Regulation of Suppliers of Gas Pipeline Services – Gas Sector Productivity

Initial report prepared for
Commerce Commission

10 February 2011

Denis Lawrence, John Kain and Tim Coelli

Economic Insights Pty Ltd
6 Kurundi Place, Hawker, ACT 2614, AUSTRALIA
Ph +61 2 6278 3628 Fax +61 2 6278 5358
Email denis@economicinsights.com.au
WEB www.economicinsights.com.au
ABN 52 060 723 631

CONTENTS

EXECUTIVE SUMMARY

Background

The Commerce Commission has engaged Economic Insights to provide advice on issues relevant to the rate of change for the initial default price paths (DPPs) for gas pipeline businesses (GPBs). The DPPs will be of the CPI–X form and the X factor is likely to be based on two terms: the productivity differential between the industry and the economy and the input price differential between the industry and the economy.

Our main objective in this initial report has been to assess whether there is robust evidence to suggest that the long–run productivity growth rate of New Zealand gas transmission and gas distribution businesses (GTBs and GDBs) is significantly different from that of the New Zealand economy as a whole. We have also examined available evidence on whether input price growth for New Zealand GPBs is significantly different to that for the New Zealand economy as a whole. Taken together these assessments have a role to play in informing decisions on an appropriate X factor for the GPB DPPs.

To undertake these assessments we have looked at three broad approaches as follows (listed in order of preference): a direct approach using information currently available on New Zealand GPBs; an indirect approach using information available on overseas GPB performance; and an indirect approach using information from other industries.

Direct approach using New Zealand GPB information

Our first task was to undertake a review of the currently available Information Disclosure Data (IDD) and other New Zealand GPB data to assess whether they would support the direct approach. This involved examining their coverage, the extent to which definitions of the series are clearly specified, their consistency over time and between businesses, the extent to which they are publicly accessible and the degree of stakeholder ownership. The conclusion of this assessment is that the data are not currently of sufficient completeness, consistency or accuracy to support a robust total factor productivity (TFP) analysis of the long run average productivity improvement rate achieved by GPBs in New Zealand. To support such a robust analysis, additional data would need to be obtained from the GPBs.

Despite these data limitations it has still been possible to undertake an exploratory TFP analysis using a relatively basic TFP specification although only short periods of potentially consistent data are available for the Vector and Powerco GDBs. It has only been possible to form TFP indexes for Vector, Powerco and GasNet for the period from 2006 to 2010. A throughput weighted average annual TFP growth rate for the industry for this period is in the order of –0.8 per cent while a corresponding customer number weighted average annual growth rate is –1.2 per cent. The corresponding economy–wide multifactor productivity (MFP) growth rate for the shorter period 2006 to 2009 is –1.5 per cent suggesting that there does not appear to have been a major difference in performance between the GDBs and the wider economy over this period, particularly once uncertainties surrounding the quality of data and the limited range of variables available for the exploratory analysis are considered.

While too short a period to form a reliable estimate of the long–run productivity differential, it is noteworthy that the partial productivity performances of the Vector and Powerco GDBs have also followed a similar pattern to those of the economy as a whole with operating and maintenance expenditure (opex) and labour partial productivity performance, respectively, being superior to that of capital partial productivity performance.

The economy–wide MFP growth rate over this relatively short recent period will reflect the impact of the global financial crisis on the New Zealand economy. To the extent that the demand for GPB outputs has also been adversely affected by the global financial crisis then this may explain part of the industry's poor recent TFP performance. Similarly, just as recovery from the global financial crisis is likely to lead to higher economy–wide MFP growth rates for a period then GPB TFP growth rates could also be expected to improve if there is a strong link between GPB outputs and general economic conditions.

Looking at the longer period from 1997 onwards, GasNet showed an annual TFP growth rate of –0.3 per cent between 1999 and 2010 compared to the economy–wide rate of 0.5 per cent between 1999 and 2009. However, GasNet only accounts for 4 per cent of the gas distribution industry and Vector Distribution and Powerco show differing TFP growth patterns.

Vector Distribution's TFP growth is only available for the period from 2006 onwards and is in the order of 0.5 per cent. However, available information for NGC Distribution which Vector acquired in 2005 points to a corresponding TFP growth rate of around 2.5 per cent between 1997 and 2003. Assuming this rate to be indicative of Vector's overall TFP performance for the same period, this points to Vector Distribution's TFP growth rate for the overall period 1997 to 2010 being markedly higher than the economy–wide growth rate. On the other hand, Powerco's TFP performance has been negative since 2004 – the only period for which potentially consistent data are available – at a growth rate of –2.4 per cent. This appears to be worse productivity growth performance than that seen in the economy. Considering this differing information from the two major GDBs, a conservative course of action would be to allocate a value of zero to the productivity differential.

A longer time series of relevant data is available for Vector Transmission although the quality and consistency of that information needs to be verified and some key variables (such as reserved capacities) are missing. There is also insufficient information available to construct a TFP series for Maui Development Limited. The data available for Vector Transmission points to a TFP growth rate of 0.5 per cent for the period 1997 to 2010 which is the same as the economy–wide growth rate for 1997 to 2009. This would lend support to allocating a value of zero to the productivity differential for gas transmission when considering the X factor.

Insufficient reliable information on asset values and capital user cost components is currently available to construct a capital input price differential and hence an overall input price differential. However, we note that there is minimal difference in the annual growth rates of the labour cost index for salary and ordinary time wage rates between the Electricity, gas and water (EGW) sector and the economy as a whole. For the period from 1997 to 2010 both labour cost indexes grew at an annual rate of 2.4 per cent. For the more recent period from 2004 to 2010 a small difference has emerged with the EGW sector labour cost index increasing at an annual rate of 2.6 per cent compared to the overall economy–wide rate of 2.4 per cent. More information would be required to form a robust overall input price differential. In the absence of such information, it would be reasonable to allocate a value of zero to the input price differential as done in Lawrence (2003).

The information obtained from the exploratory direct analysis suggests that over both the longer term and the recent short term there has been no robustly identifiable productivity differential between the gas distribution and gas transmission industries and the economy as a whole. Similarly, based on the limited information available there does not appear to have been an identifiable input price difference between these industries and the economy as a whole.

Indirect approach using overseas GPB information

Overseas GBP TFP studies may provide useful information on the long run productivity growth rates of GPBs. It should be noted, however, that this information is then combined with information on the performance of the New Zealand economy as a whole in drawing implications regarding the likely productivity differential.

The review of overseas gas network TFP studies points to a relatively wide range of GPB TFP growth rates. For the Australian GDBs for which TFP analyses have been undertaken, annual TFP growth rates over the last decade range from –0.2 per cent to 2.7 per cent. For the networks where recent data are available, TFP growth has fallen in the period after 2004. Evidence from North American GDB TFP studies also generally points to annual TFP growth of less than 1 per cent for the period since 2000. Little reliable direct evidence is available on the TFP performance of European GDBs or of GTBs in general.

While the overseas studies provide information on the TFP performance of different GPBs, allowance should be made for the operating environments of those GPBs relative to New Zealand when drawing implications for the long run productivity growth rate of New Zealand GPBs. Factors which will affect TFP growth performance include the maturity of the relevant industry under a given regulatory regime, the time elapsed since privatisation, the strength of incentives provided by relevant regulation, penetration rates, inter–fuel substitution including how gas is viewed as a viable long term fuel source and economic growth rates.

It should also be noted that the input price experiences of overseas GPBs are likely to be of only limited relevance to New Zealand GPBs as they will depend to a large extent on the labour and capital market conditions applying in the relevant countries. Materials input prices may be more influenced by international market conditions and hence exhibit more similarity in movement across countries although these will also be significantly influenced by movements in relative exchange rates. For these reasons we have not examined overseas GPB input price movements in this report.

While not providing definitive guidance, the initial review of overseas GPB TFP studies is not inconsistent with the conclusion of the preceding section that GPB productivity performance has not been demonstrably different from that of the New Zealand economy as a whole. The longer run MFP growth rate of 0.5 per cent for the New Zealand economy as a whole is within the range of TFP growth rates observed for Australian GDBs (which arguably face more favourable operating conditions) and similar to that reported for North American GDBs over a comparable period.

Indirect approach using information from other industries

If it is not feasible to undertake robust direct productivity and input price analysis of the New Zealand GPBs, another indirect option available to inform X factor decisions is to examine the TFP performance of related industries. The results from electricity network studies may be of particular relevance in this regard. The electricity and gas network industries have generally similar production characteristics and reform histories and there is significant common ownership. However, New Zealand electricity distribution businesses (EDBs) have been subject to better specified and more comprehensive IDD requirements than have New Zealand GPBs for a decade and a half and have now been subject to two rounds of detailed productivity analysis.

The latest New Zealand EDB TFP studies point to a trend TFP growth rate of approximately the same magnitude as that for the New Zealand economy as a whole for the period 1996 to 2008. Furthermore, EDB TFP growth has flattened off since 2003 as has that for the economy as a whole and as appears to be the case for gas distribution based on the exploratory analysis.

Results of TFP studies undertaken using Australian, US and Canadian EDB data are generally consistent with the latest studies of New Zealand EDB TFP growth. There is limited information available for electricity transmission TFP growth performance.

The latest New Zealand EDB TFP studies also provide the most comprehensive source of information on an input price differential that is likely to be comparable to that for GPBs. Using robust measures of capital annual user costs, Economic Insights (2009c) found that the trend growth rate of input prices for EDBs was approximately similar to that for the economy.

While again not providing definitive guidance for the purpose of considering the DPP X factor for New Zealand GPBs, the review of New Zealand and overseas electricity network TFP studies lends support to the case for allocating a value of zero to the productivity differential between GPBs and the economy as whole. Similarly, information available on the New Zealand EDB input price differential supports the case for also allocating a value of zero to the input price differential for New Zealand GPBs.

Conclusion

While recognising the shortage of complete, consistent and robust relevant data, our initial review of both direct and indirect approaches to assessing whether GPB TFP growth and GPB input price growth have been similar to those for the New Zealand economy as a whole points to there being no strong evidence to the contrary. The evidence available at this time lends support to allocating values of zero to both the productivity differential and the input price differential when considering an appropriate X factor for the gas distribution and gas transmission DPPs.

To the extent that historical productivity and input price differentials provide a good guide to future relative performance, this lends support to the case for a zero X factor going forward. It should be noted that the commencement of productivity–based regulation can be expected to provide GPBs with stronger incentives to improve productivity performance, in which case this would be likely to be a relatively conservative choice.

Obtaining more robust direct information on GPB TFP and input price growth would require obtaining from the GPBs a sufficiently long and consistent time series of the variables listed in section 3.2 of this report.

1 INTRODUCTION

The Commerce Commission ('the Commission') is currently undertaking work to set default price–quality paths ('DPPs') for suppliers of gas pipeline services in New Zealand. As part of setting the DPPs the Commission must specify a rate of change or X factor, based on the long–run average productivity growth rate achieved by suppliers in New Zealand and/or other comparable countries of the relevant goods or services, using appropriate productivity measures.

In its Issues Paper, the Commission (2010, p.25) identified three broad alternatives for informing its decision on an appropriate X factor for the initial DPPs. These were:

- the direct approach which forms total factor productivity (TFP) growth rate estimates using data (if available and sufficiently robust) from the New Zealand gas distribution and gas transmission industries;
- the indirect approach which draws on results of overseas TFP studies for broadly comparable gas distribution and gas transmission industries if the New Zealand data are not sufficiently robust; and
- a more indirect approach which draws on information from non–gas sectors of the New Zealand economy to the extent these sectors are considered relevant.

The Commission has engaged Economic Insights Pty Ltd ('Economic Insights') to advise it on whether there is robust evidence to suggest that the long–run productivity growth rate of New Zealand gas transmission and gas distribution businesses is significantly different from that of the New Zealand economy as a whole. In particular, the Commission has asked Economic Insights to provide:

- a high–level assessment of whether readily available data in a New Zealand context is sufficiently robust and adequate for undertaking a direct study;
- a description of appropriate indirect methods that could be used to inform setting of an X factor for gas pipeline businesses (GPBs);
- any relevant insights from previous work; and
- advice on the Commission's strategy for setting the rate of change for the initial DPPs.

The Commission indicated that the initial feasibility study should not include:

- a comprehensive direct study of New Zealand gas transmission and gas distribution businesses given the likely lack of robust data; or
- requests for further data from New Zealand gas transmission and gas distribution businesses (ie the feasibility study and/or further assessment studies should only be based on currently available data); or
- extensive preparation of currently available information for analysis.

Economic Insights has recently advised the Australian Energy Market Commission (AEMC) on a similar range of data, specification and procedural issues to those currently facing the Commerce Commission (Economic Insights 2009a,b, 2010a).

In 2004 Economic Insights' staff undertook a direct study of New Zealand gas distribution TFP growth using data on NGC Distribution (Lawrence 2004a). At the time NGC Distribution was the only GPB that had been relatively stable in its structure for the preceding period. Both Powerco and Vector had acquired a range of GPBs in the preceding years which made trend analysis for those entities problematic and of limited usefulness. The study drew on data from Information Disclosures and Section 70E data collected as part of the Commission's review of whether GPBs should be subject to control. A relatively basic specification of outputs and inputs had to be used to fit the available data. The study found that for the 7 year period from 1997 to 2003 NGC Distribution's TFP increased at a relatively high trend annual rate of 2.8 per cent. Subsequently, NGC Distribution was acquired by Vector.

Economic Insights' staff also undertook the TFP analyses on which the Commission's electricity distribution thresholds regime was based (Lawrence 2003) and on which the current electricity distribution DPP is based (Economic Insights 2009c).

In the following section of this report we briefly review the rationale behind the rate of change term in productivity–based regulation. In section 3 we review the specification of outputs and inputs in gas network productivity analysis and the associated data requirements. We then undertake a gap analysis relative to currently available Information Disclosure Data (IDD) and report the results of exploratory TFP analyses for the five current GPBs. A review of overseas gas network TFP studies that might form the basis of an indirect approach to forming an X factor is presented in section 4. Relevant information from TFP studies from other industries which could form the basis of a more indirect approach to setting the X factor is presented in section 5 before conclusions are drawn in section 6.

2 THE RATE OF CHANGE IN TFP–BASED REGULATION

Because infrastructure industries such as the provision of gas transmission and distribution networks are often subject to decreasing long run average costs, competition is normally limited and incentives to minimise costs and provide the cheapest and best possible quality service to users are typically not strong. The use of CPI–X price cap regulation in such industries attempts to strengthen the incentive to operate efficiently by imposing pressures on the network operator similar to the process of competition. TFP–based price cap regulation does this by constraining the operator's output price to track the level of estimated efficient unit costs for that industry. In this case the change in output prices is 'capped' as follows:

(1) $$P^1/P^0 = W^1/W^0 - X \pm Z$$

where P is the maximum allowed output price, W is a price index taken to approximate changes in the industry's input prices, 1 and 0 denote the most recent and preceding periods, respectively, X is the projected TFP change for the industry and Z represents relevant changes in external circumstances beyond managers' control which the regulator may wish to allow for. Output prices thus move in line with input prices adjusted for TFP growth. This is because TFP growth allows a unit of output to be produced using a smaller quantity of inputs over time. Ideally the index W would be 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. A commonly used alternative is to choose a generally available price index such as the consumer price index or GDP deflator.

