

Price Trends for UCLL and UBA final pricing principle

Advice on response to submissions

NZIER report to the Commerce Commission

May 2015

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Summary

- The purpose of this report is to provide advice to the Commerce Commission on price trends used in the final pricing principle price review determinations for unbundled copper local loop (UCLL) and unbundled bitstream access (UBA).
- The report recommends that price trends be calculated using methods selected on a case-by-case basis. Our recommended indices and price trends are summarised in the table below.
- Operating cost trends may need to be adjusted for productivity gains but a detailed assessment is needed to determine the rate for any such adjustment.

Table 1 Summary of recommended price trends

Cost item	Index Description	Long term price trend	Basis for calculation
Labour Opex	A Statistics New Zealand Labour Cost Index for All Salary and Wage Rates for all industries to be used to index costs of labour operating expenditure for a hypothetical new network.	2.0%	Relationship to general inflation
Prefabricated Steel and Aluminium	A Statistics New Zealand Producers Price Index for outputs of the metal fabrication industry to be used to index costs of prefabricated steel and other prefabricated metal products such as racks and cabinets.	2.9%	Relationship to international steel prices, aluminium prices and domestic labour costs
Copper	London Metals Exchange prices for Copper to be used for the cost of cable and similar products where copper is a major component and cost driver.	5.0%	Average of historical growth and forecast based on LME futures plus Consensus Economics consensus forecasts
Non Residential Buildings	A Statistics New Zealand Capital Goods Price Index for non-residential buildings to be used for the cost of constructing buildings for housing e.g. exchange equipment.	1.9%	Relationship to general inflation
Fibre Optic Cable	A US Bureau of Labour Statistics Producers Price Index for wholesale prices of Fibre Optic Cable.	-1.3%	Historical trend excluding currency effects which should be neutral in terms of long term trends
General inflation (consumption)	Consumers price index	2.0%	Current requirements of the RBNZ's policy target agreement with the Minister of Finance
Trenching costs	A Statistics New Zealand Producers Price Index for Civil Construction sector outputs.	3.3%	Relationship to construction sector labour costs and general all sector producer input price inflation

Source: NZIER

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1. Purpose and scope

The purpose of this report is to provide advice to the Commerce Commission on price trends used in the final pricing principle price review determinations for unbundled copper local loop (UCLL) and unbundled bitstream access (UBA).

The Commerce Commission used price trend information in modelling TSLRIC costs of providing UCLL and UBA and services. In this context and following submissions on draft determinations for UCLL and UBA prices, the Commerce Commission has asked for advice on:¹

- how best to estimate long term price trends – whether geometric or arithmetic averages, for example (section 2)
- whether projected trends in the Consumers Price Index (CPI) should be 2% given that this is the mid-point of the 1% to 3% band for CPI inflation targeted by the Reserve Bank of New Zealand (section 2.3.3)
- the best price indices to use to measure
 - labour costs, including whether the Statistics New Zealand Labour Cost Index for ‘technicians and associate professionals’ is the best price index to use to measure labour costs (section 3.1.1)
 - the cost of fabricated steel (section 3.2.1)
 - the cost of copper (section 3.3)
 - the cost of buildings (section 3.4.1)
 - fibre optic cable prices (section 3.5.1)
 - trenching costs (section 3.6.1)
- expected long term trends in (however best measured)
 - labour costs (section 3.1.2)
 - aluminium prices (section 3.2.2)
 - fabricated steel prices (section 3.2.2)
 - copper prices (section 3.3)
 - building costs (section 3.4.2)
 - fibre optic cable prices (section 3.5.2)
 - trenching costs (section 3.6.2)
- whether copper price futures are a good basis for projecting copper price trends (Box 2 page 17)
- the extent to which productivity or efficiency gains should be taken into account when estimating rates of growth in operating costs (section 3.1.3).

¹ The advice in this report is based on the Commerce Commission’s requests and interpretation of submissions, not NZIER’s analysis or interpretations.

2. Calculation of long-term price trends

Calculation of long term price trends should be tailored to the price measure at hand. The choice of calculation method should take account of:

- how and why the trends are being used
- the statistical properties of the price series of interest
- relevant qualitative factors such as:
 - market intelligence
 - established economic theories or physical relationships
 - institutional or policy context.

2.1. Purpose

As we understand it, the purpose of the long term price trends in the final pricing principle price review determinations is to allow for a ‘usual’ or typical rate of cost increase when determining the long term (asset) TSLRIC costs facing a hypothetical new provider of UCLL infrastructure and services.

This purpose suggests it is best to favour simplicity and transparency unless more complicated calculations provide material improvements to accuracy. This is because expectations or forecasts for long-term trends cannot be easily validated. Confidence in estimates in underlying trends and therefore the usefulness of those estimates for creating constructive engagement and sound decision making, rests partly on how easy the information is to use and to understand.

It is also important to be consistent in choices for similar decision contexts and also to minimise judgement wherever possible.

2.2. Statistical properties

Generally speaking, to understand trend growth, noise, cycle (if any) and seasonal effects need to be stripped out of the data. Doing this requires taking a view on the statistical process generating the data.

2.2.1. Importance of taking a view on the process generating the data

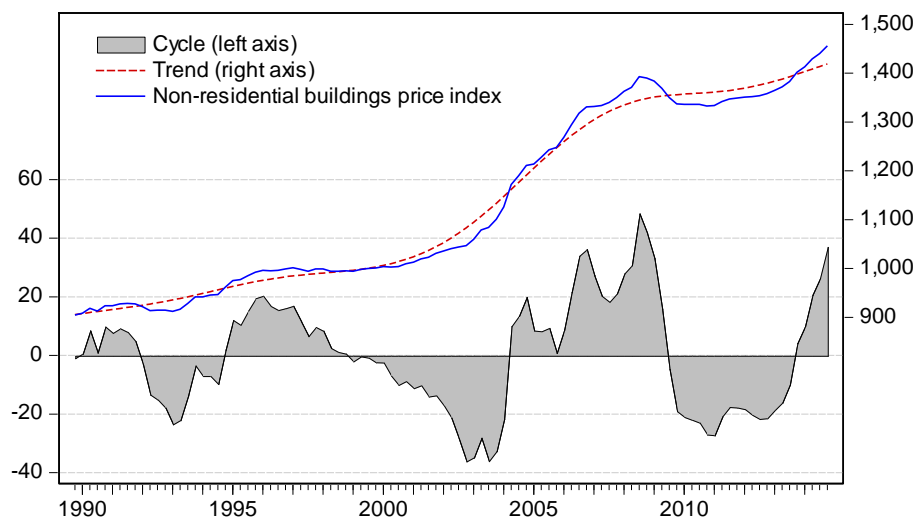
To illustrate the importance of taking account of the underlying data generation process consider what one should make of the fact that electricity consumption in New Zealand grew 16% from March to August in 2014. Most people would know, intuitively, not to make too much of this growth. This is because the seasonal patterns in this particular data generation process are well known.

Other data series have similar quirks and though they are not as readily recognisable as the electricity example it is no less important to try to remove noise, cycle and seasonal effects in order to avoid coming to misleading conclusions.

Similarly, many prices follow well defined cycles, albeit at much longer durations reflecting, for example, cycles in investment which are often referred to as ‘business cycles’. This can be seen, for example, in Figure 1 where we have charted the long term movements in non-residential building prices. The grey area shows a measure of the cyclical component of prices exhibiting cycles persisting for several years.

Figure 1 Long business cycles affecting the cost of buildings

Capital goods price index. Trend extracted using Hodrick-Prescott filter, $\lambda = 1600$.



Source: NZIER, Statistics New Zealand

Calculating trends over time carry particular complications because what appears to be a trend that increases over time may actually be the result of randomness.² This is demonstrated in Figure 2 with two data series where both, in fact, include a trend but the line in red has a constant, regular, *deterministic* time trend while the blue line has a *stochastic* trend where most of what looks like a trend is actually an accumulation of random shocks. These concepts are defined further in Box 1 below.

