.655
Eastland N/W	1.808	1.525	1.547	1.891	1.982
Electra	1.803	1.823	2.142	2.174	2.321
Electricity Ashburton	1.908	2.068	2.247	2.739	2.966
Electricity Invercargill	0.962	0.967	1.038	1.116	1.116
Horizon Energy	2.110	2.143	2.122	2.094	2.028
MainPower	2.354	2.425	2.502	2.607	2.567
Marlborough Lines	2.008	1.984	1.961	2.028	2.205
Nelson Electricity	0.721	0.705	0.702	0.686	0.671
Network Tasman	2.844	2.847	2.305	2.345	2.417
Network Waitaki	1.140	1.152	1.094	1.099	1.068
Northpower	3.728	3.743	3.630	3.660	3.653
Orion New Zealand	13.259	12.003	12.876	13.093	13.405
Otago Power	1.747	1.812	1.725	1.749	2.183
Powerco	10.793	11.116	10.770	10.800	20.139
Scanpower	0.433	0.434	0.455	0.453	0.455
The Lines Company	1.660	1.870	1.863	1.874	2.209
The Power Company	4.677	4.711	4.906	4.988	4.989
Top Energy	2.029	2.083	2.049	2.111	2.178
Unison	2.974	2.999	3.440	3.518	6.605
UnitedNetworks	30.107	29.723	30.660	30.774	
Vector	35.210	35.083	42.260	43.585	79.823
Waipa Network	1.240	1.229	1.287	1.302	1.322
WEL Networks	3.959	4.121	4.629	4.738	4.783
Westpower	1.441	1.414	1.378	1.390	1.569

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

Table B15: **Annual user cost of other capital ($m), 1999–2003**

	1999	*2000*	*2001*	*2002*	*2003*
Alpine Energy	0.281	0.276	0.269	0.266	0.266
Buller Electricity	0.053	0.052	0.052	0.053	0.055
Centralines	0.106	0.106	0.092	0.092	0.095
Counties Power	0.284	0.301	0.319	0.341	0.351
Aurora Energy	0.362	0.374	0.383	0.385	0.385
Eastland N/W	0.240	0.202	0.205	0.251	0.263
Electra	0.301	0.305	0.358	0.363	0.388
Electricity Ashburton	0.235	0.255	0.277	0.337	0.365
Electricity Invercargill	0.161	0.162	0.174	0.187	0.187
Horizon Energy	0.260	0.264	0.261	0.258	0.250
MainPower	0.312	0.321	0.332	0.346	0.340
Marlborough Lines	0.266	0.263	0.260	0.269	0.292
Nelson Electricity	0.036	0.036	0.035	0.035	0.034
Network Tasman	0.350	0.351	0.284	0.289	0.298
Network Waitaki	0.151	0.153	0.145	0.146	0.142
Northpower	0.459	0.461	0.447	0.451	0.450
Orion New Zealand	2.217	2.007	2.153	2.189	2.241
Otago Power	0.215	0.223	0.212	0.215	0.269
Powerco	1.431	1.473	1.428	1.432	2.669
Scanpower	0.057	0.058	0.060	0.060	0.060
The Lines Company	0.220	0.248	0.247	0.248	0.293
The Power Company	0.576	0.580	0.604	0.614	0.614
Top Energy	0.269	0.276	0.272	0.280	0.289
Unison	0.497	0.501	0.575	0.588	1.104
UnitedNetworks	5.034	4.970	5.126	5.145	
Vector	1.772	1.765	2.126	2.193	4.016
Waipa Network	0.164	0.163	0.171	0.173	0.175
WEL Networks	0.662	0.689	0.774	0.792	0.800
Westpower	0.191	0.187	0.183	0.184	0.208

Source: Meyrick and Associates database formed from MED consolidation of Disclosure Data

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