A positive X factor means that prices have to fall in real terms while a negative X factor means that prices can increase in real terms. Ideally the X factor will be set to allow the GPB the opportunity to earn its risk–adjusted rate of return. The cap provides the GPB with an incentive to outperform the assumptions used in setting the X factor while also providing a means of sharing the benefits of efficiency improvements between the GPB and its customers.

Productivity–based regulation, as it has been applied to date in New Zealand, argues that in choosing a productivity growth rate to base X on, it is desirable that the productivity growth rate be external to the individual firm being regulated and instead reflect industry trends at a group, national or even international level. This way regulated firms are given an incentive to match (or better) this productivity growth rate while having minimal opportunity to 'game' the regulator by acting strategically.

As outlined in Lawrence (2003) and Economic Insights (2009d), as the result of choosing the CPI to index costs, the formula for the X factor takes on the following 'differential of a differential' form:

(2) $$X \equiv [TFP^1/TFP^0 - TFP^1_E/ TFP^0_E] - [W^1/W^0 - W^1_E/ W^0_E] - M^1/M^0.$$

where the E subscript refers to corresponding variables for the economy as a whole and M refers to monopolistic mark–ups or excess profits.

What this formula tells us is that the X factor can effectively be decomposed into three 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. It is necessary to include the economy–wide TFP and input price variables because these are drivers of the CPI and need to be allowed for in setting an industry price cap that uses the CPI as the reference index. Thus, taking just the first two terms, 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 practice the price cap is typically implemented using an initial or 'starting' price adjustment (also known as a 'P_0') in the first year of the regulatory period and then a common X factor across the remaining years of the regulatory period which determines the 'rate of change' in prices. Under the TFP–based approach, the X factor is generally the industry (or group) productivity growth rate (for all DBs) and the P_0 aligns opening revenues with costs for each GPB (either in whole or in part). This report only examines X factor issues and so the M terms in equation (2) are ignored.

The former electricity distribution thresholds regime used equation (2) but with one addition. The B factor component of the X factor was simply the first growth differential component on the right hand side of (2). Attempts were made to calculate a robust input price growth differential term but conflicting evidence from statistical agency capital goods price indexes led to a recommendation that the input price growth differential term be set to zero given the uncertainties involved (Lawrence 2003, p.51). The B factor was supplemented by a C factor made up of two components. The C_1 factor in the thresholds regime was based on group TFP levels and supplemented the productivity growth differential term to take account of potential differences in future TFP growth rates given the wide spread of TFP levels in an immature regulatory regime. The C_2 factor based on group profitability differences was a glide path method for implementing the M^1/M^0 term in equation (2).

The current Commerce Amendment Act requires the Commission to specify a DPP rate of change based on the long–run average productivity improvement rate achieved by suppliers in New Zealand and/or other comparable countries, using appropriate productivity measures. The Act does not expressly state a methodology that the Commission must employ to achieve this. However, the Commission is not permitted to use comparative benchmarking in setting the rate of change and there will generally only be one rate of change for all providers of a regulated service.

In recommending a common DPP rate of change for non–exempt electricity distribution businesses, Economic Insights (2009c) used a methodology that was broadly similar to the B factor method used in Lawrence (2003) but with two refinements. These related to an improved measure of system capacity and a more rigorous and robust approach to measuring the annual cost of capital inputs. The proxy annual capital cost series used in Lawrence (2003) was shown to have closely approximated the more robust measure.

We turn next to examining the scope to measure the long–run average productivity growth rate achieved by gas pipeline businesses in New Zealand.

3 DIRECT APPROACH – MEASURING NEW ZEALAND GAS NETWORK TFP

3.1 What is total factor productivity?

Productivity indexes are formed by aggregating output quantities into a measure of total output quantity and aggregating input quantities into a measure of total input quantity. The productivity index is then the ratio of the total output quantity to the total input quantity or, when forming a measure of productivity growth, the change in the ratio of total output quantity to total input quantity.

To form the total output and total input measures we need a price and quantity for each output and each input, respectively. The quantities enter the calculation directly as it is changes in output and input quantities that we are aggregating. The relevant output and input prices are used to weight together changes in output quantities and input quantities into measures of total output quantity and total input quantity using revenue and cost measures, respectively.

There has been some debate about whether just 'billed' outputs (ie outputs explicitly charged for) should be included in the TFP measure or whether both billed outputs and 'unbilled' functional outputs (ie outputs of value to the user – such as system capacity, system reliability and redundancy – but which are not explicitly charged for) should be included. In forming the output measure for competitive industries, observed revenues shares are typically used to weight together the output quantities sold as price will approximate marginal cost in these industries. Because network industries are natural monopolies the price of billed outputs will typically not equal their marginal cost (as would be the case in a competitive industry). Furthermore, some key output dimensions that would be charged for in competitive industries may not be charged for at all in networks. Rather, charges may be levied on only some outputs for reasons of convenience, historical practice or attitudes towards risk.

Economic Insights (2009d,e) showed that all network outputs – both billed and unbilled – should ideally be included in the productivity measure and that each output should be weighted by the difference between its price and marginal cost in deriving the X factor. This is particularly the case if we are interested in setting the structure of prices to maximise economic efficiency. Economic Insights (2009c) went on to show that, appropriately implemented, both the billed output specification and the broader functional output specification (where billed outputs are a subset of functional outputs) will produce the same rate of TFP growth. Because we are mainly interested in the overall weighted average rate of price change when considering the DPP rate of change and because marginal costs are not readily observable and their estimation would currently require the use of econometric methods, we will focus mainly on billed outputs.

On the input side, the most difficult–to–measure component is the input of capital goods. Like other inputs and outputs, we need a quantity and annual cost for capital inputs. The appropriate measure to use for the capital input quantity in productivity analysis depends on the change in the physical service potential of the asset over time. For long–lived network assets such as pipelines, there is likely to be relatively little deterioration in physical service potential over the asset's life. In this case using a measure of physical asset quantity is likely to be a better proxy for capital input quantity than using the constant price depreciated asset value series as a proxy. This is because the constant price depreciated asset value proxy builds in straight–line depreciation which does not accurately reflect the pattern of service potential over time. If the physical proxy approach is adopted then the input quantity (which is the primary driver of productivity results) will be relatively unaffected by which asset valuation method is used. Rather, the asset value will affect the secondary driver of what weight is allocated to the capital quantity changes in forming the productivity measure.

The traditional approach to measuring the annual user cost of capital in productivity studies uses the Jorgenson (1963) user cost method. This approach multiplies the value of the capital stock by the sum of the depreciation rate plus the opportunity cost rate minus the rate of capital gains (ie the annual change in the asset price index). Economic Insights (2009c) implemented a more robust version of the user cost which is consistent with the important regulatory property of ex–ante financial capital maintenance (FCM) and which leads to the TFP user costs coinciding with the return of and return on capital concepts used in building blocks analysis.

For productivity studies with a limited history of investment data available (and hence there would be difficulty in forming the indexed historic cost), the asset value series is typically rolled forwards and backwards from a point estimate using investment and depreciation series. Economic Insights (2009d) recommended taking the earliest point estimate of the capital stock available, provided there was reasonable confidence in the quality of the valuation process. In the case of energy networks, sunk assets and new investment have traditionally been treated symmetrically.

Rather than using an exogenously specified annual user cost of capital, some TFP studies have used an 'endogenous' or residual approach to forming the annual user cost. This approach simply defines the difference between revenue and operating costs to be the annual cost of capital. This approach is typically used where information is relatively limited and there has been some history of building blocks regulation so that the resulting residual rate of return is likely to reflect the weighted average cost of capital (WACC) that would be used in an exogenous specification.

TFP, technical progress and relative efficiency of firms can all be measured by a number of different techniques, the most common being index number methods, data envelopment analysis (DEA) and econometric cost functions. Index number methods have the advantage of being relatively simple and transparent – they are simply a weighted average of changes in output quantities divided by a weighted average of changes in input quantities – and of being readily replicable. They are also not restricted by requiring a large number of observations to implement. DEA, which is a linear programming based method, and econometric cost functions each require a relatively large number of observations to implement and are not as transparent due to their greater complexity by comparison to the relatively simple index number methods.

The use of index number methods to calculate TFP growth, therefore, appears to ensure a relatively low cost way of informing decisions on the DPP and is the most appropriate method given the relatively small number of observations available for New Zealand GPBs.

3.2 Specifying gas network outputs and inputs

In this section we look at the data requirements to undertake TFP studies for gas distribution businesses (GDBs) and gas transmission businesses (GTBs).

3.2.1 Gas Distribution

Output quantities

Throughput: The quantity of a GDB's throughput is typically measured by the number of terajoules of gas supplied. It is usually broken down into the following components:

- domestic volume–based tariff throughput
- non–domestic (typically commercial) volume–based tariff throughput
- capacity–based tariff customers' throughput (typically industrial).

Throughput is sometimes further differentiated between peak and off–peak times of consumption but this is less relevant for gas distribution than for electricity distribution and gas transmission.

Customers: Connection–dependent and customer service activities are typically proxied by the GDB's number of customers. It is again usually broken down into the following components:

- domestic volume–based tariff customer numbers
- non–domestic (typically commercial) volume–based tariff customer numbers
- capacity–based tariff customer numbers (typically industrial).

Reserved Capacity: Industrial capacity–based customers pay a fixed charge to reserve capacity up to a given level. This guarantees they have access to gas delivery when they need it for their production processes and helps GDBs cover the cost of providing dedicated capacity which may be used only by a small number of large customers. Data on reserved capacity are usually not readily available so some studies have used observed peak demand as a proxy. However, peak demand is a poor proxy for reserved capacity as it will be affected by climatic and other exogenous influences and will be less than the summation of corresponding reserved capacities due to the diversification of load within the GDB's network.

System capacity: Studies that include unbilled functional outputs as well as billed functional outputs often include a measure of system capacity. Gas distribution networks have three primary functions: delivery of gas from supply point to demand point; the interim storage of gas to make available sufficient gas during peak periods; and, the performance of these functions safely and efficiently. Some studies include a measure of system capacity to capture the GDB's functional responsibility of making capacity available to meet the needs of customers. The measure required is somewhat analogous to the MVA–kilometre system capacity measure used in electricity distribution business (EDB) TFP studies (see, for example, Lawrence 2003) but, in this case, it needs to also capture the interim storage function of pipelines.

One such system capacity measure is that developed in Lawrence (2007a) which is the volume of gas held within a gas network converted to standard cubic meters using a pressure correction factor based on the average operating pressure. The volume of the distribution network is calculated based on pipeline length data for high, medium and low pressure distribution pipelines and estimates of the average diameter of each of these pipeline types. The quantity of gas contained in the system is a function of operating pressure. Thus, a conversion to an equivalent measure using a pressure correction factor is necessary to allow for networks' different operating pressures.

From historical observations GDB engineers can forecast the approximate load on the system per month during periods of peak flow and as a result can approximate the mean pressure in the network for the twelve month period. To maintain at least the minimum stipulated pressure at the fringe of the network and to ensure periods of peak demand can be accommodated while still meeting the minimum pressure requirement, average system pressures have to be considerably higher than these minimums. Average network pressure is, thus, a better representation of service to the majority of customers. The system capacity measure is the addition of the individual high, medium and low pressure network capacities. Pipelines owned by GDBs operating at very high pressures with characteristics normally associated with transmission or sub–transmission are typically excluded from the calculation.

Service quality: The quality of supply includes reliability (the number and duration of interruptions) 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 are available. However, it is difficult to include reliability measures as a separate output in TFP analysis due to the way output is measured. Reliability measures usually involve an improvement in reliability being reflected as a reduction in the relevant measure of the extent of unsatisfactory performance whereas in productivity analysis more of an output is measured as an increase in the corresponding output quantity. Given these difficulties, most TFP studies omit service quality as an explicit output. If service quality is improving (falling) over time then the effect of this omission would be to underestimate (overestimate) the rate of output growth and, hence, TFP growth. Service quality issues have been incorporated in price caps by the use of a separate incentive arrangement in many jurisdictions.

Output weights

Studies including only billed outputs and using revenue weights would ideally require the following break–down of total line charges:

- revenue from domestic volume–based tariff throughput
- revenue from non–domestic volume–based tariff throughput
- revenue from capacity–based tariff customers' throughput.
- domestic volume–based tariff customers' fixed charges
- non–domestic volume–based tariff customers' fixed charges
- capacity–based tariff customers' fixed charges

- capacity–based tariff customers' reserved capacity charges.

Studies which also include unbilled functional outputs would require additional information on estimated cost–based output shares derived from an econometric cost function.

Input quantities

Opex: The quantity of a GDB's operating and maintenance expenditure (opex) is typically derived by deflating the value of opex by an appropriate opex price deflator. The value of opex needs to exclude all capital–related charges and to have the same definition both over time and across GDBs. Changes in capitalisation policies and the impact of accounting standards changes need to be adjusted for. In the case of electricity distribution, Lawrence (2003) and Economic Insights (2009c) used the grossed up values of direct costs per kilometre and indirect costs per customer from the IDD as the value of operating costs because these measures best reflected the purchases of actual labour, materials and services used in operating the businesses and excluded rebates.

The opex price index used is typically the Electricity, gas and water sector labour cost index for salary and ordinary time wage rates as it directly measures the price of a major component of operating expenditure. Some studies also include a range of producer price indexes to capture changes in the price of materials and services as well as labour.

Transmission–equivalent network: The quantity of any transmission–equivalent network for the GDB is typically proxied by its transmission–equivalent pipeline length.

High pressure network: The quantity of a GDB's high pressure network is typically proxied by its high pressure pipeline length.

Medium pressure network: The quantity of a GDB's medium pressure network is typically proxied by its medium pressure pipeline length.

Low pressure network: The quantity of a GDB's low pressure network is typically proxied by its low pressure pipeline length.

Services network: The quantity of a GDB's services network is typically proxied by its estimated services pipeline length.

Meters: The quantity of a GDB's meter stock is typically proxied by its total number of meters.

Other assets: Given their diverse nature and relatively small share in total assets, the quantity of other capital inputs is typically proxied by their deflated asset value. Other capital comprises city gate stations, cathodic protection, supply regulators and valve stations, SCADA and other remote control, other IT and other non–IT equipment.

Input weights

To form input weights we first need to form an estimate of total costs which requires a consistent and reliable asset value series. Lawrence (2003) formed the value of total costs for EDBs by summing the value of operating expenditure and 12.5 per cent of total (estimated) indexed historic cost (IHC). The latter proportion was based on the NZIER (2001) assumption of a common depreciation rate of 4.5 per cent and an opportunity cost rate of 8 per cent for capital assets. In the specification used in Economic Insights (2009c) which recognises FCM we took total costs to be the sum of operating expenditure and amortisation charges (equivalent to the return of and return on capital components used in building blocks analysis). The additional information required to implement the more robust specification is the rate of inflation, the WACC, the remaining life of the opening capital stock and the expected lifespan of new capital (as well as reliable series of capital expenditures). As noted earlier, the FCM–based capital costs coincided closely with the earlier approximation method. A less preferred alternative is to define the residual of revenue less opex as the annual cost of capital.

The weights given to opex and the capital components are their shares in total cost.