One way to resolve this is to examine relationships between the series of interest and other series where control mechanisms are well known or can be reasonably used as a pricing benchmark. We provide more detail on this in the next sub-section.

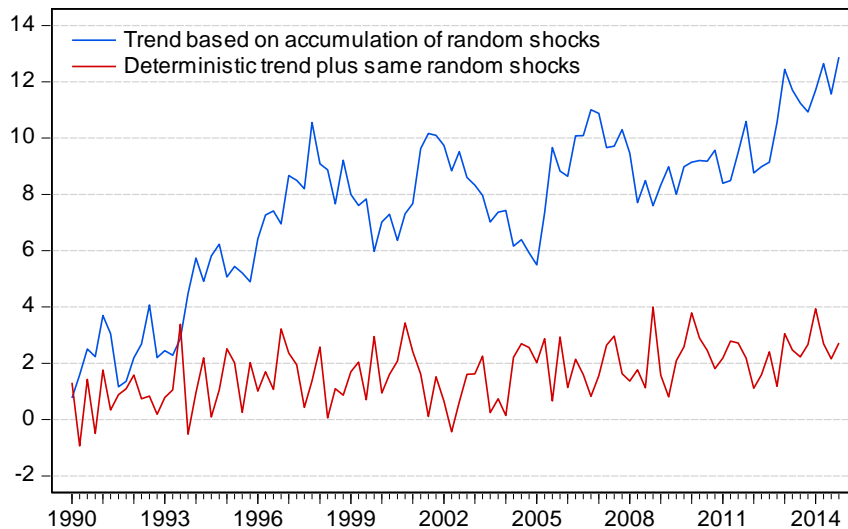
This distinction between the red line and the blue line matters a great deal for understanding trends because while *deterministic trends* are easily deciphered and forecast with a simple equation it takes a lot more effort to make sense of *stochastic trends*.

² The insight that randomness can manifest itself as patterns dates back to (at least) the work of Slutsky in the 1920s. See Slutsky, E. (1937) “The Summation of Random Causes as the Source of Cyclic Processes”. *Econometrica*, vol. 5, no. 2, April 1937, pp. 105-146.

Also errors in forecasts of *stochastic trends*, unlike for deterministic trends, will get larger and larger as the forecast horizon gets longer. This makes estimates/forecasts of trends more uncertain.¹

Figure 2 Trends may be random

Synthetic indices with common base value of 1 in 1990.³



Source: NZIER

Box 1: What looks like a trend may be random

The red line in Figure 2 is generated from the following equation involving a 1% compounding (exponential) growth rate (θ), plus random fluctuations (ϵ_t):

$$\text{Equation 1: } y_t = c \cdot e^{\theta \cdot t} + \epsilon_t$$

This sort of trend is termed *deterministic* in the sense that, because it is unchanging, the future average value of the series or price is pre-ordained.

If growth in a data series is exponential (a constant proportion) then one approach to estimating the trend is to estimate the parameter θ in a log-linear regression of the following form:

$$\text{Equation 2: } \ln(y_t) = c + \theta \cdot t + \epsilon_t$$

The blue series in Figure 2 represents a *stochastic* trend which is an accumulation of random fluctuations represented by:

$$\text{Equation 3: } y_t = c + y_{t-1} + \epsilon_t$$

³ Both series include random normal 'shocks' with mean 0 and variance = 1. The blue series has drift term = 0.01. The red series has a trend value of 0.01.

2.3. Our general approach

2.3.1. Test and compare 4 approaches

In this report we use and compare four approaches to calculating price trends:

- qualitative judgement based on policy targets
- trends modelled using benchmark prices, to deal with stochastic trends
- arithmetic averages of annual average percentage growth rates
- deterministic trends calculated using simple linear regression of the price series on time (as in Equation 2 above).

For each of these approaches we also take account of qualitative factors such as market information and macroeconomic insights about relationships between, for example, commodity prices and the New Zealand exchange rate. These insights help us to sense-check our statistical analysis.

Qualitative insights are also used to determine if historical trends are a reasonable basis for understanding trends in the future. This is not always the case, especially where we have limited data at our disposal or if we have strong reasons to expect structural changes to prices and the economy in future.

Practical considerations most often come into play we have limited information on how prices have evolved historically. Limited information commends simple and conservative approaches to trend estimation.

Arithmetic averages of annual average percentage growth rates are perhaps the simplest approach to trend calculation. They are also the default measure of long term growth used by market economists and Statistics New Zealand. We make considerable use of these measures when analysing trend growth.⁴

2.3.2. Analyse stochastic trends

Most of the series we consider have *stochastic trends*. The conventional approach to deal with stochastic trends and one we adopt here is to:

- test for the presence of a stochastic trend using two different statistical (so-called unit-root) tests
- if stochastic trends are present, test whether relationships with other series (or prices) produce a stable relationship through time (so-called *cointegrating* relationships)
- use the stable relationship, if any, to infer underlying trends and expected growth rates.⁵

⁴ In the final analysis we find that none of the data series we are considering can be reliably considered to have a linear deterministic trend. Hence we do not use trend calculation method proposed by CEG (February 2015) in paragraphs 39 to 43 of the submission titled 'Evidence on Price Trends'. Despite not adopting their precise method, we agree very much with the CGE submission's general point that trend calculations should use multiple data points – as discussed in our subsection 2.3.5 below.

⁵ There is a very large literature on stochastic trends and many other ways to deal with them in the event that cointegrating relationships cannot be found. We did not need to use any of these alternative approaches here.

In practical terms, what we do is make a great deal of the fact that price stability is mandated by government policy. Insofar as the government continues to ask the Reserve Bank to hit a target for the rate of price growth, we can form a reasonably well-informed view of general inflation as measured by the CPI.

If other prices can be shown to be related to the CPI then we can overcome the problem of understanding stochastic trends by focussing on the relationship between changes in the CPI and changes in the other prices of interest.

2.3.3. Assume 2% growth in the CPI

We assume that the Consumers Price Index will grow at a trend rate of 2% p.a.

Trend growth of 2% is consistent with the mid-point of the Reserve Bank's inflation target and with the current Policy Targets Agreement (PTA) between the Minister of Finance and the Reserve Bank of New Zealand (RBNZ) Governor:

*b) For the purpose of this agreement, the policy target shall be to keep future CPI inflation outcomes between 1 per cent and 3 per cent on average over the medium term, **with a focus on keeping future average inflation near the 2 per cent target midpoint.***

[Emphasis added]⁶

An alternative approach might be to analyse past growth in the CPI. But any such analysis would need to take account of the different policy regimes in the past – including variations in PTAs under the current Reserve Bank of New Zealand Act 1989.⁷ Any forecast would also have to then form a view of potential policy changes in future.

It is more pragmatic and reasonable simply to assume that the objective expressed in the current PTA is met and hence trend growth on the CPI is 2%.

2.3.4. Use annual average growth rates

In this report the trends we construct are exclusively annual average growth rates.⁸ This means they are less affected by volatility than, for example, the annual percentage changes used for the purposes of the RBNZ inflation target.

We also evaluate trends, in our models and analysis, based on successive quarterly values for annual average growth rates. This effectively results in analysis of moving averages. We do this because it provides more information for fitting dynamic relationships between variables over time.

⁶ The current agreement, signed in 2012, is available at: http://www.rbnz.govt.nz/monetary_policy/policy_targets_agreement/.

⁷ For most of the 2000s the Governor of the RBNZ was tasked with keeping inflation within the target band of 1% to 3% “on average over the medium term”. There was no particular emphasis on the mid-point of the band and, perhaps as a consequence, the CPI grew by an average of 2.4% p.a. – in terms of the growth rate measurement used in the PTA. Note that we use annual average growth rates in this report.

⁸ The average of the last four quarters divided by the average of the four quarters prior to that i.e. $\frac{\sum_{t=1}^3 y_t}{\sum_{t=2}^4 y_t} - 1$.

