# MEMO

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| **To** | Johnny Findlay, Chorus |
| **From** | Eilya Torshizian, NZIER |
| **Date** | 31 March 2020 |
| **Subject** | Description of Chorus Price Index information |

## Summary

This note provides a short (technical) description of the methodologies used to produce the forecasts for the cost escalation series, which will be used in Chorus's base capital and operating expenditure proposal to the Commerce Commission.

The forecasts will be used to convert forecast expenditure in 2020/2021 dollar values ('real' expenditure) to expenditure valued in the dollars of the forecast year ('nominal expenditure'). This will include adjustments for:

- changes in the Consumer Price Index (CPI) reflecting economy-wide price increases; plus

- 'real price effects' (RPE), reflecting the difference between CPI changes and changes in prices of the inputs relevant to Chorus expenditure areas.

For this purpose, Chorus and NZIER have:

- identified cost areas requiring RPE adjustment

- selected indices most relevant to the cost area to benchmark RPE adjustment rates

- produced forecasts of the identified indices.

# 1       Relevant indices

We have established frameworks to identify categories of costs to be escalated and indices to be used to benchmark these costs.

The identification of categories of costs to be escalated is based on a cost's:

- size

- similarity to other costs

- volatility.

Indices to be used to benchmark costs are selected based on whether they:

- capture price effects and not quality changes

- reflect general market conditions

- are relevant to the firm's business and costs

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- are practical to produce and forecast.

## 1.1    Narrowly focused indices

We have identified nine narrowly defined price indexes for most of the operational and capital expenditure categories provided by Chorus as listed in Table 5 (operational expenditure), Table 6 and Table 7 (capital expenditure).

The indices that we identified were relevant are:

- Operating expenditure:
  - Labour Cost Index (LCI) for the 'Professional and Technical Services', 'Information Media and Telecommunications' and Administrative and Support Services' sub-groups
  - Producers Price index (PPI) published output commodities 'Electricity: commercial consumers' and 'Rent of commercial land and buildings'
- Capital expenditure :
  - LCI 'Professional and Technical Services', 'Construction' and 'Administrative and Support Services'
  - PPI outputs 'Heavy and Civil Engineering Construction', 'Non-Residential Property Operation' and possibly[1] 'Electronic and Electrical Equipment Manufacturing'
  - USA Producer Price Index by Industry: 'Fiber Optic Cable Manufacturing'
- Hybrid expenditure:
  - PPI published output commodities 'Rent of commercial land and buildings'
  - USA Producer Price Index by Industry: 'Fiber Optic Cable Manufacturing'.

We have not identified price indices for 'software licences', 'software maintenance contracts' or 'software as a service (software in the cloud)' (SaaS). The change in the prices of these services (for a given quality of service) is a complex mixture of increases in labour costs (usually faster than the CPI), declines in hardware costs (often faster than the change in labour costs) and the business model of the supplier.

We have also not identified an index for 'Payments to RSPs to use their poles' but suggest that this could be based on either the 'typical price change clause' in the Chorus lease contract or a general measure of the rate of inflation such as the change in CPI.

Since we did not find any robust predictors to provide forecasts for "PPI - Published output commodities 'Electricity: commercial consumers'" and "PPI Outputs 'Non-Residential Property Operation'", we choose "Producers Price Index – Outputs for all industries (PPI-O All industries)" as the more broad relevant index.

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[1]    New Zealand indices are unlikely to be granular enough to accurately measure price changes in hardware such as optical network terminals (ONT) or the cost of network hardware servicing.

## 1.2 Regulator and experts prefer broadly based indices

However the expert advice provided to the Commerce Commission on price trends for broadband services[2] suggests:

- Use of a smaller number of more aggregated indices for labour costs – LCI all groups rather than the four sub-groups identified in the table.

- Assessment of the correlation between particular price indices and the CPI so that CPI trend forecasts can be used to forecast the trends in New Zealand price indices.

Overall the classification of expenditure by Chorus for network operating and capital expenditure are much more granular than the indexes applied by:

- The Commerce Commission to electricity distribution businesses (EDBs)

- Published information on the regulation of NBN Co Australia or UK broadband network providers

# 2 Methodology used for forecasts

The labour cost forecast models make use of three inputs from NZIER's regular forecasts and forecast models:

- forecasts of the all-sectors, all salary and wage rates LCI

- forecasts of GDP

  − short term forecasts based on sector- and expenditure-specific cycles in economic activity

  − long term forecasts based on labour force growth and trend historical multifactor productivity growth

- long term trends in industry-specific GDP forecasts based on a descriptive (Vector Auto-Regression) model of trend shares of GDP by industry.