3.2.2 Gas Transmission

Output quantities

Relatively few TFP studies of gas or electricity transmission have been carried out, in part because it has been relatively problematic to specify and adequately quantify transmission outputs. There have generally been two outputs included: throughput and a measure of system capacity. The measure of pipeline capacity usually attempts to incorporate both delivery capacity and length dimensions. Most Australian regulators require pipelines to supply a maximum feasible capacity estimate in terajoules per day. This can then be multiplied by pipeline length to form the desired measure. However, there has been some debate over what constitutes maximum feasible terajoules per day and this figure is not available for some GTBs, including the New Zealand GTBs.

The Maui Development Ltd (MDL) transmission pipeline charges customers on the basis of gigajoules of energy transmitted plus the product of gigajoules and the distance the gas is transported. This would point to two output quantity measures: throughput and throughput multiplied by average distance transported.

Vector Transmission charges customers throughput and capacity reservation fees which point to using throughput and the amount of reserved capacity as relevant outputs. However, given that the Vector Transmission network is relatively spread out and bottlenecks could occur at different parts of the system, it would also be important to identify where capacity was being reserved.

Lawrence (2004b) undertook a high–level TFP analysis of the former NGC Transmission (now Vector Transmission) network and used two outputs: throughput and system capacity, with two different proxies being used for system capacity (length of pipelines and their asset value).

Output weights

If output quantities can be linked to identified revenue streams then revenue shares for each output could be formed. Otherwise it would be necessary to use estimated cost–based output shares derived from an econometric cost function. Given the limited number of GTB observations available on which to base econometric analysis, it might be necessary to use corresponding distribution results as a proxy.

Input quantities and weights

The same approach to input specification and weighting is generally used for transmission pipelines as for distribution. There will generally be fewer pipeline types for each GTB and compressor stations should ideally be included as a separate capital input.

3.3 Data gap analysis

To establish the long run average productivity growth rate of GPBs in New Zealand we would ideally require data covering one full business cycle (which may be 10 to 15 years) for the variables identified in the preceding section for each GPB. The AEMC (2009) considered that 8 years of data was the minimum required to establish a reliable TFP trend. This was also the time period available when the Commission set the original electricity distribution business (EDB) thresholds parameters in 2003. However, data also need to satisfy a number of important criteria. The main considerations were identified by Economic Insights (2009a) as the following:

- What is the coverage of currently collected data across the output and input prices and quantities required for robust productivity analysis?
- Have available data been supplied subject to clear and precise definitions?
- Have available data been supplied consistently through time for each business and consistently across businesses?
- Are available data in the public domain or accessible by interested parties?
- Do both regulators and regulated businesses feel the data are robust and consistent and do all relevant parties have 'ownership' of the data as being an accurate and consistent record of actual outputs produced and inputs used?

The primary source of data currently available for New Zealand GPBs for productivity analysis is the annual IDD submissions. It is important to note that the IDD were not originally developed for the purpose of productivity analysis and so their ability to support that purpose is reliant on the coincidence of productivity data requirements and those of the (mainly financial) general disclosure objectives thought relevant at the time. In this section we will assess the IDD against the above criteria for data suitable for use in productivity analysis.

Coverage

Some of the output quantity variables identified in the preceding section are included in the IDD but at an aggregate level only. For instance, for gas distribution total throughput and total customer numbers are included in the 'Statistics' section of the IDD as is total system length on the input side. There is no coverage of total capacity reserved by industrial customers and associated revenue although the maximum monthly amount of gas entering the system is reported. While some studies have used peak demand measures as a proxy for total capacity reserved by industrial customers this will be a poor proxy due to the influence of climatic conditions varying demand for the end product and the diversification of load within the GDB's system. To adequately measure this output, data on the capacity reserved by industrial customers are required.

Line charge revenue is disclosed but only at an aggregate level. Disaggregated data on throughput, customer numbers and revenue are available in Powerco's and Vector's Compliance Statements for the gas distribution Authorisation but only from 2008 onwards.

Opex data on direct line costs per kilometre and indirect line costs per gas customer are presented in the IDD although the series exhibit considerable volatility and were subject to significant revisions in the early years. Asset values are variously described as book values, at cost or on a depreciated replacement cost basis and reported at an aggregate level only for property, plant and equipment. Some are subject to significant revaluation discontinuities in some instances. Service line lengths are included in the denominator used in some cases but not in others.

The IDD data coverage for GTBs is broadly similar to that for GDBs.

The Commission (2010) asked the GPBs whether they would be able to supply more detailed information on some variables such as pipeline length broken down by material, diameter and pressure. The GPBs generally indicated they would be able to supply information for a period of 5 to 10 years depending on the variable. However, all noted that historic data was likely to be of questionable quality. For instance, Vector (2010, p.11) noted:

> 'The gas distribution and gas transmission sectors in New Zealand have not been subject to the same degree and extent of detailed regulation and regulatory intervention as their electricity counterparts. … As a result the extent, robustness and historical range of available data for gas transmission and distribution are significantly less than that experienced in electricity. Vector recommends the Commission take a pragmatic approach for this reset to setting a rate of change and quality standards as it will have to rely on unavoidably incomplete data. … the Commission should recognise that historical data that has not previously been required for disclosure may not be available or may not be available in the form or level of aggregation that the Commission wants.'

Definitions

The Commission's (2010, p.33) Issues Paper noted the following with respect to the basis on which GPBs currently provide IDD:

> 'GPBs may have used different interpretations and approaches for disclosing data, thus creating issues for undertaking consistent analysis. For example:
>
> - the information disclosure financial statements include an income statement and balance sheet, but not information from which capital expenditure and revaluations can be reliably extracted;
> - valuation methods and methods of determining depreciation are not specified;

- methods of allocating costs between gas and non–gas activities are not typically specified nor required to be disclosed, nor is it clear whether double counting of some costs is permitted in the allocation process.'

The Commission is currently considering future requirements to improve the coverage, quality and consistency of the IDD. Given the lesser focus placed on gas IDD relative to electricity IDD, it is likely that less emphasis has previously been placed on obtaining consistent definitions over time and across businesses. For instance, GasNet (2010, p.10) noted:

> 'As GasNet has restructured, revalued and improved its data over this period, there are some step changes in results reported across the time series which would need to be considered.'

Lawrence (2004b, p.16) also noted:

> 'The primary data sources used for the NZ gas pipeline businesses are the Disclosure Data and data supplied in response to Section 70E notices. Where there is a difference between the Disclosure Data and information supplied in response to Section 70E notices, the Section 70E responses are used.'

In some instances the differences in key variables between the two sources were quite significant (eg Section 70E reported revenue exceeded IDD reported revenue by 20 per cent in 2003).

Consistency

Apart from the inconsistencies in the IDD noted above, the major impediment to undertaking a TFP study based primarily on the IDD is the effects of industry restructuring and GPB amalgamation. Lawrence (2004a, p.1) noted:

> 'Changes in the structure of the distribution industry in recent years, particularly the splitting up of UnitedNetworks' gas distribution operations between Powerco and Vector, make it difficult to obtain consistent data through time. However, two companies – NGC Distribution and Wanganui Gas – have remained relatively stable in their structure since 1997.'

Soon after the study was undertaken NGC Distribution was acquired by Vector. The Commission (2010) asked whether Vector still continues to collect separate disclosure data for the former NGC Distribution network. Vector (2010, p.12) responded:

> 'Information disclosure for our gas distribution networks is consolidated in accordance with advice from the Ministry of Economic Development. We do still collect information that is disaggregated by the two historic distribution networks and this disaggregated information could be provided. However, the Commission must recognise that to make this information available would be a complex process and, due to the assumptions that would need to be made, the final numbers may not sum to the previously disclosed totals. …
>
> 'Vector gathers additional data on our gas pipeline businesses, but these are collected for internal purposes and are not always of an auditable standard. They

> are also not necessarily in a format or at a level of disaggregation that may be useful to the Commission. To disaggregate the data we collect to provide numbers at the level of individual gas pipeline businesses would be a complex and lengthy task and the results may not be fully accurate given the need to re-interpret historical data.'

Based on this response and an examination of the IDD it would be difficult to update the Lawrence (2004a) study without substantial input from Vector in supplying 'NGC Distribution–equivalent' data from 2005 onwards.

The acquisition of UnitedNetworks' gas distribution operations by Powerco and Vector in 2002 and 2003, respectively, continues to make it difficult to assemble a consistent longer time–series of GDB productivity data. Powerco's coverage only appears to be relatively consistent from 2004 onwards. Vector note that the IDD for UnitedNetworks for 2003 only relates to a 6 month period and that the Vector IDD for 2002 and earlier years relates to all of the UnitedNetworks operation. Vector data is further affected by its purchase of NGC Distribution in 2004 and 2005. Further evidence of difficulties with Vector reporting consistent data can be found in their line lengths reported over the 2004 to 2006 period. Vector (2006, p.24) notes:

> 'NGC service pipeline length included in System Length (km) disclosure for 2006, but excluded from 2005 disclosure due to lack of data.'

There are likely to be considerable difficulties in attempting to backcast current series to get consistent coverage over an extended period due to loss of relevant corporate memory with staff turnover, particularly as a result of amalgamations, and potential inability to recover information from legacy information systems.

After examining the consistency of the incomplete set of relevant IDD variables, we are of the view that some potentially useable data are available for Powerco for the period 2004 to 2010, for Vector Distribution for the period 2006 to 2010, for GasNet (Wanganui) for the period 1999 to 2010, for Vector Transmission for the period 1997 to 2010 and for MDL for the period 2006 to 2009. However, as noted, a number of inconsistencies remain even within these limited periods and the shorter periods of potentially consistent data for the two large GDBs remains a major concern.

Public domain

The IDD are in the public domain but would need to be supplemented by additional data to enable robust direct TFP measures to be formed. It would be desirable for any additional data used in constructing robust historical TFP series or facilitating construction of future TFP series to also be in the public domain. This allows stakeholders to test the veracity of the data and to undertake their own sensitivity analyses and updates of relevant TFP analysis.

Stakeholder 'ownership'

As noted above, most GPBs acknowledged the relatively poor quality of currently disclosed data in their submissions on the Commission's (2010) Issues Paper. For instance, Vector (2010, p.6) noted:

> 'We agree with the Commission that the small size of the sample of GPBs may well limit the robustness of any analysis of NZ gas sector productivity. However, a bigger issue may be a lack of reliable and robust data.

GasNet (2010, p.7) also stated:

> 'We also question whether there is a dataset of sufficient longevity and quality for GDBs which would provide the required inputs for a TFP study. … We acknowledge in principle GDBs should be able to prepare historical data sufficient to meet the Commission's requirements, but we suggest this would only be achieved at quite considerable cost to the businesses. … We also question whether it will be possible to achieve a dataset which is consistent across the sector, for example in respect of asset valuation.

The Commission (2010, p.33) also observed:

> 'The current information disclosure regime, however, does not provide sufficiently detailed information for the purpose of regulatory decision making. … The result is that the information that is immediately available for all GPBs is limited and the robustness, accuracy, and consistency of data is unclear in the absence of an agreed audit/verification process.'

It is evident, therefore, that there is not a high level of 'ownership' of or confidence in currently disclosed data by the key stakeholders. It would be necessary to supplement currently available data with additional data and information from the GPBs before a robust TFP study could be undertaken. As noted above, even then there are likely to be considerable difficulties in obtaining consistent data for the period before the major amalgamations.

Vector (2010, p.6) suggested that the Commission make an effort during the forthcoming regulatory period 'to reform information disclosures to improve available information gathered over that period and use the information gathered to conduct a robust productivity analysis for the regulatory period starting in 2017'. The Economic Insights (2009a) review for the AEMC of Australian regulatory data available to support the introduction of productivity–based regulation came to a similar conclusion (although it should be noted Australia does not currently have any equivalent of the New Zealand IDD).

The conclusion of this assessment of New Zealand GPB data currently available to the Commission is that that data is not of sufficient completeness, consistency or accuracy to support a robust TFP analysis of the long run average productivity improvement rate achieved by GPBs in New Zealand. However, it is still possible to undertake an exploratory preliminary TFP analysis based on the current data and we turn to that in the following section.

3.4 Exploratory TFP analysis

A relatively minimalist TFP specification can be supported using the variables available in the IDD. This specification involves two outputs and two inputs for both GDBs and GTBs along similar lines to Lawrence (2004a,b). However, in this case there has been no opportunity to ensure data consistency and only relatively short periods of potentially consistent data are available for the two major GDBs.

Specification and time periods

The exploratory distribution TFP model includes two outputs: energy throughput in gigajoules and customer numbers. There is no information available on capacities reserved by industrial customers. We examine two different output weightings. For cost–based output weights we apply a weight of 25 per cent to throughput and 75 per cent to customer numbers following PEG (2007). For revenue–based output weights we apply a weight of 75 per cent to throughput (reflecting variable charges) and 25 per cent to customer numbers (reflecting fixed charges). These proportions are based on Vector Distribution's pricing schedules and average consumption patterns and are similar to revenue shares reported by PEG (2007) for Ontario GDBs.

The exploratory distribution TFP model includes two inputs: opex and pipeline length. Opex is formed by scaling up values of direct costs per kilometre and indirect costs per customer to form more consistent measures of opex following the approach Lawrence (2003) used for the EDB B factors. The electricity, gas and water (EGW) sector labour cost index for salary and ordinary time wage rates is used to proxy the price of opex inputs. Pipeline length is used to proxy the annual quantity of capital inputs. While this is not our preferred measure as more disaggregated information on pipeline lengths by type is ideally required, the aggregate length can be used as a proxy using the assumption that the composition of pipeline length remains relatively constant over time. We also look at two input weightings. Firstly, following the Lawrence (2003) approach used in the B factor analysis, we proxy an exogenous annual capital cost by taking 12.5 per cent of the reported asset value. Secondly, we used an endogenous annual cost of capital generated as the difference between reported revenue and our calculated value of opex. For all GDBs and GTBs the differences in total input indexes resulting from using the endogenous approach as opposed to the exogenous approach were relatively minor. As a result, we will only report results using the preferred exogenous approach.

The exploratory transmission TFP model also includes two outputs following the Lawrence (2004b) Model 2: energy throughput in gigajoules and asset value as a proxy for system capacity. Other information required to calculate average distances transported and hence the capacity function charged for by MDL or reserved capacity as charged for by Vector are not available. We again examine the same two output weightings as used in the GDB model.

The exploratory transmission TFP model includes the same two inputs used in the GDB model (opex and pipeline length) and uses the same approach to input weighting.

Once the impacts of business amalgamations are considered and affected data excluded from the analysis, we have varying potentially useable time periods across the three GDBs and two GTBs. For Vector Distribution we have potentially useable data for the period 2006 to 2010, for Powerco we have the period 2004 to 2010 and for GasNet we have the period 1999 to 2010. For Vector Transmission we have potentially useable data for the period 1997 to 2010 and for MDL we have the period 2006 to 2009 (the only data currently available).

Caveat

It should be noted that the analysis presented here is exploratory only and illustrative of potential direct TFP results. Additional data would need to be obtained from GDBs and GTBs covering additional variables and a longer time period before a robust TFP analysis could be undertaken and a long–run average productivity improvement rate achieved by gas network suppliers in New Zealand could be established with confidence. There has been no opportunity to verify the consistency of data used. Rather, anomalous time periods resulting from business amalgamations have been excluded from the analysis. The preliminary exploratory analysis is in line with the Commission's request that no extensive preparation of currently available information be undertaken as part of the feasibility study and that no additional data be requested from GPBs at this stage.