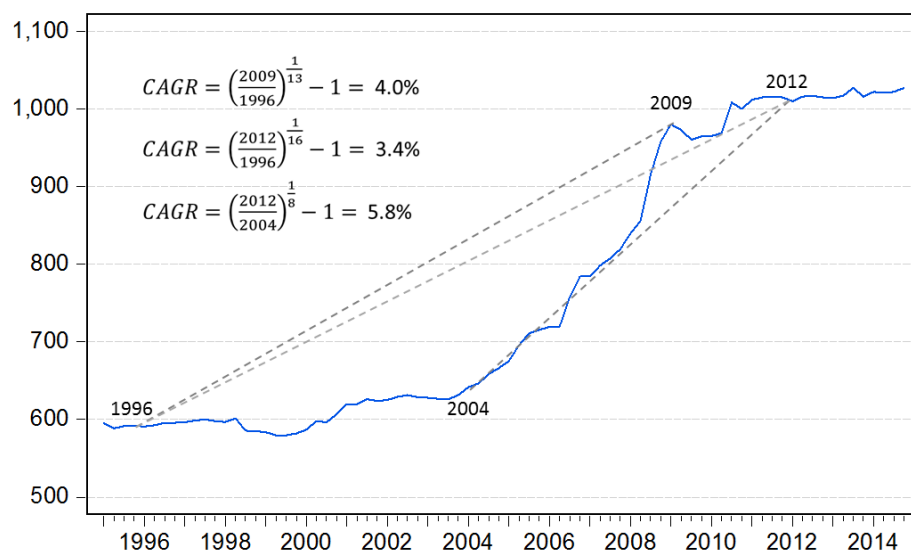
2.3.5. Avoid using compound growth rates

It is unwise to calculate long term price trends using a geometric average of two data points – or compound average growth rate (CAGR). That is, unless those two data points can be shown to be representative of the underlying data generation process. In general, estimating 1 number (a trend parameter) using 2 data points is unwise as it induces large amounts of variability and imprecision – as shown in Figure 3.

As a general rule it is the case that macroeconomists and time series statisticians virtually never use exponential growth measures. This is mainly because in the real world inexorable or constant exponential growth is rare if at all possible. This means exponential growth calculations, while sometimes useful summaries, are not good characterisations of data generation processes.

Figure 3 Sensitivity of compound growth rates to data points

CGAR = compound annual average growth rates. Data is a fabricated metals producer price index.



Source: NZIER, Statistics New Zealand

2.3.6. Reasoned and consistent judgement

The final choice of trend growth rate is based on a reasoned and consistent judgement about which approach to trend calculation will have the least error and potential statistical bias given the price series at hand. In some cases the choice is obvious and somewhat mechanical. In other cases it is more complex. In all cases, we seek to apply consistent reasoning in our recommendations.

3. Price measures and estimates of trends

3.1. Labour Opex

3.1.1. Measure using Labour Cost Index

The best series to use for understanding long term trends in Labour Opex is the Statistics New Zealand Labour Cost Index for All Salary and Wage Rates for all industries.⁹ This index captures increases in the unit cost of labour after removing changes in costs attributable to changes in the composition and quality of the workforce.

We understand that at least one submission on the draft determinations for UCLL and UBA prices suggested that the Statistics New Zealand Labour Cost Index for ‘technicians and associate professionals’ is the best price index to use to measure Labour opex. Apparently this is the price index used by Chorus in its contract terms with field service workers.

While it is useful context to know which series are currently used in commercial contracts, our view is that current commercial agreements should not be an important factor in understanding price or cost trends or the right index to measure those trends. Furthermore, labour opex extends well beyond field technicians and includes customer services, finance, human resources, and property management personnel or related labour costs.

3.1.2. Trend growth for the LCI

We assess that the LCI will grow at 2.0% per annum. This is equivalent to growth in the CPI. Our considerations in coming to this conclusion are summarised in Table 2

LCI trend growth is expected to be lower in future than it has been in the past. This change is based on the fact that the CPI is expected to grow more slowly in the future (2.0%) than it has on average since the Reserve Bank Act came into effect in 1991.¹⁰

Historically, the LCI grew at an average growth rate of 2.2% and an evaluation of the deterministic trend underlying past movements suggests growth of 2.3%.

The LCI is assessed as having a stochastic trend and a test was carried out which confirmed that the LCI had a cointegrating relationship with the CPI.^{11,12} This analysis

⁹ Series reference LCIQ.SG51Z9.

¹⁰ As discussed in section 2.3.3. We ignore inflation prior to 1991 on the grounds that the monetary policy regime prior to that point was drastically different to the regime we have now. We also assume, implicitly, that the loose bipartisan agreement on monetary policy amongst a majority of political parties in New Zealand persists in future.

¹¹ The Augmented Dickey Fuller (ADF), (due to Dickey and Fuller, 1979) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) tests are both used to test for unit roots – in all analysis referred to in this report. The tests used include time trends. The two tests are used as they have different propensities towards errors. The ADF test is more likely to find a unit root where there is none and the KPSS test is more likely to reject a unit root where there is one.

¹² We carry out single equation Engle-Granger (1987) tests for cointegration where only two variables are involved and where more variables are involved we also use the Johansen (1991) system cointegration test. If cointegration is confirmed we use

suggests that trend growth in the LCI is 0.97 times growth in the CPI. Given our expectation of 2.0% trend growth in the CPI this coefficient suggests the LCI will grow at a trend rate of 1.9% (0.01946 at 5 decimal places).

This does not warrant a projected trend materially different from the CPI. That being so we prefer to err on the side of being conservative and recommend a trend growth rate equal to expected trend growth in the CPI.¹³

Table 2 Labour cost expected trend

Growth rates are annual average percentage changes

Measure	Value
Suggested trend growth rate	2.0%
Historical average of LCI (1995-2014) ¹⁴	2.2%
Deterministic trend annual	2.3%
Presence of stochastic trend?	Yes
Cointegrated with CPI?	Yes
Relationship to CPI via simple least-squares	0.97
Implied LCI trend given expected CPI growth	1.9%
Historical annual average of CPI (1995-2014) ¹⁵	2.3%
Deterministic trend annual growth in CPI	2.3%
Expectation of CPI growth in future	2.0%
NZIER forecast LCI growth rate, average to 2020	2.0%

Source: NZIER

The LCI trend growth rate we have chosen is consistent with our *Quarterly Predictions* forecasts extrapolated to 2020. However, the *Quarterly Predictions forecasts* and similar other forecasts in the market differ from the trend growth rates shown here as they include forecasts of the length and intensity of economic cycles over the next 6 to 60 months. This needs to be kept in mind if comparisons are made between these trend figures and measures of growth rates from other sources.

simple log linear regression to extract cointegrating relations. This is for simplicity as it speeds calculation of equality test on coefficients.

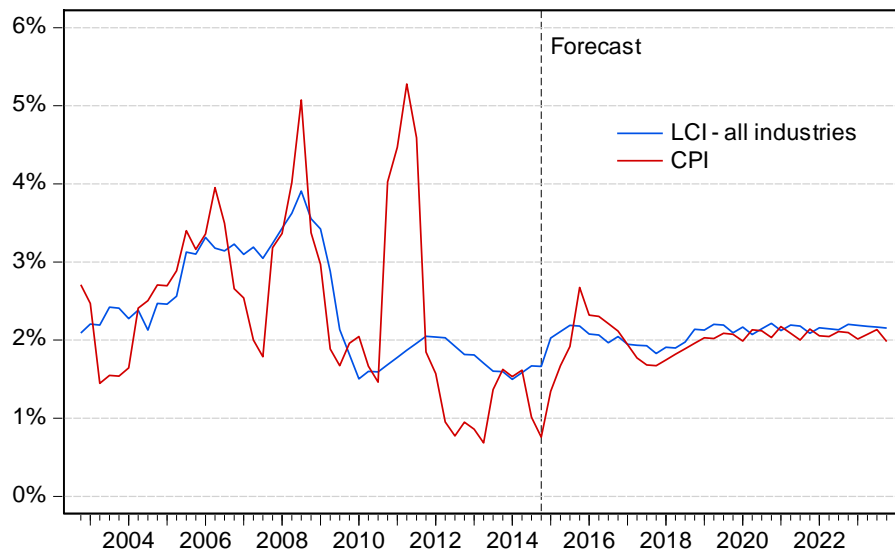
¹³ The confidence interval around the coefficient estimate suggests the coefficient is statistically different from 1 but not by much (confirmed by a Wald test). Furthermore, this assumes that CPI forecast is without error which, in practice, it isn't. There are also reasons to believe that an ageing population will cause increased upward pressure on labour costs in future.