## 2.1 LCI All Industries

The forecast of the LCI All Industries is determined jointly with other key measures of macroeconomic activity. The forecasts are produced through an iterative forecast process that considers both demand and supply aspects of the macroeconomy, institutional settings and economic shocks to global demand or local supply.

The forecast can be accurately described as having both a long term trend component and a cyclical component. The trend component is forecast using the relationship between CPI inflation and overall wage inflation.

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[2]   'Price Trends for UCLL and UBA final pricing principle, Advice on response to submissions, NZIER report to the Commerce Commission, May 2015' available at https://comcom.govt.nz/__data/assets/pdf_file/0027/60678/NZIER-Price-Trends-for-UCLL-and-UBA-final-pricing-principle-2-November-2015.PDF

## 2.2 LCI Electricity, Gas and Water (EGW) forecast model

The LCI EGW is forecast using an econometric model with two parts:

- a model of the long term trend in the LCI EGW as a function of all-sectors, all salary and wage rates LCI and population growth (a generalised demand measure of EGW industry output)

- a model of short run and cyclical movements in the LCI EGW as a function of changes in net migration and the EGW industry output gap.

Output gaps, for EGW and all other sectors forecast here, are constructed from a (Hoddrick Prescott) filtered trend of industry activity around which cycles can be measured. These cycles dissipate over time leaving our forecasts to be based on long term trends.

The LCI trend model shows the LCI EGW grows at rates of around 60% faster than economy-wide labour costs.

## 2.3 LCI Construction forecast model

The LCI Construction is forecast using the same general approach as for LCI EGW. That is, an econometric model with two parts:

- a model of the long term trend in the LCI Construction as a function of all-sectors, all salary and wage rates LCI and population growth as a generalised construction demand measure

- a model of short run and cyclical movements in LCI Construction as a function of changes in net migration and the construction industry output gap.

The model fit implies that construction sector labour costs rise, on average, at 130% of the rate of the general LCI. This is higher than for EGW. Population changes also have a more marked effect on cost escalation than in the case of EGW.

## 2.4 LCI professional and technical services

The LCI Professional and Technical Services forecast is based on a model of the trend relationship with the all-sectors, all salary and wage rates LCI.

## 2.5 PPI outputs: All industries

The PPI-outputs index for all industries is forecast using an iterative forecast process that considers both demand and supply aspects of the macroeconomy, institutional settings and economic shocks to global demand or local supply.

The forecast can be accurately described as having both a long term trend component and a cyclical component. The trend component is forecast using the relationship between CPI and overall PPI inflation.

## 2.6 PPI outputs: Heavy and Civil Engineering, PPI - Published output commodities 'Rent of commercial land and buildings' and 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing'

The three PPI series is forecast using an econometric model with two parts:

- a model of the long term trend in the PPI-outputs index for the series as a function of all-sectors Producers Price Index for inputs and the LCI Construction
- a model of short run and cyclical movements in the PPI-outputs index for Heavy and Civil Engineering as a function of changes in net migration, the construction sector output gap, and the sector output gap.

## 2.7 USA Producer Price Index by Industry: Fiber Optic Cable Manufacturing

To provide forecasts for the price index, we used the relationship between the (four) lags of copper prices to predict the growth of the 'USA Producer Price Index by Industry: Fiber Optic Cable Manufacturing'. The relationship was significant and negative with a high predictive power (Adj_r2 = 0.93).

## 2.8 CPI and foreign exchange rate

Forecasts of the (All group) CPI, used to translate our forecasts to Real Price Effect (RPE) rates. The source of CPI data is Stats NZ.

The exchange rate is used to convert international (US dollar) prices to New Zealand dollar prices. The source of the exchange rate data is Reserve Bank of New Zealand.