Distribution results

Lawrence (2004a) used a simple two output, two input specification based on available data to examine NGC Distribution's TFP growth for the period 1997 to 2003. TFP was found to have increased at an annual trend rate of 2.8 per cent over this period. The study used cost–based output shares to weight the two outputs together but both throughput and customer numbers were growing strongly over this period and using the alternate proxy of revenue weights produced a similar trend growth rate.

As noted above, NGC Distribution was purchased by Vector in 2005 and Vector has since provided consolidated rather than separate IDD returns. Furthermore, Vector has indicated that while it would be possible to produce disaggregated 'NGC Distribution–equivalent' data for the subsequent period, this would involve a number of assumptions and take some time to do. It has, therefore, not been possible to simply update the earlier Lawrence (2004a) study. The next option examined was to calculate TFP growth for the consolidated Vector Distribution operations from 2005 onwards and compare these to the earlier NGC Distribution results. Data continuity issues affecting the Vector Distribution IDD shortened the available period to 2006 to 2010.

Between 2006 and 2010 Vector Distribution's throughput fell at an annual rate of 2.3 per cent while its customer numbers continued to increase at an annual rate of 2.5 per cent. This divergence in throughput and customer number growth rates now makes the variation between cost–based output versus revenue–based output weights significant. As shown in table 1, the cost–weighted output index[1] increased at an annual rate of 1.3 per cent[2] over the last 5 years while the revenue–weighted output index declined at an annual rate of 1.1 per cent.

Input use declined at an annual rate of 1.8 per cent resulting from an annual reduction in the quantity of opex of nearly 9 per cent and an annual increase in the quantity of capital input of just over 2 per cent. Combining the input index with the two alternate output indexes we get an annual TFP growth rate of 2.9 per cent using the cost–weighted output index and an annual TFP growth rate of 0.6 per cent using the revenue–weighted output index.

[1] All indexes presented in this report use the chained Fisher indexing method (see Lawrence 2003).
[2] For convenience growth rates presented in this report use the logarithmic endpoint to endpoint method.

Table 1: **Vector Distribution's output, input and productivity indexes, 2006–2010**

Year	*Cost–weighted output*	*Revenue–weighted output*	*Input*	*Cost–weighted TFP*	*Revenue–weighted TFP*	*Opex partial productivity*	*Capital partial productivity*
2006	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2007	1.0146	0.9844	0.9894	1.0205	0.9949	1.0747	0.9732
2008	1.0319	0.9759	0.9377	1.0943	1.0407	1.2821	0.9743
2009	1.0430	0.9642	0.9291	1.1168	1.0378	1.3485	0.9701
2010	1.0516	0.9555	0.9322	1.1228	1.0250	1.3509	0.9691
Growth rate	1.26%	–1.14%	–1.76%	2.89%	0.62%	7.52%	–0.79%

Source: Exploratory Economic Insights estimates based on Information Disclosure Data

The TFP index growth rate for the period 2006 to 2010 based on cost–weighted output is thus very similar to the corresponding growth rate obtained in Lawrence (2004a) for the earlier period 1997 to 2003 for NGC Distribution. However, the TFP growth rate for the period 2006 to 2010 based on revenue–weighted output is now much lower compared to the corresponding growth rate based on Lawrence (2004a) for the earlier period 1997 to 2003 for NGC Distribution as a result of the divergence in throughput and customer number growth rates. The revenue–weighted TFP growth rate of 0.6 per cent is associated with annual growth rates of 7.5 per cent in opex partial productivity (the quantity of output relative to the quantity of opex) and –0.8 per cent in capital partial productivity.

Vector Distribution accounted for 67 per cent of the gas distribution industry's throughput in 2010 and for 57 per cent of its overall customer numbers.

We turn next to the second largest gas distribution network, Powerco, which accounted for 29 per cent of industry throughput and 39 per cent of overall customer numbers in 2010. Potentially useable productivity data for Powerco are available from 2004 to 2010. This is the period after a series of gas network acquisitions by Powerco culminating in the purchase of part of the former UnitedNetworks in late 2002.

Between 2004 and 2010 Powerco's throughput fell at an annual rate of 1 per cent while its customer numbers fell at an annual rate of 0.8 per cent. Because there is little divergence in throughput and customer number growth rates, the choice of cost–based output versus revenue–based output weights will not be as critical as in the previous case and so we will only present revenue–weighted output results. From table 2, it can be seen that the output index decreased at an annual rate of just over 0.9 per cent over the last 7 years.

Overall input use increased at an annual rate of 1.5 per cent resulting from an annual reduction in the quantity of opex of 0.9 per cent and an annual increase in the quantity of capital input of 2.3 per cent. Combining the input index and output indexes we get an annual TFP growth rate of –2.4 per cent.

The TFP growth rate of –2.4 per cent is associated with annual growth rates of around 0 per cent in opex partial productivity and –3.2 per cent in capital partial productivity. Opex partial productivity spiked by nearly 20 per cent in 2008 as reported opex fell markedly in that year before returning to its trend levels.

Table 2: **Powerco's output, input and productivity indexes, 2004–2010**

Year	*Output*	*Input*	*TFP*	*Opex partial productivity*	*Capital partial productivity*
2004	1.0000	1.0000	1.0000	1.0000	1.0000
2005	0.9968	1.0285	0.9692	0.9055	0.9738
2006	1.0459	1.0364	1.0092	1.0203	0.9540
2007	0.9702	1.0447	0.9286	1.0081	0.8976
2008	0.9431	1.0099	0.9339	1.1964	0.8755
2009	0.9480	1.0533	0.9001	1.0138	0.8664
2010	0.9452	1.0922	0.8654	0.9980	0.8296
Growth rate	–0.94%	1.47%	–2.41%	–0.03%	–3.21%

Source: Exploratory Economic Insights estimates based on Information Disclosure Data

The smallest of the three GDBs, GasNet (formerly Wanganui Gas Ltd), has been the most stable in terms of structure over the past decade. Potentially useable productivity data are available for the period 1999 to 2010. However, GasNet only accounted for 4 per cent of throughput and 4 per cent of customer numbers in 2010.

Table 3: **GasNet's output, input and productivity indexes, 1999–2010**

Year	*Output*	*Input*	*TFP*	*Opex partial productivity*	*Capital partial productivity*
1999	1.0000	1.0000	1.0000	1.0000	1.0000
2000	1.0479	1.0161	1.0313	0.9942	1.0509
2001	1.1143	0.9644	1.1555	1.2487	1.1175
2002	1.1493	0.9587	1.1988	1.3228	1.1493
2003	1.1729	1.0105	1.1607	1.1697	1.1563
2004	1.1804	1.0606	1.1130	1.0279	1.1540
2005	1.1744	1.1069	1.0609	0.9173	1.1385
2006	1.1063	1.1247	0.9836	0.8335	1.0666
2007	1.1153	1.1759	0.9485	0.7482	1.0664
2008	1.0993	1.2369	0.8888	0.6468	1.0482
2009	1.0395	1.2077	0.8608	0.7049	0.9448
2010	1.1458	1.1896	0.9632	0.8175	1.0360
Growth rate	1.24%	1.58%	–0.34%	–1.83%	0.32%

Source: Exploratory Economic Insights estimates based on Information Disclosure Data

Between 1999 and 2010 GasNet's throughput grew at an annual rate of 1.6 per cent while its customer numbers grew at an annual rate of only 0.1 per cent. However, since 2004 throughput and customer numbers have both fallen by 0.4 and 0.9 per cent per annum, respectively. For convenience, we will only present revenue–weighted output results here. From table 3, it can be seen that GasNet's output index increased at an annual rate of just over 1.2 per cent over the last 12 years although output peaked in 2004.

Overall input use increased at an annual rate of 1.6 per cent resulting from an annual increase in the quantity of opex of just over 3 per cent and an annual increase in the quantity of capital input of 0.9 per cent. Combining the input index and output indexes we get an annual TFP growth rate of –0.3 per cent.

The TFP growth rate of –0.3 per cent is associated with annual growth rates of around –1.8 per cent in opex partial productivity and 0.3 per cent in capital partial productivity. Opex partial productivity halved between 2002 and 2008 but has improved by over a quarter in the last two years relative to its 2008 level.

In summary, a mixed picture of GDB TFP growth performance emerges from the exploratory productivity analysis. Vector Distribution has had ongoing positive TFP growth over the last 5 years, building on the strong TFP growth performance of NGC Distribution from 1997 to 2003. This is particularly the case when cost–based weights are used to aggregate outputs and TFP growth remains positive when revenue–based output weights are used. Vector's good TFP growth has also been driven by relatively large reductions in the quantity of opex inputs over the last 5 years. Powerco and GasNet, on the other hand, have both had negative TFP growth in recent years as both throughput and customer numbers have fallen as demand for gas has fallen. In the case of GasNet a strong growth in the quantity of opex inputs in recent years has also been a driver of the negative observed TFP growth.

It is difficult to derive a single distribution industry TFP growth rate from the exploratory analysis due to the varying time periods for which data are available and the likely difficulty in extending the assumption of constant composition of pipeline length by type from each business to the industry as a whole. However, if we use the relatively short period from 2006 to 2010 – the only period for which data are available for all three GDBs – and weight TFP growth for this period by shares in industry throughput for 2010, we obtain a weighted average annual TFP growth rate of –0.8 per cent. However, the largest GDB (Vector Distribution) and its predecessor component for which previous results are available has shown positive TFP growth over an extended period.

Transmission results

Lawrence (2004b) examined the TFP performance of a number of GTBs in Australia and New Zealand. While the focus was primarily on comparing performance across the businesses in 2003, the report also presented a TFP time–series for the then NGC Transmission for the period 1997 to 2003. The average annual TFP growth for the 6 years 1997 to 2002 was 0.7 per cent. Results for 2003 were affected by an asset revaluation and have not been included in this calculation. NGC Transmission was purchased by Vector in 2005.

Using the IDD it has been possible to extend the Lawrence (2004b) approach for the period 1997 to 2010. The IDD for the period 1997 to 2003 differs for some variables compared to the Lawrence (2004b) data which was based primarily on Section 70E responses and Commission adjustments to ensure consistency. In this analysis we use only the IDD data as it is all that is available for the whole period. Since Vector did not have gas transmission operations prior to its purchase of NGC Transmission and has not acquired other gas transmission operations since, the IDD provides a more consistent series than is the case for the NGC and Vector distribution businesses.

Between 1997 and 2010 Vector Transmission's throughput grew an annual rate of 3.3 per cent while its system capacity proxy grew at an annual rate of 0.5 per cent. However, throughput grew at twice this annual rate between 1997 and 2003 and has declined slightly since 2004. We are only able to construct a cost–weighted output measure for transmission and use the same weights as in Lawrence (2004b). From table 4, it can be seen that Vector Transmission's output index increased at an annual rate of just over 1.4 per cent over the last 14 years although annual output growth was 1.9 per cent up to 2003 and 1.2 per cent since 2004.

Table 4: **Vector Transmission's output, input and productivity indexes, 1997–2010**

Year	*Output*	*Input*	*TFP*	*Opex partial productivity*	*Capital partial productivity*
1997	1.0000	1.0000	1.0000	1.0000	1.0000
1998	1.0253	1.0957	0.9358	0.6828	1.0227
1999	1.0596	1.1243	0.9424	0.6344	1.0608
2000	1.0904	1.0733	1.0159	0.7998	1.0811
2001	1.1044	1.0727	1.0296	0.8122	1.0950
2002	1.1253	1.1420	0.9854	0.6841	1.1000
2003	1.1217	1.1164	1.0048	0.7407	1.0965
2004	1.1156	1.2041	0.9265	0.5632	1.0905
2005	1.1389	1.1845	0.9614	0.6060	1.1132
2006	1.1601	1.2651	0.9170	0.5074	1.1340
2007	1.1548	1.1644	0.9917	0.6445	1.1288
2008	1.2020	1.1223	1.0710	0.7555	1.1749
2009	1.1884	1.1355	1.0466	0.7196	1.1616
2010	1.2021	1.0700	1.1234	0.8854	1.1745
Growth rate	1.42%	0.52%	0.38%	–0.94%	1.24%

Source: Exploratory Economic Insights estimates based on Information Disclosure Data

Overall input use increased at an annual rate of 0.5 per cent resulting from an annual increase in the quantity of opex of 2.4 per cent and an annual increase in the quantity of capital input of just 0.2 per cent. However, the quantity of opex inputs grew annually at nearly 7 per cent up to 2003 and has fallen annually by around 6 per cent since 2004.

Upon combining the input index and output indexes we get an annual TFP growth rate of 0.9 per cent for the last 14 years. For the period up to 2003 annual TFP growth was only 0.1 per cent using the IDD and as opex usage increased sharply but it has grown strongly at 3.2 per cent since 2004 as opex usage has been cut significantly.

The TFP growth rate of 0.9 per cent is associated with annual growth rates of around –0.9 per cent in opex partial productivity and 1.2 per cent in capital partial productivity. Opex partial productivity halved between 1997 and 2006 but has since improved by three quarters in the last four years relative to its 2006 level. Opex partial productivity growth since 2004 has been at a very strong annual rate of 7.5 per cent.

In 2009 Vector Transmission accounted for just over 40 per cent of gas transmission throughput. The other 60 per cent of gas transmission throughput is provided by the Maui pipeline operated by MDL. Maui has only been required to supply partial IDD since 2006 with the commencement of the open access regime. Only data covering the four years 2006 to 2009 are currently available and this does not cover revenue or asset values, both of which are used in the Lawrence (2004b) specification. However, we note that MDL's throughput has increased at an annual rate of 5.3 per cent between 2006 and 2009 while its pipeline length has remained constant and its opex quantity has increased at the high annual rate of 15 per cent. Without information on asset values in particular it is difficult to determine the impact these output and input growth rates would have on overall TFP growth. In the absence of more information on MDL's operations we will use Vector Transmission's TFP growth results as being representative of the TFP growth rate for the gas transmission industry.

Economy–wide productivity growth

The best measure of economy–wide productivity growth currently available for New Zealand is Statistics New Zealand's (2010a) multifactor productivity (MFP) series. The MFP series was used in Economic Insights (2009c) to form the productivity differential between EDBs and the economy as a whole. It covers the 'measured' or market sector of the New Zealand economy and has currently been produced for the period 1978 to 2009. In this analysis we will examine the period from 1997 onwards, the same period that the IDD is potentially available for the various GPBs.