¹⁴ 1995 to 2014 is the span of available data – based on complete March year annual average growth rates. The use of March years is by convention – it is the period used for the major official statistics in the System of National Accounts.

¹⁵ We chose this period because it is the period for which we have LCI data to make comparisons.

Figure 4 Relationship between the LCI and the CPI

Annual average percentage change



Source: NZIER

3.1.3. Adjustment for efficiency gains

Additional adjustment to LCI trend growth should be considered, when calculating OPEX costs, if there is good evidence that providers of UCLL and UBA services achieve productivity gains which are larger than those achieved across the entire economy, on average.

Growth in labour costs was used for indexing growth in overall operating costs in the Commerce Commission’s draft determinations. One submission suggested that this should be corrected by an efficiency factor reflecting productivity gains over time.

The key question is what the value of such an adjustment should be?

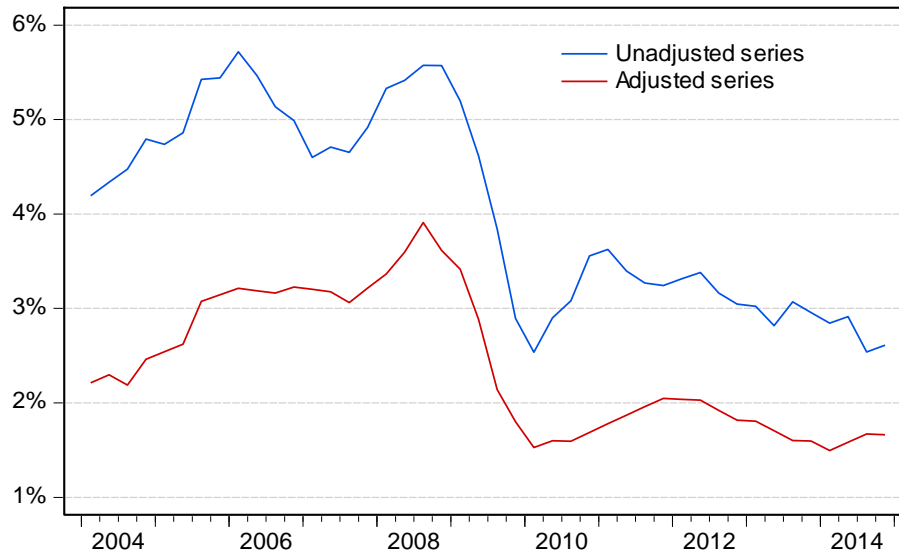
The LCI does already contain adjustments for labour quality changes reflecting productivity gains. The effects of this adjustment can be seen in Figure 5. This chart tracks growth in the LCI for all sector salary and wage rates alongside the equivalent – so-called ‘analytical’ – series that has not been adjusted for estimated changes in labour quality. The difference between the two series has averaged around 1.7% over the past 15 years. This is equal to measured gains in labour productivity.¹⁶

So, if providers of UCLL and UBA services are expected to achieve the same efficiency gains as other industries, on average, then 0% would be a reasonable adjustment.

¹⁶ Before adjustments for industry compositions which reduce measured labour productivity growth to 1.3% p.a.

Figure 5 Effects of quality adjustment in the LCI

Annual average percentage change in all sector salary and wage rates



Source: NZIER, Statistics New Zealand

Figure 6 shows that, on average, the Information Media and Telecommunications industry has had faster productivity growth than other industries (averaging 2.4% overall or multifactor productivity growth as opposed to 0.8% growth for measured sectors as a whole). However, there is wide variation in productivity and this variation has the effect that, by simple comparison, there is not a statistically significant difference between productivity growth in the Information Media and Telecommunications industry and other industries. This can be seen by the fact that the blue shaded areas for each industry group all overlap.¹⁷

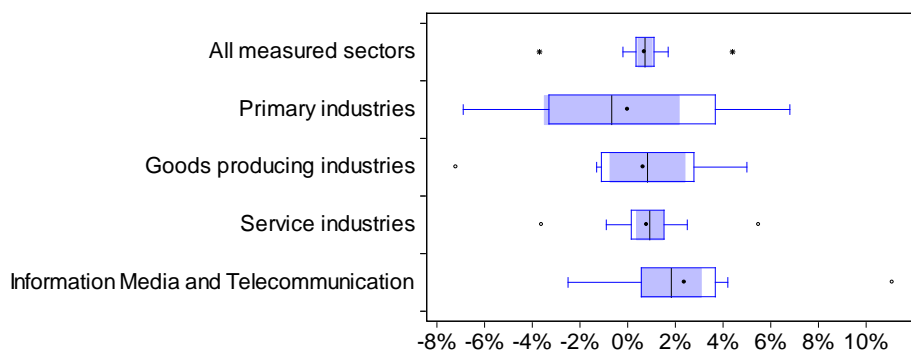
Figure 6 is intended to show the overall spread of productivity growth rates by industry. The boxes represent the 75% of observations; the blue shaded areas are 95% confidence intervals for the median value; the black dot is the average value; the black line in the box is the median value; the clear dots are outlying (extreme) maximum and minimum values; and the boxes plus the lines extending from the boxes are the spread of the data excluding outliers.

This analysis is indicative only. The Information Media and Telecommunications industry covers a much wider range of activities than the ones of interest for the UCLL and UBA services. Thus, more detailed analysis would be needed before a firm conclusion could be reached on the value of a productivity adjustment.

¹⁷ This is descriptive only. It does not account for correlations in growth rates across time.

Figure 6 Variations in productivity growth across industries

Annual percent changes in multifactor productivity, 1997-2012¹⁸



Source: NZIER, Statistics New Zealand

Note also that the question of productivity adjustment also raises questions of incentives. These are well beyond the scope of this particular assessment of cost adjustment but need to be considered in the context of the overall review of the final pricing principles. On the face of it, there needs to be some scope for higher returns as a pay-off to more efficient service provision. Determining the right incentive structure is something that needs to be considered in the overall package of a pricing determination.

3.2. Fabricated metal products

3.2.1. Measured by Producers Price Index for outputs from the metal fabrication industry

The prices of non-cable related use of metals – such as aluminium and steel products – are best measured by a Producers Price Index for the outputs of the Fabricated Metal Product Manufacturing industry (PPI-O metals). The industry coverage of this index is shown in Table 3. Primary metals manufacturing is captured in a separate industry category.

The index measures the factory door cost of the outputs from these industries. Thus this index strikes a balance between measuring cost increases associated with metals and other increases in costs such as labour and land. This is an important balance to strike as many of the metal products or assets used for UCLL services will have a substantial labour component in their costs.

¹⁸ In this chart: the boxes represent the spread of 75% of observations; the blue shaded areas are 95% confidence intervals for the median value; the black dot is the average value; the black line in the box is the median value; the clear dots are outlying (extreme) maximum and minimum values; the boxes plus the lines extending from the boxes are the spread of the data excluding outliers.