# Appendix A Econometric model statistics

## Table 1 LCI EGW model

**Trend equation**

| Dependent Variable: LN(LCI_EGW) | | | | |
| --- | --- | --- | --- | --- |
| Method: Fully Modified Least Squares (FMOLS) | | | | |
| Sample (adjusted): 1994Q1 2019Q3 | | | | |
| Explanatory variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LN(LCI_All) | 1.61 | 0.098 | 16.54 | 0.00 |
| LN(Population(-4)) | -1.16 | 0.201 | -5.77 | 0.00 |
| C | 13.42 | 2.395 | 5.60 | 0.00 |
| R-squared | 0.9967 | Mean dependent var | | 6.7936 |
| Adjusted R-squared | 0.9968 | S.D. dependent var | | 0.1704 |

**Cycle equation**

| Dependent Variable: Residual from trend equation | | | | |
| --- | --- | --- | --- | --- |
| Method: Least Squares | | | | |
| Sample (adjusted): 1994Q4 2019Q3 | | | | |
| Explanatory variable | Coefficient | Std. Error | t-Statistic | Prob. |
| NetMigration(-4) | 1.8E-07 | 3.9E-08 | 4.2E+00 | 1.1E-04 |
| EGWGap(-3) | 2.4E-02 | 1.2E-02 | 1.9E+00 | 6.7E-02 |
| AR(1) | 9.5E-01 | 3.3E-02 | 2.9E+01 | 0.0E+00 |
| R-squared | 0.95 | Mean dependent var | | 0.0005 |
| Adjusted R-squared | 0.95 | S.D. dependent var | | 0.0058 |

Source: NZIER

## Table 2 LCI construction model

**Trend equation**

| Dependent Variable: LN(LCI_Construction) | | | | |
|---|---|---|---|---|
| Method: Fully Modified Least Squares (FMOLS) | | | | |
| Sample (adjusted): 1997Q1 2019Q3 | | | | |
| Explanatory variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LN(LCI_All) | 1.408 | 0.051 | 25.7 | 0.00 |
| LN(Population(-16)) | -0.418 | 0.11 | -3.82 | 0.00 |
| C | 4.191 | 1.25 | 3.32 | 0.00 |
| R-squared | 0.993 | Mean dependent var | | 6.97 |
| Adjusted R-squared | 0.992 | S.D. dependent var | | 0.21 |

**Cycle equation**

| Dependent Variable: Residual of trend equation | | | | |
|---|---|---|---|---|
| Method: Least Squares | | | | |
| Sample (adjusted): 1997Q2 2019Q3 | | | | |
| Explanatory variable | Coefficient | Std. Error | t-Statistic | Prob. |
| ConstructionGap | 0.013 | 0.005 | 1.82 | 0.066 |
| NetMigration(-4) | -0.0000001 | 0.001 | -3.91 | 0.001 |
| AR(1) | 0.85 | 0.045 | 20.99 | 0.000 |
| R-squared | 0.915 | Mean dependent var | | 0.000 |
| Adjusted R-squared | 0.902 | S.D. dependent var | | 0.005 |

Source: NZIER

## Table 3 LCI Professional and technical services model

| Dependent Variable: LN(LCI_Professional) | | | | |
|---|---|---|---|---|
| Method: Dynamic Least Squares (DOLS) | | | | |
| Sample (adjusted): 2008Q4 2019Q3 | | | | |
| Explanatory variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LN(LCI_All) | 1.23 | 0.02 | 56.2 | 0.00 |
| C | -1.94 | 0.17 | -12.5 | 0.00 |
| R-squared | 0.98 | Mean dependent var | | 6.96 |
| Adjusted R-squared | 0.99 | S.D. dependent var | | 0.02 |

Source: NZIER

## Table 4 PPI heavy and civil engineering outputs model

**Trend equation**

| Dependent Variable: LN(PPI_CIVIL) | | | | |
|---|---|---|---|---|
| Method: Fully Modified Least Squares (FMOLS) | | | | |
| Sample (adjusted): 1995Q1 2019Q3 | | | | |
| Explanatory variable | Coefficient | Std. Error | t-Statistic | Prob. |
| LN(PPI_inputs) | 0.482 | 0.039 | 12.42 | 0.00 |
| LN(LCI_construction) | 0.961 | 0.044 | 21.72 | 0.00 |
| C | -3.11 | 0.062 | -50.02 | 0.00 |
| R-squared | 0.98 | Mean dependent var | | 6.70 |
| Adjusted R-squared | 0.98 | S.D. dependent var | | 0.22 |

**Cycle equation**

| Dependent Variable: Residual of trend equation | | | | |
|---|---|---|---|---|
| Method: Least Squares | | | | |
| Sample (adjusted): 1995Q2 2019Q3 | | | | |
| Explanatory variable | Coefficient | Std. Error | t-Statistic | Prob. |
| ConstructionGap | 0.0012 | 0.00001 | 38.2 | 0.00 |
| ProfessionalGap | 0.000033 | 0.00001 | 1.43 | 0.05 |
| NetMigration(-4) | -0.00000006 | 0.00001 | -1.32 | 0.21 |
| AR(1) | 0.956 | 0.01 | 4.42 | 0.00 |
| R-squared | 0.98 | Mean dependent var | | 0.00 |
| Adjusted R-squared | 0.97 | S.D. dependent var | | 0.01 |