Table 5: **'Measured' sector multifactor productivity indexes, 1997–2009**

Year	*Labour partial productivity*	*Capital partial productivity*	*Multifactor productivity*
1997	1.0000	1.0000	1.0000
1998	1.0252	0.9989	1.0152
1999	1.0343	0.9796	1.0128
2000	1.0963	1.0147	1.0641
2001	1.1060	1.0011	1.0633
2002	1.1131	1.0045	1.0689
2003	1.1345	1.0249	1.0897
2004	1.1487	1.0238	1.0970
2005	1.1655	1.0204	1.1050
2006	1.1842	1.0125	1.1122
2007	1.1694	0.9841	1.0905
2008	1.1907	0.9751	1.0978
2009	1.1726	0.9230	1.0641
Growth rate	1.33%	–0.67%	0.52%

Source: Statistics New Zealand (2010a)

From table 5 we see that MFP has increased at an average annual growth rate of 0.5 per cent over the 13 years to 2009. This resulted from annual growth in labour partial productivity of 1.3 per cent and in capital partial productivity of –0.7 per cent. However, economy–wide MFP peaked in 2006 and has declined since then. For the period 1997 to 2004 MFP grew at an annual rate of 1.3 per cent but this has fallen to –0.6 per cent for the period since 2004 and –1.1 per cent since 2006. The fall in MFP observed in 2009 will reflect the impact of the global financial crisis on the New Zealand economy.

It should be noted that the Statistics New Zealand MFP series uses the traditional National Accounts value added or 'net' approach to forming the productivity measure. This differs from the 'gross' output approach used in the GPB analysis presented in this report and generally used in regulatory reviews. While the same underlying data and range of outputs and inputs appear in both the gross and net approaches, in the net approach intermediate inputs are deducted from outputs to form a value added measure which is what appears in the numerator of the MFP calculation. Labour and capital are then the only two inputs included in the denominator of the calculation. In the gross output approach, intermediate inputs appear in the denominator along with labour and capital and are not deducted from outputs in numerator. Put another way, the inputs included in the denominator are opex (which covers labour and purchased materials and services) and capital inputs.

All else equal, a net or value added productivity measure such as the MFP will normally produce a higher productivity growth rate than a gross productivity (or TFP) measure calculated from the same underlying output and input data. This is because the value added or net approach uses a smaller denominator in the productivity calculation and so productivity gains are expressed relative to a smaller base and the growth rate is correspondingly higher. Allowance should ideally be made for this in comparing MFP and TFP growth rates.

X factor implications

From the exploratory GDB TFP analysis undertaken in this report it has only been possible to form TFP indexes for all three GDBs for the period from 2006 to 2010. A throughput weighted average annual growth rate for the industry for this period is in the order of –0.8 per cent while a corresponding customer number weighted average annual growth rate is –1.2 per cent. The corresponding economy–wide MFP growth rate for the shorter period 2006 to 2009 is –1.5 per cent suggesting that there does not appear to have been a major difference in performance between the GDBs and the wider economy, particularly once uncertainties surrounding the quality of data and the limited range of variables available for the exploratory analysis are allowed for. While too short a period to form a reliable estimate of the long–run productivity differential, it is noteworthy that the partial productivity performances of the Vector and Powerco GDBs have also followed a similar pattern to those of the measured sector as a whole with opex and labour partial productivity performance, respectively, being superior to that of capital partial productivity performance.

The economy–wide MFP growth rate over this relatively short recent period will reflect the impact of the global financial crisis on the New Zealand economy. To the extent that the demand for GPB outputs has also been adversely affected by the global financial crisis then this may explain part of the industry's poor recent TFP performance. Similarly, just as recovery from the global financial crisis is likely to lead to higher economy–wide MFP growth rates for a period then GPB TFP growth rates could also be expected to improve if there is a strong link between GPB outputs and general economic conditions.

Looking at the longer period from 1997 onwards, GasNet showed an annual TFP growth rate of –0.3 per cent between 1999 and 2010 compared to the economy–wide rate of 0.5 per cent between 1999 and 2009. However, GasNet only accounts for around 4 per cent of the gas distribution industry and Vector Distribution and Powerco show differing TFP growth patterns.

Vector Distribution's TFP growth is only available for the period from 2006 onwards and is in the order of 0.5 per cent (using revenue–based output weights and considerably higher using cost–based output weights). However, available information for NGC Distribution which Vector acquired in 2005 points to a corresponding TFP growth rate of around 2.5 per cent between 1997 and 2003. Assuming this rate to be indicative of Vector's overall TFP performance for the same period, this points to Vector Distribution's TFP growth rate for the overall period 1997 to 2010 being markedly higher than the measured sector growth rate. Offsetting this, however, is Powerco's TFP performance which has been negative since 2004 – the only period for which potentially consistent data are available – at a growth rate of –2.4 per cent. This appears to be worse productivity growth performance than that seen in the measured sector. Taking account of this differing information from the two major GDBs, a conservative course of action would be to allocate a value of zero to the productivity differential.

A longer time series of relevant data is available for Vector Transmission although the quality and consistency of that information needs to be verified and some key variables (such as reserved capacities) are missing. There is also insufficient information available to construct a TFP series for MDL. The data available for Vector Transmission points to a TFP growth rate of 0.5 per cent for the period 1997 to 2010 which is the same as the MFP growth rate for 1997 to 2009. This would lend support to allocating a value of zero to the productivity differential for gas transmission when considering the X factor.

Insufficient reliable information on asset values and capital user cost components is currently available to construct a capital input price differential and hence an overall input price differential. However, we note that there is minimal difference in the annual growth rates of the labour cost index for salary and ordinary time wage rates between the Electricity, gas and water sector and the economy as a whole. For the period from 1997 to 2010 both labour cost indexes grew at an annual rate of 2.4 per cent. For the more recent period from 2004 to 2010 a small difference has emerged with the EGW sector labour cost index increasing at an annual rate of 2.6 per cent compared to the overall economy–wide rate of 2.4 per cent. More information would be required to form a robust overall input price differential and, in the absence of such information, it would be reasonable to allocate a value of zero to the input price differential as done in Lawrence (2003).

While recognising the shortage of complete, consistent and robust relevant data, the information obtained from the exploratory direct analysis suggests that over both the longer term and the more recent short term there has not been a robustly identifiable productivity differential between the gas distribution and gas transmission industries and the economy as a whole. Similarly, based on the limited information available there does not appear to have been an identifiable input price difference between these industries and the economy as a whole. To the extent that historical productivity and input price differentials provide a good guide to future relative performance, this lends support to the case for a zero X factor going forward. It should be noted that the commencement of productivity–based regulation can be expected to provide GPBs with stronger incentives to improve productivity performance, in which case this would be likely to be a relatively conservative choice.

4 INDIRECT APPROACH – OVERSEAS GAS NETWORKS

Drawing on the results of overseas TFP studies for broadly comparable gas distribution and gas transmission industries may have a role to play in assessing a suitable X factor if the New Zealand data are not sufficiently robust. These studies may provide useful information on the long run productivity growth rates of GPBs. It should be noted, however, that this information is combined with information on the performance of the New Zealand economy as a whole in drawing implications regarding the likely productivity differential. In most cases information on the performance of the relevant overseas economy was not presented in the studies reviewed and, in any case, the relevant productivity differential here is that applying to the New Zealand economy. This indirect approach also has a role to play as a means of 'checking' the results of direct productivity studies based on New Zealand GPB data.

In this section we will review recent GPB TFP studies and results for Australia, North America and Europe.

4.1 Australian gas distribution TFP studies

Economic Insights' staff have undertaken a series of detailed TFP studies of Australian GDBs in recent years. Lawrence (2007a) initially constructed a TFP model for the three Victorian GDBs – Envestra Victoria, Multinet and SP AusNet – covering the years 1998 to 2006. Jemena Gas Networks (JGN) then requested Economic Insights (2009f) to extend the study to include its New South Wales (NSW) distribution network with data for the period 1999 to 2009. Envestra Ltd then requested Economic Insights (2010b) to further extend the study to include its South Australian and Queensland networks with data covering the period 1999 to 2010. The latter studies did not involve updating the time period covered in the earlier studies.

The primary data sources for these studies were information supplied by Envestra, JGN and the three Victorian GDBs in response to common detailed data surveys. The surveys covered key output and input value, price and quantity information. Because an important part of the later studies was comparisons with the Victorian GDB results presented in Lawrence (2007a), a number of adjustments were made to the functional coverage of JGN's data to ensure more like–with–like comparisons.

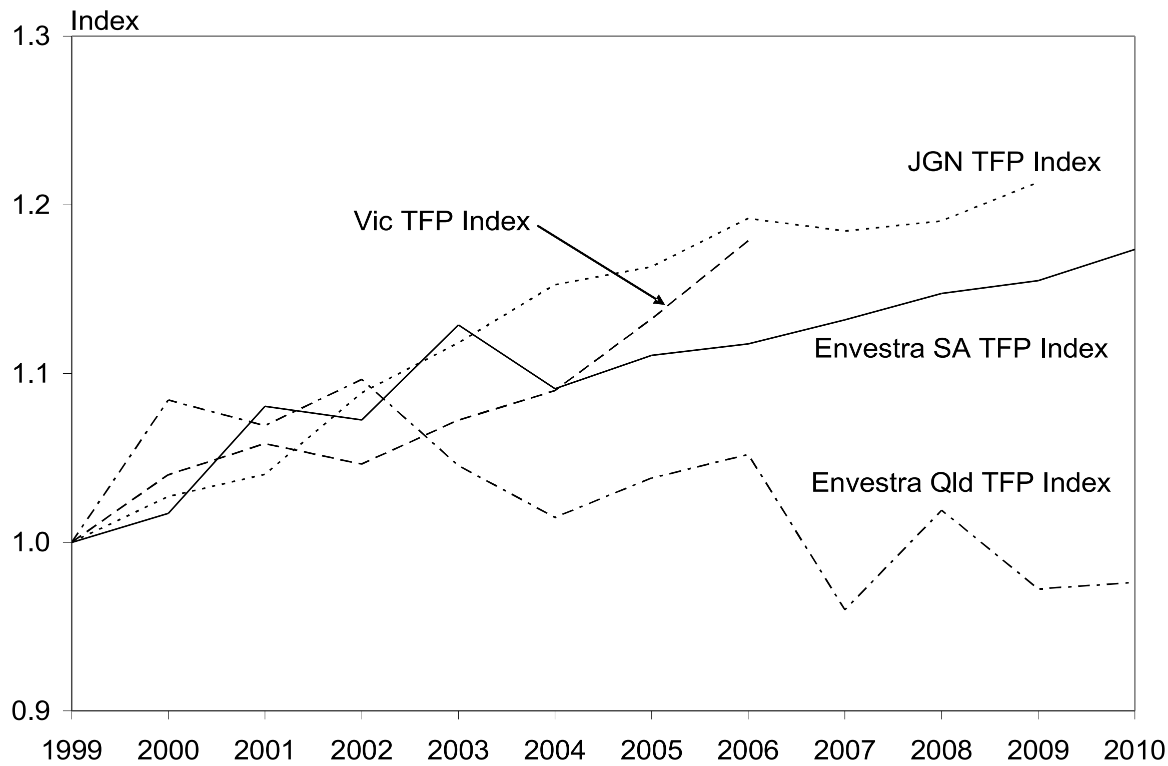
The TFP measure used included three outputs (throughput, customer numbers and system capacity) and 8 inputs (opex, lengths of transmission pipelines, high pressure pipelines, medium pressure pipelines, low pressure pipelines and services, meters, and other capital). With one minor exception, the specification used closely paralleled the EDB B factor specification used in Lawrence (2003).

The system capacity measure used in the studies was that developed in Lawrence (2007a) which was the volume of gas held within a gas network converted to standard cubic meters using a pressure correction factor based on the average operating pressure. The volume of the distribution network was calculated based on pipeline length data for high, medium and low distribution pipelines and estimates of the average diameter of each of these pipeline types. The quantity of gas contained in the system is a function of operating pressure. Thus, a conversion to an equivalent measure using a pressure correction factor was necessary to allow for networks' different operating pressures.

Cost–based output shares were derived from the econometric cost function outlined in Lawrence (2007a) based on data for the three Victorian GDBs for the period 1998 to 2006. A weighted average of the cost–based output shares was formed using the share of each observation's estimated costs in the total estimated costs for all GDBs and all time periods following Lawrence (2003). This produced a cost–based output share for throughput of 13 per cent, for customers of 49 per cent and for system capacity of 38 per cent.

Gas pipeline assets tend to be long lived and 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 either a straight line or a declining balance approach. 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 amount less service every year. For this reason the studies proxied the quantity of capital input by the physical quantities of the principal assets. This approach also had the advantage of being invariant to the different depreciation profiles that may have been used by the different pipeline businesses.

Figure 1: **Envestra SA and Qld, JGN and Victorian GDB TFP indexes, 1999–2010**

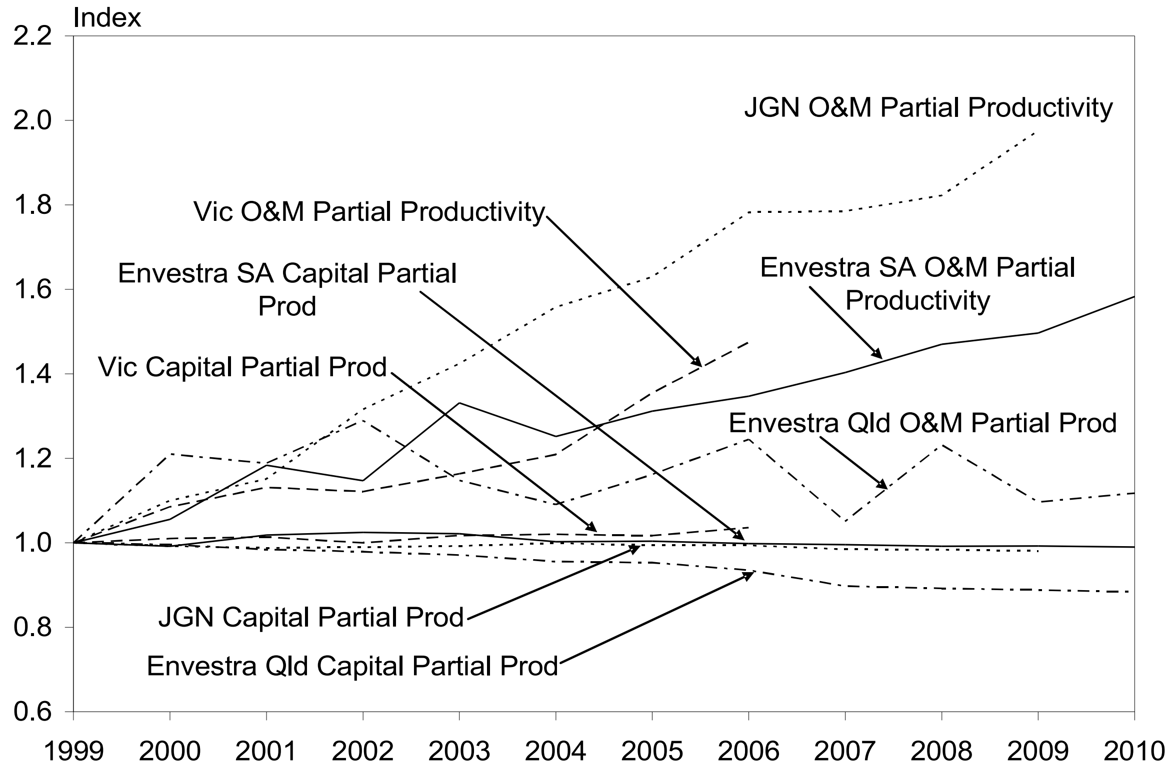


Source: Economic Insights (2010b, p.30) using Economic Insights' Australian GDB database

TFP indexes for Envestra SA and Envestra Qld, JGN and the Victorian gas distribution industry are plotted in figure 1 for the period starting in 1999. The Victorian gas distribution industry's annual TFP growth over the period 1999 to 2006 was 2.3 per cent. JGN's annual TFP growth over the period 1999 to 2009 was 1.9 per cent although this fell to 1 per cent for the more recent period from 2004 to 2009. Envestra SA had an average annual TFP growth rate of 1.5 per cent over the period 1999 to 2010 but this also reduced to 1.2 per cent for the more recent period of 2004 to 2010.