Table 3 Coverage of Metal Fabrication Industry

Iron and Steel Forging
Structural Steel Fabricating
Prefabricated Metal Building Manufacturing
Architectural Aluminium Product Manufacturing
Metal Roof and Guttering Manufacturing (except Aluminium)
Other Structural Metal Product Manufacturing
Boiler, Tank and Other Heavy Gauge Metal Container Manufacturing
Other Metal Container Manufacturing
Other Sheet Metal Product Manufacturing
Spring and Wire Product Manufacturing
Nut, Bolt, Screw and Rivet Manufacturing
Metal Coating and Finishing
Other Fabricated Metal Product Manufacturing n.e.c.

Source: Australia-New Zealand Standard Industry Classification, 2006

3.2.2. Trend growth in PPI-O metals

We estimate trend growth rates of 2.9% p.a. based on the historical (cointegrating) relationship between the PPI-O Metals and a combination of the labour cost index (the same index discussed in section 3.1.1), international steel prices (in NZ dollars) and aluminium prices (also in NZ dollars).

The trend growth estimate we use includes both historical relationships and expected future prices for international metals prices. Alternatively it could be based solely on forward looking prices. If we used only forward-looking prices the trend growth would be 1.7%.

The reason we include history plus expectations for metal prices is because our forecast average growth rates for steel are heavily influenced by a correction in steel prices in the current year and into 2016. This 33% change is a very large fluctuation and if we did not adjust for it our projection would be dominated, in effect by only two observations. One way to remove this effect but to do so using actual data is to take an average growth rate inclusive of historical movements. This sort of correction is typical of commodity prices which are extremely volatile.

We reflect future trends, when we could rely solely on historical trends, because, for example:

- there are good reasons to believe metals prices could, in future, face structural changes due to rising costs of energy associated with, inter alia environmental policies
- a forward looking view on steel is needed to account for market expectation that this is one sector where demand may be sluggish (with a moderation of construction activity in China) relative to capacity (of which there is a great deal).

The aluminium prices we use are London Metals Exchange (LME) US dollar prices. This is the most widely used market place in the world for these metals prices.¹⁹

¹⁹ Trade on the LME futures exchange accounts for “more than 80% of all non-ferrous metal futures” in the world (see <http://www.lme.com/about-us/>).

These are converted to NZ dollar equivalents using monthly average wholesale exchange rates.

The projections of Aluminium prices are LME market futures for up to December 2018 and an extrapolation of Consensus Economics long term consensus forecasts to 2020 and beyond. This is shown in Figure 7.

Table 4 Metals PPI-O trend

Growth rates are average annual

Measure	Value
Trend growth rate	2.9%
Historical average growth (1995-2014) ²⁰	3.0%
Deterministic trend	3.7%
Stationary	Yes
Cointegrating relation:	Yes
LCI	1.28
Steel (NZ\$ price)	0.23
Aluminium (NZ\$ price)	-0.15
Implied metal fabrication trend growth rate based on expected price trends only:	1.7%
Trend growth in LCI	2.0%
Expected Long term growth in steel prices	-0.1%
Expected Long term growth in aluminium prices	6.0%
Implied metal fabrication trend growth rate based on expected price trends plus historical growth in metals prices:	2.9%
Trend growth in LCI	2.0%
Historical average + expected steel price growth	2.9%
Historical + expected average aluminium price growth	2.0%

Source: NZIER

The conversion of international prices back to New Zealand dollars is based on the forecast for the New Zealand dollar from the NZIER's March quarter 2015 *Quarterly Predictions* – in which the NZ dollar is expected to depreciate towards a long run average of 66 cents to the US dollar.

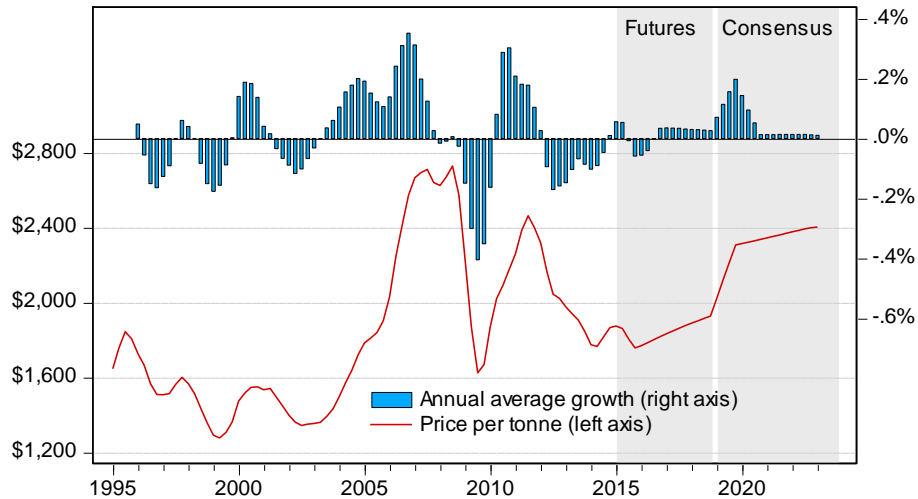
We use the Asia Hot-Rolled Coil price to measure steel prices – principally because this is the main steel price for Asia monitored by *Consensus Economics* energy publication which we use for gauging market sentiment in terms of longer term

²⁰ 1995 to 2014 is the span of available data – based on complete March year annual average growth rates. The use of March years is by convention – it is the period used for the major official statistics in the System of National Accounts.

outlook for prices.²¹ We also use the *Consensus Economics* surveys for short term forecasting because there is no public futures market for steel in Asia. The projected steel prices are shown below.

Figure 7 Aluminium price projections

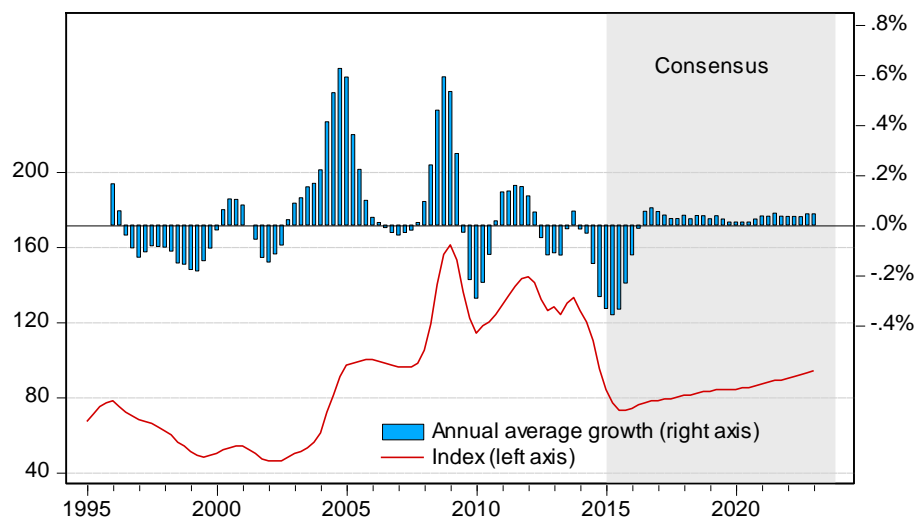
US dollar prices



Source: NZIER, Consensus Economics, LME

Figure 8 Steel prices

US dollar



Source: NZIER, Consensus Economics

²¹ The history we use for understanding historical movements is a combination of World Bank steel prices (from the 'Pink Sheets') and Asia HRC prices. The World Bank series is long, which is helpful, but discontinued in 2011.