The only one of the included Australian GDBs not to experience TFP growth over this period was Envestra Qld. Its annual TFP growth for the period 1999 to 2010 was –0.2 per cent and this reduced further to –0.6 per cent for the more recent period of 2004 to 2010. Being a small GDB operating in a subtropical climate, Envestra Qld faces a quite different operating environment to the southern GDBs. The Queensland residential demand for gas is mainly for hot water and for cooking with there being minimal demand for space heating. While Envestra Qld had slower output growth than the other included GDBs, its input growth was considerably higher than those of the other GDBs.

Figure 2: **Envestra SA and Qld, JGN and Victorian GDB PFP indexes, 1999–2010**



Source: Economic Insights (2010b, p.30) using Economic Insights' Australian GDB database

The Envestra SA, Envestra Qld, JGN and Victorian partial factor productivity (PFP) indexes are plotted in figure 2 starting from 1999. For all the GDBs, opex partial productivity growth has been considerably stronger than that for capital partial productivity which has remained relatively flat over the period. The relatively stronger growth in opex PFP compared to capital PFP is similar to the performance of the two major New Zealand GDBs reported in the previous section.

In table 6 we compare the key characteristics of the six included Australian GDBs and the three New Zealand GDBs. Vector Distribution, the largest of the three New Zealand GDBs, has only between one third and 40 per cent the throughput of the three Victorian GDBs and only one quarter the throughput of JGN. It has less than 30 per cent the customer numbers of each of the Victorian GDBs and only 14 per cent the customer numbers of JGN. However, Vector Distribution has similar system length to Envestra SA and around half that of the three Victorian GDBs. This leads to two major New Zealand GDBs having lower customer density (customers per kilometre) than any of the Australian GDBs, including Envestra Qld. However, Vector Distribution has by far the highest energy density (throughput per customer) of the included Australian and New Zealand GDBs reflecting the relative importance of commercial and industrial customers for Vector. Powerco and GasNet have the fourth and fifth highest energy densities, respectively, of the nine included GDBs. While these differences in key characteristics could be expected to influence relative productivity levels, it is not clear what, if any, impact it could be expected to have on relative TFP growth rates.

Table 6: **New Zealand and included Australian GDBs' key characteristics, 2006**

GDB	*Throughput*	*Customers*	*System capacity*	*System length*	*Energy density*	*Customer density*
	TJ	No	Sm^3	kms	GJ/cust	cust/km
Envestra SA	26,703	367,482	83,573	10,707	73	34
Envestra Qld	5,163	75,668	26,515	3,248	68	23
JGN	94,788	975,033	358,799	37,225	97	26
Envestra Vic	57,430	498,807	114,375	18,235	115	27
Multinet	60,138	647,572	111,859	21,075	93	31
SP AusNet	71,294	520,289	112,667	19,635	137	26
Vector	23,306	136,769	n.a.	9,358	170	15
Powerco	10,553	103,986	n.a.	5,609	101	19
GasNet	1,035	10,581	n.a.	362	98	29

Source: Economic Insights' Australian GDB database and IDD

The other recent TFP study of GDBs in Australia was that by Pacific Economics Group (2008) undertaken for the Victorian regulator and covering only the three Victorian GDBs. The study used a less detailed TFP model than Lawrence (2007a) with three outputs and two inputs. The outputs were throughput, customer numbers and peak demand for capacity customers (presumably as a proxy for reserved capacity). The study used revenue weights to aggregate the outputs. Capital input was proxied by the constant price depreciated asset value. The sample period was 1998 to 2007. PEG estimated that TFP for Victoria's gas distribution industry grew at an average annual rate of 2.9 per cent over the 1998 to 2007 period. Output quantity grew at an average rate of 1.1 per cent per annum while input quantity was estimated to have declined at 1.8 per cent per annum over the same period. The TFP index exhibits considerable volatility with a 15 per cent increase in 2006 followed by a 9 per cent decrease in 2007.

4.2 North American gas distribution TFP studies

North American gas distribution regulatory decisions have generally included relatively low TFP trends reflecting the more mature nature of the North American industry. For instance, decisions for Boston Gas covering the periods 1997 to 2003 and 2004 to 2013 included TFP trends of 0.4 and 0.6 per cent per annum, respectively (PEG 2006). Another Massachusetts GDB decision, that for Berkshire Gas, included a TFP trend of 0.4 per cent per annum covering the period 2002 to 2011. Californian decisions for San Diego Gas and Electric and Southern California Gas have included TFP trends of 0.7 and 0.5 per cent, respectively, while Canadian decisions for Consumers Gas and Union Gas in Ontario for the period up to 2003 included TFP trends of 0.6 and 0.9 per cent, respectively.

In a more recent report for the Ontario Energy Board, PEG (2007) estimated that the annual TFP growth rates for the period 2000 to 2005 for the Ontario GDBs Enbridge Gas Distribution and Union Gas were 0.7 per cent and 1.9 per cent, respectively. The report also presented TFP growth rates based on a sample of 36 US GDBs for the 11 year period from 1994 to 2004 which were between 1.2 and 1.4 per cent (depending on which capital measure was used). However, there are two very distinct patterns of productivity growth within this period with a break point around 1999. In the period 1994 to 1999 TFP grew at around 2 per cent annually. Since 1999, however, annual productivity growth has been much more modest. From 1999 to 2004 TFP grew at between 0.5 and 0.7 per cent annually based on the indexes presented. This slowing down in productivity growth occurred primarily as a result of a reversal of the trend in input use from a decline to an increase and also a slow down in output growth.

Lawrence (2007b) also reported opex partial productivity growth results based on a sample of around 70 US GDBs using the Platts (2007) subscription data. These data are assembled from a range of official sources including Federal Energy Regulatory Commission (FERC) Form 2 filings, Energy Information Administration (EIA) Form 176 filings and Annual Reports to the individual state Public Utility Commissions. A total output index was formed using two outputs: throughput measured in millions of cubic feet and customer numbers. The weights used to aggregate the two outputs were 25 per cent on throughput and 75 per cent on customer numbers derived from the cost function estimation reported in Lawrence (2007a).

The opex partial productivity index was formed by dividing the output index by the constant price opex series. The opex partial productivity average annual growth rate for the period 1998 to 2005 was 0.7 per cent. This growth rate was slightly lower than the corresponding PFP growth rate of 1 per cent obtained by PEG (2007) over a similar period.

4.3 North American gas transmission TFP study

There have been relatively few TFP studies undertaken of gas transmission activities. This relates in part to the difficulty of adequately defining transmission outputs for TFP purposes, in part to the smaller number of GTBs compared to GDBs and in part to the difficulty in obtaining consistent GTB data.

Jamasb, Pollitt and Triebs (2008) studied the impact of US transmission pipeline regulatory reform using a Malmquist–based productivity analysis for a panel of US interstate GTBs. The

Malmquist productivity index is based on linear programming data envelopment analysis methods. The study used data on 39 GTBs covering the period from 1996 to 2004 taken from FERC Form 2 returns. A number of adjustments had to be made to the data to ensure the GTBs had plausible characteristics and some variables were excluded from the analysis. A number of output specifications were examined with the most comprehensive one including total length of pipe, total horsepower rating of compressor stations and total delivery volume. The sole input included in the analysis was total expenditure.

The study reports very high annual TFP growth rates with the comprehensive output specification having the lowest annual TFP growth rate of 2.9 per cent. The highest annual TFP growth rate reported for the expenditure–based models is nearly 6 per cent. The authors note that different methodologies used by different studies and different market environments make comparisons across studies difficult.

4.4 European gas network TFP studies

There have been few direct studies of either gas distribution or gas transmission TFP undertaken in Europe. This largely results from a lack of relevant consistent data being available at the gas network level. To overcome this lack of available data, European regulators have had to rely on indirect 'virtual TFP' approaches which will be examined in the following section.

A focus of European network regulation has been on establishing achievable targets for real unit operating expenditure (RUOE) which is operating expenditure divided by a measure of overall output. As such, this measure is broadly analogous to the inverse of a conventional partial productivity measure which divides an output index by the quantity of a particular input. RUOE reductions (ie partial productivity improvements) are typically reported for operating expenditure, maintenance and renewals.

Oxera (2008) is one of the few studies to report RUOE figures for gas distribution. However, the report notes that historical data are not available for UK GDBs and so Ofgem forecasts are used for the period 2008 to 2013 for 8 GDBs. Oxera (2008, p.43) notes that results for some years appear erratic and are excluded from the analysis. Average annual RUOE reductions (ie approximate partial productivity improvements) of 2.3 per cent for opex and 0.9 per cent for maintenance expenditure are reported.

4.5 Implications

The review of overseas gas network TFP studies points to a relatively wide range of GPB TFP growth rates. For the Australian GDBs for which TFP analyses have been undertaken, annual TFP growth rates over the last decade range from –0.2 per cent to 2.7 per cent. For the networks where recent data are available, TFP growth has fallen in the period after 2004. For instance, the TFP growth rate for JGN fell from 2.8 per cent for the five years before 2004 to 1 per cent for the five years after 2004. Evidence from North American GDB TFP studies also generally points to annual TFP growth of less than 1 per cent for the period since 2000. Little reliable direct evidence is available on the TFP performance of European GDBs or of GTBs in general.

While the overseas studies provide information on the TFP performance of different GPBs, allowance should be made for the operating environments of those GPBs relative to New Zealand when drawing implications for the long run productivity growth rate of New Zealand GPBs. Factors which will affect TFP growth performance include the maturity of the relevant industry under a given regulatory regime, the time elapsed since privatisation, the strength of incentives provided by relevant regulation, penetration rates, how gas is viewed as a viable long term fuel source and economic growth rates. For example, Australian GDBs have been subject to regulatory regimes incorporating stronger incentives for a longer period of time than have New Zealand GDBs, gas is viewed as being readily available for the foreseeable future and, hence, as an attractive fuel source and economic conditions have generally been stronger for a prolonged period. All else equal, these factors could be expected to lead to the Australian GDBs having higher TFP growth rates than their New Zealand counterparts. These differences make it more difficult to draw direct comparisons which, in turn, are likely to make the indirect approach less helpful than direct information on the productivity performance of the New Zealand GPBs.

It should also be noted that the input price experiences of overseas GPBs are likely to be of only limited relevance to New Zealand GPBs as they will depend to a large extent on the labour and capital market conditions applying in the relevant countries. Materials input prices may be more influenced by international market conditions and hence exhibit more similarity in movement across countries although these will also be significantly influenced by movements in relative exchange rates. For these reasons we have not examined overseas GPB input price movements in this report.

While not providing definitive guidance, the initial review of overseas GPB TFP studies is not inconsistent with the conclusion of the preceding section that GPB productivity performance has not been demonstrably different from that of the New Zealand economy as a whole. The longer run MFP growth rate of 0.5 per cent for the New Zealand economy as a whole is within the range of TFP growth rates observed for Australian GDBs (which arguably face more favourable operating conditions) and similar to that reported for North American GDBs over a comparable period. Similarly, TFP growth rates for the overseas GDBs have generally fallen in recent years as has the MFP growth rate for the New Zealand economy.

5 INDIRECT APPROACH – OTHER INDUSTRIES

Given that data available to conduct direct TFP analyses of New Zealand GPBs are of limited quality and consistency, another indirect option available to inform X factor decisions is to examine the TFP performance of related industries. In this section we review TFP growth rate information available for New Zealand electricity distribution businesses, for overseas electricity networks, for the broader electricity, gas and water (EGW) sector and the 'virtual TFP' approach used by some European regulators.

5.1 New Zealand electricity distribution TFP growth

The industries which are most likely to have similar characteristics to the gas distribution industry are other infrastructure network industries. And of these industries, electricity distribution is likely to be the most similar because it is highly capital intensive, has relatively long–lived assets which are characterised by little physical deterioration in service potential over their lifetime and has a relatively mature technology. Both industries supply important energy products which participate in the overall energy market and so face many similar demand characteristics. Reflecting the similarities in the two industries, there is often co–ownership by suppliers of both electricity and gas distribution businesses. Furthermore, both industries tend to be regulated in broadly the same way and have had similar regulatory histories. Other network industries such as telecommunications are subject to much more rapid technological change or are relatively labour intensive (eg postal services) or have had different regulatory histories (eg water supply).

While there are many similarities between the gas and electricity distribution industries, there has been a greater focus on regulation of electricity distribution in New Zealand over the last decade and the development of a better quality and more consistent electricity distribution database. Furthermore, there have now been two rounds of electricity distribution TFP analysis and the subsequent setting of price cap parameters based on these analyses. The refinement of the initial IDD material used in Lawrence (2003) included:

- adjusting for the effects of the separation of distribution and retailing activities in 1999
- allowing for the effects of the major Auckland CBD outage in 1998
- removing reporting anomalies associated with EDB amalgamations, and
- correcting EDB reporting errors and anomalies.

This in turn provided a sound basis for the expanded TFP analysis reported in Economic Insights (2009c). Given the superior quality of data available for the New Zealand electricity distribution industry and its now relatively long history of TFP analysis, it is worthwhile considering the TFP growth rate information that has emerged from this industry.

Economic Insights (2009c) used a three output, four input TFP specification covering the 13 year period from 1996 to 2008 for each of New Zealand's 28 EDBs. The outputs included were throughput, customer numbers and system capacity while the inputs included were opex, overhead lines, underground cables, and transformers and other capital. Outputs were weighted using cost–based output shares, capital input quantities reflected the production characteristics of the industry and an exogenous annual capital cost was used. This specification is broadly similar to the thresholds B factor specification used in Lawrence (2003).

Industry TFP was found to grow strongly up to 2003 and then level off after that. Over the 13 year period industry TFP grew at a trend rate of around 1 per cent per annum, approximately the same rate the SNZ economy–wide MFP index grew by over the same period. This led to a productivity growth differential of effectively zero. Opex partial productivity grew considerably more strongly than TFP while the partial productivity of capital grew less strongly than TFP.

Using a rigorous measure of the annual cost of capital inputs, Economic Insights (2009c) found that the electricity distribution industry exhibited slightly slower input price growth than the economy as a whole over the 13 year period. This pointed to a small input price growth differential in the order of –0.2 to –0.3 per cent per annum. All else equal, this would have tended to make the X factor marginally larger than it would have been based solely on productivity considerations. Economic Insights recommended setting the input price growth differential term in the X factor to zero given its relatively small magnitude over both the whole period and the more recent period. Taking account of the uncertainties involved – including future economic conditions – Economic Insights further recommended a conservative course of action in favour of the EDBs of setting the X factor to zero. The Commerce Commission's (2009) subsequent DPP decision for non–exempt EDBs was consistent with this recommendation.