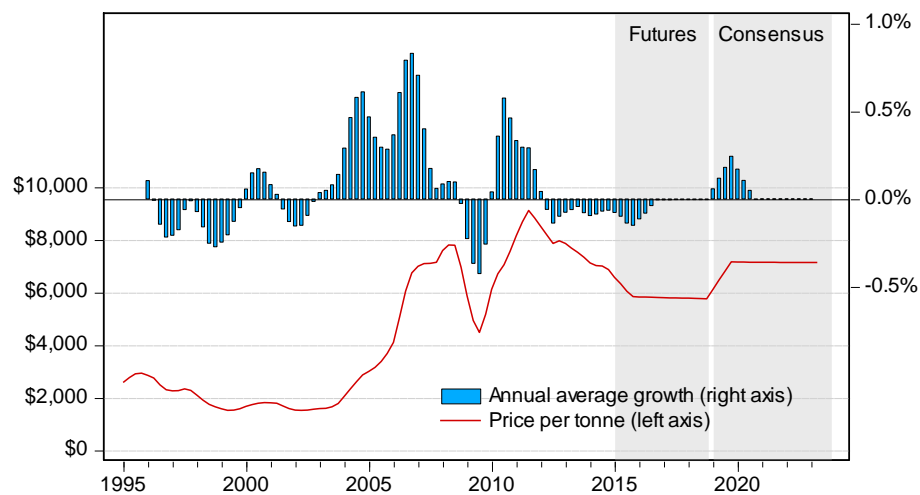
3.3. Copper prices

Our estimate of the trend for copper prices is 5.0% p.a. This estimate follows the same approach taken in the previous section.

The benchmark price series we use for copper is the LME price. Projected prices are a combination of futures prices and *Consensus Economics* consensus forecasts (see Figure 9). The prices are translated into New Zealand dollars using historical wholesale exchange rates and forecasts from NZIER's March 2015 *Quarterly Predictions*.

Figure 9 Copper price projections

US dollars



Source: NZIER, Consensus Economics, LME

Our projection is based on both historical and forecast average growth rates, in keeping with the treatment of steel and aluminium trends in the previous section. Sensitivity of our estimate to this approach is summarised in Table 5.

Box 2: Rationale for using futures prices

Futures prices are used to capture the current state of the market and the extent to which the market is presently above or below some average or expected longer term ('equilibrium') spot price.

On their own, they are an imperfect source of information for understanding long term trends. Hence we supplement these price expectations with historical growth and Consensus Forecasts.

The reason the futures price remains useful is that the position of the spot price relative to the futures price holds 'crowd-sourced' information about whether current supply conditions (inventories) are tight or loose relative to demand and hence the trajectory for prices (whether an upward adjustment or a downward adjustment).

A futures price which is some distance above the spot price (higher than the holding cost of the commodity) suggests conditions are tight (inventories are low) while a futures price below the spot price suggest that inventories are reasonably well-stocked.

In our forecasting we use futures prices as a one-for-one predictor of the expected spot price. This is an approximation in the sense that there are two competing factors which mean that a futures price can be above or below the expected spot price.

A futures price may lie above the expected spot price because of the opportunity cost (rate of interest) of holding a futures contract. On the other hand, a risk premium may be demanded to compensate for riskiness in holding long term positions.¹ This risk premium implies that futures prices may lie below the expected spot price.

We assume that, on average, these two competing effects cancel each other out and futures prices are a sound estimator of expected spot prices. We then use this estimate of expected spot prices as our forecast of future spot prices. This approach has been shown to be an improvement on extrapolation of trends or 'naïve' methods such as modelling prices as a random walk.¹

The copper price trend we have estimated is similar to but lower than historical trends. This is shown in Figure 10 which shows that copper prices grew, on average, by 6.4% p.a. between 1960 and 2005. Since 2005 prices grew in excess of 12% per annum but this is most likely unsustainable over the long run. Price growth at that rate creates significant incentives to substitute away from copper. Rates of around 5% or 6%, however, are roughly consistent with expenditure on copper maintaining its share of nominal income. Over the entire period 1960 to 2015 prices grew at an average rate of 7.5%.

Table 5 Copper price trends

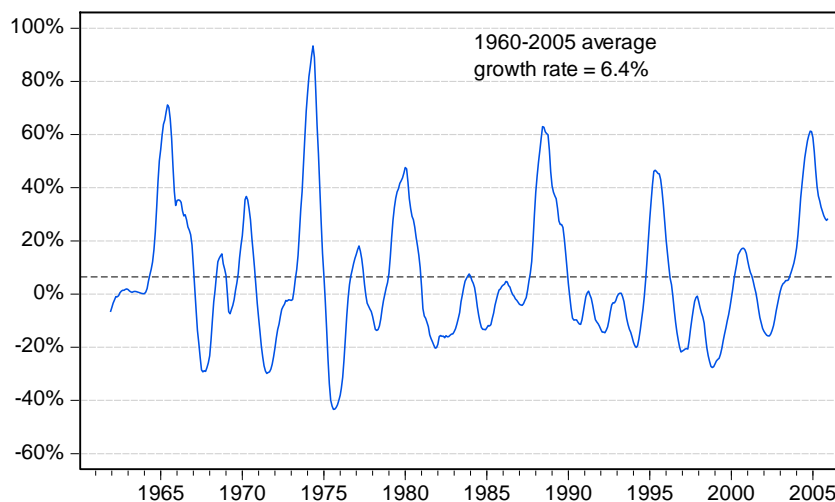
Annual average growth rates

Measure	US dollar	NZ dollar
Trend growth rate		5.0%
Historical average (1995-2014) ²²	8.1%	6.1%
Expected average (2015-2023)	0.3%	2.6%
Historical + expected average	5.6%	5.0%

Source: NZIER, LME, Consensus Economics

Figure 10 Long run historical copper price growth

Annual average growth in nominal US dollars per metric tonne



Source: World Bank *Pink Sheets*

3.4. Building costs

3.4.1. Measured using Capital Goods Prices for Non-Residential buildings

The best series to use for understanding long term trends in the costs of non-residential buildings is the Statistics New Zealand Capital Goods Price Index for non-residential buildings.

²² We adopt this time period to be consistent with our treatment of the other metals series.

The Capital Goods Price Index for non-residential buildings includes costs of acquiring building assets, as opposed to lease and maintenance costs although we would expect ‘no-arbitrage’ conditions to ensure a consistent relationship between the cost of capital assets and lease costs.

3.4.2. Long term trend

Our estimate for long term trend growth in non-residential building costs is 1.9%.

Our approach to estimating the long term trend for this price series is the same as for the LCI measure (discussed in section 3.1.2). A summary of the factors taken into account are listed in Table 6.

Table 6 Non-residential buildings

Growth rates are annual averages

Measure	Value
Suggested trend growth rate	1.9%
Historical average (1992-2014) ²³	1.9%
Deterministic trend annual	2.3%
Stationary?	Yes
Cointegrated with CPI?	Yes
CPI relationship	0.96
Implied trend growth rate	1.9%
Annual average of CPI (1992-2014)	1.9%
Deterministic trend annual growth in CPI	2.2%
Expectation of CPI growth in future	2.0%
NZIER forecast non-residential buildings growth rate, average to 2020	1.3%

Source: NZIER

In the case of the LCI analysis there was grounds to reject the idea that the LCI grows more slowly, on trend, than the CPI. This is not the case here.

3.5. Fibre optic cable costs

3.5.1. Measured using US Producers Price Index

We use the US Producers Price Index for fibre optic cable to measure fibre cabling. This is an index specific to fibre optic cable produced by the Fibre Optic cable

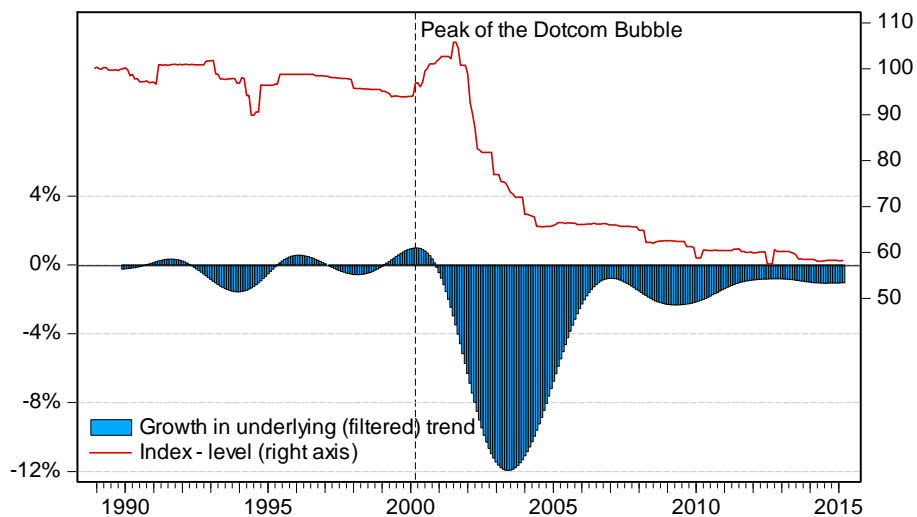
²³ 1992 to 2014 is the span of available data – based on March year annual average growth rates. The use of March years is by convention – it is the period used for the major official statistics in the System of National Accounts.

manufacturing industry. The index is produced by the US Bureau of Labor Statistics (US BLS) and starts in 2003.

A longer price index is available from the US BLS for monthly fibre optic cable prices from 1988. We choose not to use this series because data prior to 2003 is severely affected by the dotcom bubble, consequent over-investment in fibre and subsequent massive price collapse. This means that for much of the 1990s fibre-optic prices reflected unsustainable trends and were not reflective of trends which are likely to persist in the future. This can be seen in Figure 11 below with prices fairly flat up until the early 2000s after which prices collapsed 30% between December 2000 and December 2003.

Figure 11 Effect of dotcom bubble on fibre optic price trend in US

Annual percent change. Trend extracted using Hodrick-Prescott filter, $\lambda = 14400$.



Source: NZIER US BLS

There is no New Zealand index for fibre optic cable. Although the New Zealand Capital Goods Price Index for cables does contain fibre optics that index also contains power cables, speaker cables, electric wires, conductor, and telephone cables. Fibre optics are a small part of this index – although exactly how small is confidential. The products in this category are not similar to fibre-optic cable – except in the case of telephone cable. This means we have no reason to think that the index is representative of cost trends for fibre optic cable. We would also expect the cost of fibre optic to evolve differently to these other cables given quite different production technologies.

Submissions on the Commerce Commission’s draft determinations included a suggestion to use the ratio of value and volume indices for fibre optic cable produced by the Japanese Electric Wire and Cable Makers Association.²⁴ This approach is not

²⁴ Strictly speaking, the ratio of a value index to a quantity index is not the correct way to estimate changes in prices. To estimate changes in prices one should use differences in growth rates and apply these to a common index base.

unreasonable when other information is not available but the US BLS index follows established price index conventions and has sound provenance in the sense that it has been constructed by a reputable independent central government (federal) statistical agency. The Japanese indices are also of limited length – dating back to 2009 – making them of limited value for understanding trends.

A number of Statistical agencies in Europe produce Producer Price (output) indices for fibre optic cable manufacturing and Eurostat publishes an aggregate measure.

The reason we choose US measures over European indices is that we are more certain of the long run status and position of the US currency than the Euro. However, we do consider EU indices as a sense-check for our evaluation of trends in the US index.

The US statistics are also preferred because they include a product-specific index while the European series are industry indices and so include products and services other than fibre optic cables produced by the fibre optic cable manufacturing industry.

Another option raised in submissions, for indexing or understanding fibre optic cable prices, is to use prices paid by Chorus. We did not have access to this data but if we did we would be hesitant about using firm-specific information from a single firm to understand cost trends. This is because these prices will reflect firm-specific decisions as well as generalisable cost changes and without other information we would not be able to discern which is which.

3.5.2. Long term trend

The fibre optic cable index we have is too short to provide a good sense of the long term dynamics of the historical series. For this reason we believe it is prudent to use the simple annual average growth rate in the price index (-1.3% p.a.) as a measure of long term price trend.

Table 7 provides our chosen trend growth rate alongside alternative metrics and a fitted deterministic trend and average growth rate for data from prior to 2003.

Table 7 Fibre optic cable

Growth rates are annual averages

Measure	Value
Suggested trend growth rate	-1.3%
Historical average (1991-2014) ²⁵	-2.0%
Historical average (2006-2014) ²⁶	-1.3%
Unit root (2006-2014)?	Inconclusive
Estimated deterministic trend	-1.5%
Estimated deterministic trend (1988 – 2000)	-0.5%

²⁵ BLS commodity price index (WPU10260333) incorporating monthly data from December 1988 to December 2014.

²⁶ Growth rates for these years incorporate index data points from March 2004 quarter through to the March 2014 quarter.

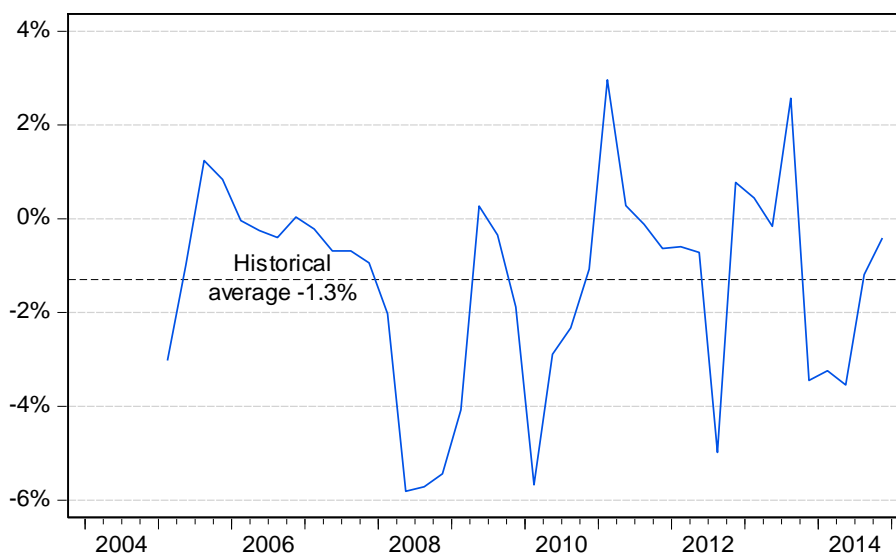
Source: NZIER, US Bureau of Labour Statistics

In our view there is no strong reason to conduct any adjustment for exchange rate effects. This is because there is no reason to expect the price of fibre optics to be correlated with the value of the NZ dollar and, over the long term, upward and downward swings in the value of the dollar should cancel each other out.

This is in contrast to the case for commodity prices where the NZ dollar tends to move with changes in commodity prices and this has the effect of partially shielding New Zealand firms from increases in international commodity prices and also limiting NZ dollar reductions in prices of commodities being imported.²⁷

Figure 12 Historical growth in US fibre optic prices

Annual average growth in Producer Price Index, product series



Source: NZIER, US BLS

By way of comparison, Table 8 provides average growth rates for European price indices at the industry, as opposed to product level, and compares them to US series. The average growth rates are the same in 3 out of 5 cases and generally similar. This gives confidence that the US series is comparable to other prices internationally.

Table 9 provides an indication of how price trends might change if we were to explicitly account for currency movements and ignore hedging of currency risk. Historical and forecast trends for an NZ dollar index are -0.8% p.a.²⁸

²⁷ This is why exchange rate adjustment is included for metals commodities but not for fibre optics. For further discussion on the relationships between commodity prices and the New Zealand exchange rate see, for example, Parker and Wong (2014) and Mabin (2011).

²⁸ A NZ dollar version of the long run series from the BLS – from December 1988 – would have a historical average annual growth rate of -0.1%.