Further analysis of EDB TFP growth can be found in PEG (2009) which used a less detailed TFP model covering the period 1999 to 2008. The model covered three outputs: throughput, customer numbers and peak demand. Peak demand appeared to be included as a proxy for contracted reserved capacity. Two inputs – opex and aggregate capital – were included. The latter quantity was proxied by the constant price depreciated asset value which included straight–line depreciation. Industry TFP was found to grow at an annual rate of 1.2 per cent. PEG (2009) presented eight X factor options and recommended an X factor range of between 0.2 per cent and –0.6 per cent. While the PEG (2009) analysis can be critiqued on a range of grounds (eg not allowing for the effects of the Auckland CBD outage on opex, use of widely varying output weights across EDBs and the use of endogenous capital costs when realised rates of return vary widely), it lends support to the robustness of the Economic Insights (2009c) finding.

A lack of reliable and consistent data on New Zealand electricity transmission has prevented robust estimates of electricity transmission TFP growth being formed.

5.2 Electricity network TFP growth in other countries

There have been a number of direct electricity distribution TFP studies undertaken in Australia and the US in recent years. As part of a detailed benchmarking project undertaken for Australian EDBs, Lawrence (2005) calculated TFP indexes for 13 of Australia's 15 EDBs covering the period 1999 to 2003. The TFP specification used included three outputs (throughput, customer numbers and system capacity) and five inputs (opex, overhead lines, underground cables, transformers and other capital). The specification used was thus identical to that used by Lawrence (2003) in the TFP study on which the New Zealand EDB thresholds' B factor was based. The data used in the analysis were collected by direct survey from the EDBs and underwent extensive checking to make them as consistent as possible across EDBs (as there was no IDD equivalent in Australia). Taking a throughput–weighted average of the TFP index annual growth rates for the 13 individual EDBs produces an overall EDB TFP growth rate of –0.4 per cent for the period 1999 to 2003. However, there were marked differences in performance across states with the five Victorian EDBs exhibiting weighted average annual TFP growth of 0.8 per cent while nearly all EDBs in Queensland and NSW exhibited negative TFP growth over the period.

A study of the TFP growth of the five Victorian EDBs can also be found in PEG (2008b). This study uses a four output (peak throughput, off–peak throughput, customer numbers and non–coincident peak demand), two input (opex and aggregate capital) specification broadly similar to that used in PEG (2009). The study was undertaken for the Victorian regulator and covers the period 1995 to 2007. Excluding the period of high TFP growth following the privatisation of the Victorian EDBs in the 1990s, weighted average annual TFP growth was 1.1 per cent for the period 1999 to 2007. For the period 1999 to 2003 the weighted average annual TFP growth rate was 0.9 per cent, similar to that found using the results of Lawrence (2005).

In a recent TFP study of US EDBs, NERA (2010) calculated TFP growth for a sample of 72 EDBs over the 37 year period 1973 to 2009 using mainly FERC Form 1 data. The outputs included were four different types of throughput while two inputs – opex and capital – were included. The capital quantity measure is based on a capital stock derived from an initial asset value and subsequent capital expenditure. It uses 'one hoss shay' depreciation (which assumes assets remain at their full productive efficiency right up until they are retired) and so will better approximate the production characteristics of the industry than series based on depreciated asset values. The study finds a long–run annual TFP growth rate of 0.9 per cent for the whole period. However, annual TFP growth rates have declined recently and the annual growth rate for the last 10 years of the period was –1.1 per cent. The use of an output measure based solely on throughput could be expected to increase the volatility observed in the TFP series.

Another recent study reporting TFP growth results for the US was PEG (2008c). This study also used FERC Form 1 data for 69 EDBs and covered the period 1988 to 2006. The study included two output variables: throughput and the number of retail customers. Cost–based output weightings of 0.63 for customer numbers and 0.37 for throughput were used. The annual TFP growth rate for the 19 year period was found to be 0.7 per cent. A similar growth rate was evident for the more recent period from 2000 to 2006. PEG (2008c) also reported preliminary TFP growth results for Ontario EDBs. A number of significant data gaps have prevented robust TFP growth estimates being formed for Ontario EDBs but a flat TFP performance is reported for the period 2002 to 2006 with a near zero growth rate.

As with gas transmission, there have been relatively few direct studies of electricity transmission TFP growth undertaken. One study that has focused on electricity transmission performance is SumicSid (2009) which reports the results of a detailed benchmarking exercise for a group of 22 European ETBs. While the main focus of the study is on comparing efficiency levels, some results for productivity growth are also presented using a panel of 9 ETBs for the period 2003 to 2006. The methodology used was DEA–based Malmquist indexes and the main focus was on total expenditure for construction, maintenance, planning and administration.

The frontier model consisted of three outputs: a normalised grid measure, connection density and the capacity of connected power for renewable energy including hydro. The normalised grid measure took account of over 1,200 different asset types in 8 groups differentiated with respect to voltage, power, current and complexity, among other things.

The study reported an annual productivity growth rate for best–practice ETBs in the range of 2.2 to 2.5 per cent. These results compared with earlier European results for broadly similar measures for the period 2000 to 2003 of 1.3 per cent annually and with results for Norwegian regional ETBs for the period 2001 to 2004 of 2.1 per cent annually.

5.3 EGW sector productivity growth

A number of national statistical agencies have published MFP growth information for a range of broad industry sectors in recent years. The closest coverage for gas networks in these National Accounts–based reports are results for the electricity, gas and water (EGW) sector. However, in some instances these sectoral results have been the subject of much contention and have likely served to highlight a number of potentially significant problems with underlying National Accounts processes.

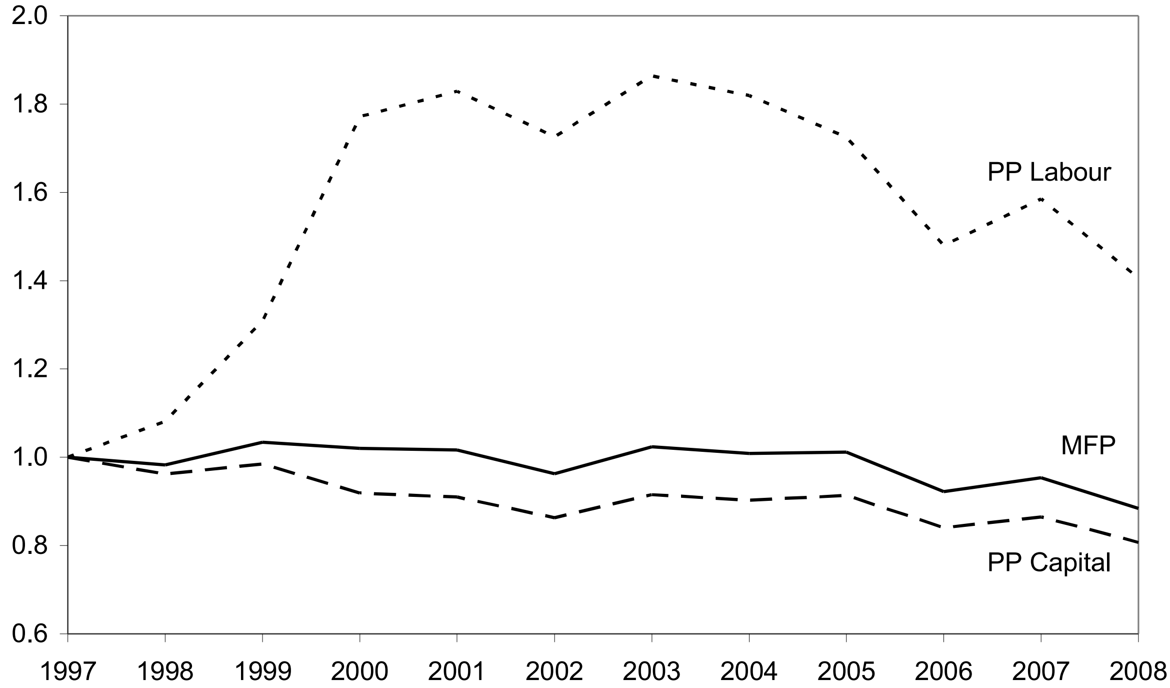
The Australian Bureau of Statistics' (2010) sectoral MFP results are particularly problematic. The EGW sector value–added MFP series has declined every year since 1998. This has led to the implausible result that EGW sector MFP has fallen by one third between 1998 and 2010. Put another way, this result implies that it required 50 per cent more inputs in 2010 to produce the same quantity of output than it did in 1998. The implied MFP annual growth rate over the period 1998 to 2010 is the equally implausible –3.3 per cent.

Lawrence (2007c) has drawn attention to the apparent inconsistency between the ABS EGW sectoral MFP results and results from a range of firm–level productivity studies from across the Australian industries included in the EGW sector. The ABS and the Productivity Commission are believed to be currently investigating the apparently anomalous Australian sectoral MFP results. An equally problematic result for Mining sector MFP for the period after 2001 has also received much attention. Until the Australian sectoral series are either corrected or fully explained, they are of limited use for regulatory purposes.

SNZ (2010b) has also recently published sectoral MFP estimates covering the period from 1978 to 2008. The EGW MFP and partial productivities of labour and capital series are shown in figure 3 for the period 1997 to 2008 starting with the first year for which IDD are available.

The New Zealand EGW MFP index remained relatively flat between 1997 and 2005 with an annual growth rate of only 0.1 per cent. However, EGW MFP has fallen markedly since 2005 and by 2008 was 13 per cent below its 2005 level producing an annual growth rate of –4.5 per cent over this four year period.

Figure 3: **New Zealand EGW Sector MFP and PFP indexes, 1997–2008**



Source: Economic Insights calculations based on SNZ (2010b).

EGW labour partial productivity grew strongly between 1997 and 2003 but has generally declined since 2003 while capital partial productivity has generally declined over the whole period. The SNZ EGW series appears to be more plausible than the corresponding ABS series and points to a generally flat MFP performance for the sector with a period of declining MFP in recent years. For the 12 years from 1997 to 2008 the overall average annual MFP growth rate was –1.1 per cent.

Considerably more attention has been focussed on European sectoral National Accounts in the construction of the European Union (EU) KLEMS database, where KLEMS is an acronym for 'capital, labour, energy, materials and services'. Considerable time and effort has been spent on the construction of the database by the University of Groningen and other agencies. It is likely that more confidence could be placed on results based on this database given the quality control and checking that has been a feature of its construction. Despite this, however, high level National Accounts–based series will not be able to capture the same degree of detail as studies based on firm level data.

Oxera (2008, p.27) report EGW sector TFP growth rates for the UK using the EU KLEMS database. For the period 1990 to 2004 an annual TFP growth rate of just under 1 per cent is reported while a rate of just over 1 per cent is reported for the period from 1980 to 2004. The third period reported is the longer period from 1970 to 2004 with a much higher TFP growth rate of around 2.2 per cent implying that there was a period of relatively high measured TFP growth during the 1970s and more modest TFP growth since then. Data for the 1970s are likely to be less reliable than data for more recent periods.

5.4 'Virtual TFP' growth rates

As noted in section 4, European regulators have often relied on indirect 'virtual TFP' approaches given the lack of available data to undertake direct comparisons. The idea behind the virtual comparator approach is that the productivity growth target for a particular industry can be set as a weighted average of productivity growth rates for other sectors of the economy that perform similar functions. The weights in the weighted average are intended to be set based on shares of the function in the utility's overall costs. For example, Reckon (2008, p.21) included the wholesale trade sector as one comparator for the Dutch gas transmission system on the grounds that:

> 'The wholesale and commission trade sector involves a similar geographical spread of activities as gas transmission network and its supply chain. It also includes management of operations, contracts, suppliers and customers which have similarities to the activities involved in providing a gas transmission network.'

The virtual TFP approach is also sometimes referred to as a 'workload' approach as it involves finding suitable comparators for each of the tasks or workloads undertaken by the utility.

Oxera (2008, pp.23–4) provide a useful discussion of the criteria that should be applied in selecting sectors to form the virtual comparator. The main considerations are:

- comparability of the sector with the subject industry, particularly in terms of the rate of technological change
- the impact of atypical performance and exogenous factors, pointing to the desirability of including longer periods when forming the target rate
- business cycle timing
- comparability of volume growth and the impact of economies of scale
- comparability of input price growth, and
- ability to substitute between inputs.

The use of this approach has been facilitated by the relatively well developed EU KLEMS database. However, studies using this general approach tend to have produced a relatively wide band of productivity estimates and analysts have not always provided the regulator with definitive guidance. For instance, Reckon (2007, p.6) provided Ofgem with a range of 0.1 per cent to 4.8 per cent for annual labour productivity growth in gas distribution comparators but declined to form a weighted average noting:

> 'We do not think that it is correct to take a weighted average of the figures … as a point estimate to be applied to gas distribution networks. Doing so would amount to placing excessive reliance on a loose concept of similarity between the components of the gas distribution networks' activities and the chosen comparators for each component.

> 'Instead, we take the view that we cannot know for certain to what extent the operation of gas distribution networks in the next decade will share relevant features of the comparator industries between 1973 and 2004. All we can hope for is that the spread of trends between the sectors … represents a reasonable distribution of possible outcomes for gas distribution over the next control period.
>
> 'It is for Ofgem to choose a figure to use in price control calculations in the face of the inherent uncertainty about future costs.'

These reservations aside, the virtual comparator approach relies on having good quality productivity data available for other sectors of the economy. The EU KLEMS data facilitates this process in Europe. In New Zealand, however, sectoral productivity data is still in its relative infancy with series having only recently been published by SNZ for the first time. The contention surrounding the ABS sectoral MFP estimates in Australia renders that information unsuitable for use in regulatory reviews. Consequently, we do not see use of the virtual TFP approach for the New Zealand GPBs being feasible at this point in time as the robustness of sectoral productivity data and results would need to improve first.

5.5 Implications

If it is not feasible to undertake robust direct productivity and input price analysis of the New Zealand GPBs, another indirect option available to inform X factor decisions is to examine the TFP performance of related industries. The review of productivity and input price growth results for industries other than gas networks indicates that the results from electricity network studies may be of particular relevance in this regard. The electricity and gas network industries have generally similar production characteristics and reform histories and there is significant common ownership. However, New Zealand EDBs have been subject to better specified and more comprehensive IDD requirements than have New Zealand GPBs for a decade and a half and have now been subject to two rounds of productivity analysis.

The latest New Zealand EDB TFP studies point to a trend TFP growth rate of approximately the same magnitude as that for the New Zealand economy as a whole for the period 1996 to 2008. Furthermore, EDB TFP growth has flattened off since 2003 as has that for the economy as a whole and as appears to be the case for gas distribution based on the exploratory direct analysis in section 3.

Results of TFP studies undertaken using Australian, US and Canadian EDB data are generally consistent with the latest studies of New Zealand EDB TFP growth. There is limited information available for electricity transmission TFP growth performance.

The latest New Zealand EDB TFP studies also provide the most comprehensive source of information on an input price differential that is likely to be comparable to that for GPBs. Using robust measures of capital annual user costs, Economic Insights (2009c) found that the trend growth rate of input prices for EDBs was approximately similar to that for the economy as a whole.