Table 8 Comparison of European and US indices

Average annual growth in industry level fibre optic manufacturing producer price indices

Region	Length of data series	Average of average annual growth
Euro area (18 countries)	Dec 2003 - Dec 2014	-1.9%
Euro area (19 countries)	Dec 2003 - Dec 2014	-1.9%
European Union (15 countries)	Dec 2003 - Dec 2014	-1.4%
European Union (27 countries)	Dec 2003 - Dec 2014	-1.4%
European Union (28 countries)	Dec 2003 - Dec 2014	-1.4%
Germany	Dec 1996 - Dec 2014	-1.5%
US BLS <u>Industry</u> index	Dec 2003 - Dec 2014	-1.4%
US BLS <u>Commodity</u> index	Dec 1988 - Dec 2014	-2.0%

Source: NZIER, Eurostat, US BLS

Table 9 Currency effects on fibre optic price trends

Annual average percent growth

Period	US PPI, fibre optics	USD/NZD	NZ dollar index
Average 2006 - 2014	-1.3%	2.4%	1.1%
Average 2006 - 2020	-1.3%	0.4%	-0.8%
Mar-06	0.3%	0.3%	0.5%
Mar-07	-0.2%	-2.8%	-3.0%
Mar-08	-1.1%	14.3%	13.2%
Mar-09	-5.3%	-17.1%	-22.4%
Mar-10	-1.9%	9.4%	7.4%
Mar-11	-0.9%	5.5%	4.6%
Mar-12	-0.3%	10.6%	10.4%
Mar-13	-1.1%	1.2%	0.0%
Mar-14	-1.1%	0.6%	-0.5%
Mar-15	-1.3%	-2.0%	-3.3%
Mar-16	-1.3%	-10.1%	-11.4%
Mar-17	-1.3%	-1.3%	-2.6%
Mar-18	-1.3%	-0.7%	-2.0%
Mar-19	-1.3%	-0.5%	-1.8%
Mar-20	-1.3%	-0.6%	-1.9%

Source: NZIER

3.6. Trenching costs

3.6.1. Measured by Producers Price Index for outputs from the civil construction industry

The best series to use for understanding long term trends in trenching costs is the Statistics New Zealand Producers Price Index for outputs of the Heavy and Civil Engineering Construction sector.

Advice to the Commerce Commission from Beca (2014) included a forecast for trenching cost inflation using Statistics New Zealand's Capital Goods Price Indices for non-residential buildings and for Heavy and Civil Engineering Construction. These are likely to be one component of trenching cost inflation but they are incomplete because these indices exclude operational costs and labour costs. The Capital Goods Price Indices only measure asset and plant and machinery prices.

In contrast, the Producers Price Index for outputs of the Heavy and Engineering Civil Construction sector measures 'factory gate' prices and captures all costs of production except taxes and subsidies.

Our recommendation to use the Producers Price Index for outputs of the Heavy and Civil Engineering Construction sector is based on the kinds of firms which feature in the Heavy and Civil Engineering sector:

Heavy and civil engineering firms specialise in large infrastructure projects such as roads, dams, tunnels, and telecommunications and electricity networks. The sub-sector has 35 large firms (employing more than a hundred people) and these account for 72% of employment, or 20,000 workers. (MBIE, 2013)

3.6.2. Trends in heavy and civil engineering output prices

We expect long term trend growth in trenching costs is expected to be 3.3%. This is slightly lower than trend rates of inflation of the past but higher than expected trend rates of producer and consumer price inflation (2.0%) and higher than the trend growth value forecast in Beca (2014) of 3.0%.

Our forecast of trend growth (see Table 10) is based on estimated (econometric) long run relationships between annual average growth in the Producers Price Index for outputs of the Heavy and Engineering Civil Construction sector and two predictive series:

- general inflation in operating costs captured in the Producers Price Index for inputs purchased by all sectors
- labour costs captured by the Labour Cost Index for the construction sector.

Table 10 PPI Heavy and Civil Engineering trends

Growth rates are average annual

Measure	Value
Suggested trend growth	3.3%
Historical average PPI Heavy and Civil Engineering	3.2%
Deterministic trend	3.8%
Stationary?	I(1), KPSS and ADF
Cointegrated with PPI and LCI	Yes
Relationship to PPI – inputs for all sectors	0.54
Relationship to LCI – construction	0.93
Annual historical average of PPI growth	2.6%
Expectation of PPI growth in future	2.0%
Annual historical average of LCI - construction growth	2.2%
Expectation of LCI - construction growth in future	2.3%
Implied trend growth rate for PPI civil, given historical trends	3.5%
Forecast trend given historical trends and expectations of PPI and LCI - construction growth	3.3%

Source: NZIER

Cost inflation in civil construction can be and has been sustainably above general inflation in the economy (see Figure 13). One factor driving relatively high rates of inflation in civil construction is the fact that much of the sector is non-tradable (locally based services). Relative to tradable goods, non-tradable goods and services face less competitive pressure and this promotes comparatively high wage inflation without productivity gain.²⁹

That said, it is important to note that inflation in the Producers Price Index for outputs of the Heavy and Civil Engineering Construction sector is not necessarily ‘exogenous’ to (i.e. unaffected by) the decisions of regulators including decisions that the advice in this report is intended to support.

The majority of projects in the Heavy and Civil Engineering Construction sector have costs set by regulators or centralised local and national government purchasers using price indices published by Statistics New Zealand – for the purposes of setting capital expenditure allowances or indexing contracts. The market for civil engineering construction is also dominated by a relatively small number of suppliers and risk-averse purchasers.

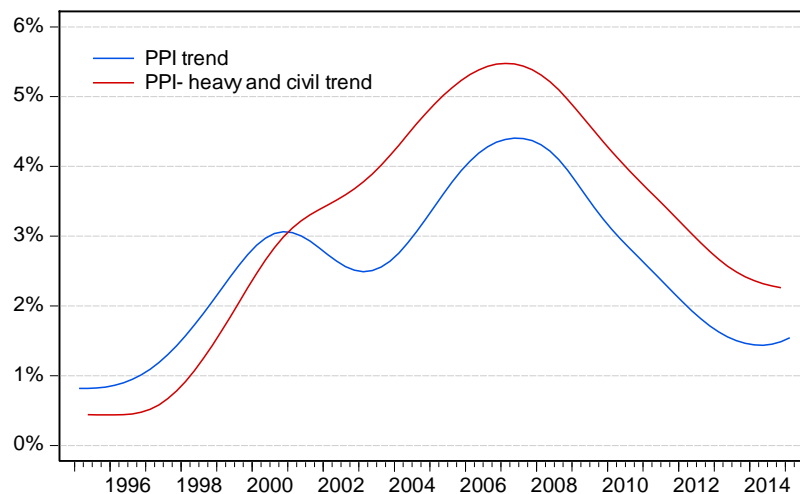
²⁹ In macroeconomics these dynamics are known as ‘Balassa-Samuelson effects’ – an explanation for persistent price differentials between regions and countries based on local labour or firms in high productivity regions demanding a wage premium despite being in sector’s with only average productivity. See e.g. Balassa (1964). This is also similar to ‘Baumol’s cost disease’ which explains that some industries do not achieve productivity gains but will nonetheless maintain or even increase their share of income and consequently have rapid price or cost inflation. This was first described in Baumol and Bowen (1966).

Given these distinctive characteristics of the Heavy and Civil Engineering Construction sector it is likely that output price inflation in the sector is affected by regulatory decisions about cost inflation.

Nonetheless, it is a fact that government regulation and purchasing does use Statistics New Zealand cost indices – including Heavy and Civil Engineering Construction sector indices – to set prices and cost allowances. The best measure of inflation or price trends is therefore the relevant sector-specific price index even if the systematic use of this index by government agencies creates a self-fulfilling forecast.³⁰

Figure 13 High cost inflation in heavy and civil engineering

Annual growth in underlying trend (Hodrick-Prescott filter)



Source: NZIER

³⁰ If government decisions about cost escalation could be sufficiently coordinated, it would be wise to index costs according to underlying measures of inflation such as a generalised labour cost index. This would help to sever the link between actual cost escalation and expectations of cost escalation used by government agencies and regulators. In the absence of such coordination, indexing cost to alternative general measures would simply understate reasonable expectations for cost inflation.

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