The GPBs have generally supported the use of electricity lines business TFP results as an interim substitute for robust direct information on GPB TFP growth rates. For instance, Vector (2010, p.6–7) stated:

> 'While we agree with the Commission's intention to attempt to use a range of methods to develop a productivity analysis for the New Zealand gas pipelines sector, Vector suggests that the small size of the sector and the lack of robust available data may mean that none of the approaches can successfully produce robust results. One option for this reset could be to set a rate of change equivalent to that used for the electricity distribution default price path for the first regulatory period, reform information disclosures to improve available information gathered over that period and use the information gathered to conduct a robust productivity analysis for the regulatory period starting in 2017. While this is not ideal, it may be the most practical option available in the circumstances.'

Similarly, GasNet (2010, p.7) stated:

> 'we suggest the Commission gives serious consideration to setting an X factor equal to 0 for the purpose of the Initial DPP for GDBs, similar to the one which has been adopted for EDBs after two different, but extensive TFP studies were undertaken.'

New Zealand EGW sector MFP results lend further support to the case that GPB TFP growth is likely to have been relatively flat over the last decade and to have declined in recent years. As such, it is likely to have followed a similar pattern to the economy as a whole. The apparent problematic nature of Australian sectoral MFP results and the relative immaturity of New Zealand sectoral results caution against using the virtual comparator approach at this time as a means of informing New Zealand GPB X factor decisions.

While again not providing definitive guidance for the purpose of considering the DPP X factor for New Zealand GPBs, the review of New Zealand and overseas electricity network TFP studies lends support to the case for allocating a value of zero to the productivity differential between GPBs and the economy as whole. Similarly, information available on the New Zealand EDB input price differential supports the case for also allocating a value of zero to the input price differential for New Zealand GPBs. Taken together, the information on EDB productivity and input price differentials lends support to the case for allocating a value of zero to the X factor for New Zealand GPBs. This is broadly consistent with the conclusion of section 3 that GPB productivity performance and input price growth has not been demonstrably different from that of the New Zealand economy as a whole.

6 CONCLUSIONS

Our main objective in this initial report has been to assess whether there is robust evidence to suggest that the long–run productivity growth rate of New Zealand gas transmission and gas distribution businesses is significantly different from that of the New Zealand economy as a whole. We have also examined available evidence on whether input price growth for New Zealand GPBs is significantly different to that for the New Zealand economy as a whole. Taken together these assessments have a role to play in informing decisions on an appropriate X factor for the GPB DPPs.

To undertake this assessment we have looked at three broad approaches as follows (listed in order of preference): a direct approach using information currently available on New Zealand GPBs; an indirect approach using information available on overseas GPB performance; and an indirect approach using information from other industries. Normally this assessment would be made using the direct approach and information on New Zealand GPBs and the economy as a whole only. This way we can be confident that the information relates directly to the industry in question and the effects of different operating and institutional environments are minimised. However, if data to support this approach are not available or not of sufficient quality then there may be a case for examining the experience of overseas GPBs as a second best approach. If data from overseas GPBs prove inconclusive or operating and institutional environment differences are excessive then there may be a case for using information from industries in New Zealand performing similar functions to GPBs.

Our first task, then, was to undertake a review of the currently available IDD and other New Zealand GPB data to assess whether they would support the direct approach. This involved examining their coverage, the extent to which definitions of the series are clearly specified, their consistency, the extent to which they are publicly accessible and the degree of stakeholder ownership. The conclusion of this assessment was that the data are not of sufficient completeness, consistency or accuracy to support a robust TFP analysis of the long run average productivity improvement rate achieved by GPBs in New Zealand and of the rate of GPB input price growth. To support such an analysis additional data would need to be obtained from the GPBs.

Despite these data limitations it has still been possible to undertake an exploratory direct TFP analysis using a relatively basic TFP specification although only short periods of potentially consistent data are available for Vector Distribution and Powerco. It has only been possible to form TFP indexes for all three GDBs for the period from 2006 to 2010. The analysis suggests that there does not appear to have been a major difference in performance between the GDBs and the wider economy, particularly once uncertainties surrounding the quality of data and the limited range of variables available for the exploratory analysis are allowed for. Looking at available evidence from the period since the late 1990s, there appears to have been differing TFP performance among the GDBs with Vector Distribution's TFP increasing over time and Powerco's declining. Taking account of this differing information from the two major GDBs, a conservative course of action would be to allocate a value of zero to the productivity differential.

The data available for Vector Transmission points to a TFP growth rate of 0.5 per cent for the period 1997 to 2010 which is the same as the MFP growth rate for 1997 to 2009. This would lend support to allocating a value of zero to the productivity differential for gas transmission in considering an appropriate X factor.

Insufficient reliable information on asset values and capital user cost components are currently available to construct a capital input price differential and hence an overall input price differential. However, there is minimal difference in the annual growth rates of the labour cost index for salary and ordinary time wage rates between the Electricity, gas and water sector and the economy as a whole. More information would be required to form a robust overall input price differential. In the absence of such information, standard practice would be to allocate a value of zero to the input price differential as done in Lawrence (2003).

The information obtained from the exploratory direct analysis, thus, lends support to the case for an overall X factor of zero based on zero values for both the productivity differential and the input price differential for both gas distribution and gas transmission.

Turning to the first of the indirect approaches, overseas studies may provide useful information on the long run productivity growth rates of GPBs. However, differences in operating and institutional environments make it more difficult to draw direct comparisons which, in turn, are likely to make the indirect approach less helpful than direct information on the productivity performance of the New Zealand GPBs. It should be noted, however, that this information then needs to be combined with information on the performance of the New Zealand economy as a whole in drawing implications regarding the likely productivity differential as the relevant productivity differential here is that applying to the New Zealand economy.

The longer run MFP growth rate of 0.5 per cent for the New Zealand economy as a whole is within the range of TFP growth rates observed for Australian GDBs (which arguably face more favourable operating conditions) and similar to that reported for North American GDBs over a comparable period. Similarly, TFP growth rates for the overseas GDBs have generally fallen in recent years as has the MFP growth rate for the New Zealand economy. This indirect approach thus lends further support to allocating a value of zero to the productivity differential for GDBs. There is insufficient information available on overseas GTB productivity performance to draw on this approach in the case of GTBs.

The input price experiences of overseas GPBs are likely to be of only limited relevance to New Zealand GPBs as they will depend to a large extent on the labour and capital market conditions applying in the relevant countries. Materials input prices may be more influenced by international market conditions and hence exhibit more similarity in movement across countries although these will also be significantly influenced by movements in relative exchange rates. For these reasons we have not examined overseas GPB input price movements in this report.

Turning to the second of the indirect approaches (using information from industries in New Zealand performing similar functions to GPBs), the results from electricity network studies may be of particular relevance. The electricity and gas network industries have generally similar production characteristics and reform histories in New Zealand. However, New Zealand EDBs have been subject to better specified and more comprehensive IDD requirements than have New Zealand GPBs for a decade and a half and they have now been subject to two rounds of productivity analysis.

The latest New Zealand EDB TFP studies point to a trend TFP growth rate of approximately the same magnitude as that for the New Zealand economy as a whole for the period 1996 to 2008. Furthermore, EDB TFP growth has flattened off since 2003 as has that for the economy as a whole and as appears to be the case for gas distribution based on the exploratory direct analysis. Results of TFP studies undertaken using Australian, US and Canadian EDB data are generally consistent with the latest studies of New Zealand EDB TFP growth. There is limited information available for electricity transmission TFP growth performance.

The latest New Zealand EDB TFP studies also provide the most comprehensive source of information on an input price differential that is likely to be comparable to that for GPBs. Using robust measures of capital annual user costs, Economic Insights (2009c) found that the trend growth rate of input prices for EDBs was approximately similar to that for the economy as a whole.

While again not providing definitive guidance for the purpose of considering the DPP X factors for New Zealand GPBs, the review of New Zealand and overseas electricity network TFP studies lends support to the case for allocating a value of zero to the productivity differential between GPBs and the economy as whole. Similarly, information available on the New Zealand EDB input price differential supports the case for also allocating a value of zero to the input price differential for New Zealand GPBs. Taken together, the information on EDB productivity and input price differentials lends support to the case for allocating a value of zero to the X factor for New Zealand GPBs.

Overall, our initial review of both direct and indirect approaches to assessing whether GPB TFP growth and GPB input price growth have been similar to those for the New Zealand economy as a whole points to there being no robust evidence to the contrary. The evidence available at this time lends support to allocating values of zero to both the productivity differential and the input price differential when considering an appropriate X factor for the gas distribution and gas transmission DPPs. Obtaining more robust direct information on GPB TFP and input price growth would require obtaining from the GPBs a sufficiently long and consistent time series of the variables listed in section 3.2.

REFERENCES

Australian Bureau of Statistics (ABS) (2010), *Experimental Estimates of Industry Multifactor Productivity, Australia: Detailed Productivity Estimates*, Catalogue No 5260.0.55.002, Canberra, 9 December.

Australian Energy Market Commission (AEMC) (2009), *Review into the use of Total Factor Productivity for the determination of prices and revenues, Design Discussion Paper*, Sydney, 28 August.

Commerce Commission (2009), *Initial Reset of the Default Price–Quality Path for Electricity Distribution Businesses*, Decisions Paper, Wellington, 30 November.

Commerce Commission (2010), *Initial Default Price–Quality Path for Gas Pipeline Businesses*, Issues Paper, Wellington, 12 April.

Economic Insights (2009a), *Assessment of Data Currently Available to Support TFP–based Network Regulation*, Report by Denis Lawrence and John Kain to the Australian Energy Market Commission, Canberra, 9 June.

Economic Insights (2009b), *Energy Network Total Factor Productivity Sensitivity Analysis,* Report by Denis Lawrence to the Australian Energy Market Commission, Canberra, 9 June.

Economic Insights (2009c), *Electricity Distribution Industry Productivity Analysis: 1996–2008*, Report by Denis Lawrence, Erwin Diewert, John Fallon and John Kain to the Commerce Commission, Canberra, 1 September.

Economic Insights (2009d), *Asset valuation methods and productivity–based regulation,* Report by Erwin Diewert, Denis Lawrence and John Fallon to the Commerce Commission, Canberra, 11 June.

Economic Insights (2009e), *The theory of network regulation in the presence of sunk costs*, Technical Report by Erwin Diewert, Denis Lawrence and John Fallon to the Commerce Commission, Canberra, 8 June.

Economic Insights (2009f), *The Productivity Performance of Jemena Gas Networks' NSW Gas Distribution System*, Report by Denis Lawrence to Jemena Gas Networks (NSW) Ltd, Canberra, 18 August.

Economic Insights (2010a), *A Model of Building Blocks and Total Factor Productivity–based Regulatory Approaches and Outcomes*, Report by Denis Lawrence and John Kain to the Australian Energy Market Commission, Canberra, 29 June.

Economic Insights (2010b), *The Productivity Performance of Envestra's South Australian and Queensland Gas Distribution Systems*, Report by Denis Lawrence to Envestra Ltd, Canberra, 30 September.

GasNet (2010), *Initial Default Price-Quality Path for Gas Pipeline Businesses – Issues Paper: Submission on Sections 1 – 3 and 5 – 9*, Wanganui, 14 May.

Jamasb, T., M. Pollitt and T. Triebs (2008), *Productivity and Efficiency of US Gas Transmission Companies: A European Regulatory Perspective*, EPRG Working Paper 0806, Cambridge.

Jorgenson, D.W. (1963), 'Capital Theory and Investment Behaviour', *American Economic Review* 53, 247–59.

Lawrence, Denis (2003), *Regulation of Electricity Lines Businesses, Analysis of Lines Business Performance – 1996–2003*, Report by Meyrick and Associates to the New Zealand Commerce Commission, Canberra, 19 December.

Lawrence, Denis (2004a), *Productivity Growth in New Zealand Gas Distribution Networks*, Report by Meyrick and Associates to the New Zealand Commerce Commission, Canberra, 14 May.

Lawrence, Denis (2004b), *Comparative Benchmarking of Gas Networks in Australia and New Zealand*, Report by Meyrick and Associates to the New Zealand Commerce Commission, Canberra, 14 May.

Lawrence, Denis (2005), *Benchmarking Western Power's Electricity Distribution Operations and Maintenance and Capital Expenditure*, Report by Meyrick and Associates to Western Power Corporation, Canberra, 3 February.

Lawrence, Denis (2007a), *The Total Factor Productivity Performance of Victoria's Gas Distribution Industry*, Report by Meyrick and Associates to Envestra, Multinet and SP AusNet, Canberra, 23 March.

Lawrence, Denis (2007b), *Response to Pacific Economics Group on Meyrick Opex Rate of Change and Productivity Reports*, Report by Meyrick and Associates to Envestra, Multinet and SP AusNet, Canberra, 15 October.

Lawrence, Denis (2007c), 'What do we need to measure and analyse better?', Presentation to joint ABS/Productivity Commission Productivity Perspectives Conference, Canberra, 17 December.

NERA Economic Consulting (NERA) (2010), *Total Factor Productivity Study for Use in AUC Proceeding 566 – Rate Regulation Initiative*, Boston, 30 December.

New Zealand Institute of Economic Research (NZIER) (2001), *Analysis of lines business costs*, Report prepared for Ministry of Economic Development, Wellington.

Oxera (2008), *Network Rail's Scope for Efficiency Gains in CP4*, Report prepared for Office of Rail Regulation, Oxford, April.

Pacific Economics Group (PEG) (2006), *Incentive Regulation for Ontario Power Distribution*, Presentation prepared for the Ontario Energy Board, Madison, 20 June.

Pacific Economics Group (PEG) (2007), *Rate Adjustment Indexes for Ontario's Natural Gas Utilities*, Report prepared for the Ontario Energy Board, Madison, June.

Pacific Economics Group (PEG) (2008a), *TFP Research for Victoria's Gas Distribution Industry*, Report prepared for the Essential Services Commission, Madison.

Pacific Economics Group (PEG) (2008b), *TFP Research for Victoria's Power Distribution*

Industry: 2007 Update, Report prepared for the Essential Services Commission, Madison, December.

Pacific Economics Group (PEG) (2008c), *Calibrating Rate Indexing Mechanisms for Third Generation Incentive Regulation in Ontario*, Report prepared for the Ontario Energy Board, Madison, February.

Pacific Economics Group (PEG) (2009), *X Factor Recommendations for New Zealand Electricity Distribution Price Controls,* Report prepared for Electricity Networks Association, July.

Platts (2007), *Energy Advantage*, www.energyadvantage.com

Reckon LLP (2007), *Gas distribution price control review: Update of analysis of productivity improvement trends*, Report prepared for Ofgem, London, 27 September.

Reckon LLP (2008), *The productivity growth of GTS*, Report prepared for NMa Energiekamer, London, 15 July.

Statistics New Zealand (SNZ) (2010a), *Productivity Statistics: 1978−2009*, Wellington, 16 March.

Statistics New Zealand (SNZ) (2010b), *Industry Productivity Statistics 1978–2008*, Wellington, June.

SumicSid (2009), *International Benchmarking of Electricity Transmission System Operators*, e[3]GRID Project – Final Report, Brussels, 9 March.

Vector (2006), *Gas Distribution Activities 2006: Information for Disclosure*, Auckland.

Vector (2010), *Submission on Initial Default Price-Quality Path for Gas Pipeline Businesses: Issues Paper*, Auckland, 14 May.