Source: NZIER

## Table 5 Operational expenditure price indices

Proposed narrow price index measure

| Area | Breakdown of activities/inputs | Narrow index |
|---|---|---|
| **Network** | Rent | PPI - Published output commodities 'Rent of commercial land and buildings' |
| | Rates | |
| | Electricity | PPI - Published output commodities 'Electricity: commercial consumers'. PPI-O All industries used for forecasts* |
| | Field technicians (standard, external) | LCI 'Information Media and Telecommunications' or 'Professional and Technical Services' |
| | Project management (internal) | LCI 'Information Media and Telecommunications' or 'Professional and Technical Services' |
| **Technology** | Software maintenance contracts | |
| | Software as a service (software in the cloud) | |
| | Network electronics service agreements | Possibly 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing' |
| | IT technical staff (internal) | LCI 'Information Media and Telecommunications' or 'Professional and Technical Services' |
| | IT project management (internal) | LCI 'Information Media and Telecommunications' or 'Professional and Technical Services' |
| **Business support** | Various types of internal staff costs | |
| | Legal | LCI 'Professional and Technical Services' |
| | Accounting | LCI 'Professional and Technical Services' |
| | Communications | LCI 'Professional and Technical Services' |
| | Product design | LCI 'Professional and Technical Services' |
| | Marketing | LCI 'Professional and Technical Services' |
| | Strategy | LCI 'Professional and Technical Services' |
| | Customer experience | LCI 'Professional and Technical Services' |
| | Human resources | LCI 'Professional and Technical Services' |

Source: NZIER

## Table 6 Capital expenditure price indices

Proposed narrow price index measure

| Area | Breakdown of activities/inputs | Narrow measure |
|---|---|---|
| **IT Capex** | IT technical staff (internal) | LCI Professional and Technical Services |
| | IT project management (internal) | LCI Professional and Technical Services |
| | Software licences | |
| **NGA connections** | In-property hardware (e.g. ONTs) | Possibly 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing' |
| | Field technicians (standard, external) | LCI 'Professional and Technical Services' |
| | Fibre | USA Producer Price Index by Industry: Fiber Optic Cable Manufacturing |
| **POA connections** | In-property hardware (e.g. ONTs) | Possibly 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing' |
| | Field technicians (standard, external) | LCI 'Professional and Technical Services' |
| | Fibre | USA Producer Price Index by Industry: Fiber Optic Cable Manufacturing |
| **Network electronics** | IT technical staff (internal) | LCI 'Professional and Technical Services' |
| | Network electronics hardware | Possibly 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing' |
| | Network electronics service agreements | Possibly 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing' |
| **Greenfield expansion** | Ducts | PPI Outputs 'Heavy and Civil Engineering Construction' |
| | Field technicians (standard, external) | LCI 'Professional and Technical Services' |
| | Fibre | USA Producer Price Index by Industry: Fiber Optic Cable Manufacturing |
| | Civil labour (digging) | PPI Outputs 'Heavy and Civil Engineering Construction' |

Source: NZIER

## Table 7 Capital expenditure price indices

Proposed narrow price index measure

| Area | Breakdown of activities/inputs | Narrow measure |
|---|---|---|
| **Fibre extension and enhancements** | Fibre | USA Producer Price Index by Industry: Fiber Optic Cable Manufacturing |
| | Ducts | PPI Outputs 'Heavy and Civil Engineering Construction' |
| | Civil labour (digging) | LCI 'Construction' or PPI Outputs 'Heavy and Civil Engineering Construction' |
| | Network electronics hardware | Possibly 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing' |
| | Field technicians (standard, external) | LCI 'Professional and Technical Services' |
| **IFRS15 customer** | IT technical staff (internal) | LCI 'Professional and Technical Services' |
| | Call centre staff | LCI 'Administrative and Support Services' |
| **Poles Capex** | Field technicians (higher spec, external) | LCI 'Professional and Technical Services' |
| | Payments to RSPs to use their poles | |
| **Network sustain** | Civil labour (digging up roads) | LCI 'Construction' or PPI Outputs 'Heavy and Civil Engineering Construction' |
| | Field technicians (standard, external) | LCI 'Professional and Technical Services' |
| | Replacing equipment | Possibly 'PPI Outputs 'Electronic and Electrical Equipment Manufacturing' |
| **Building and services** | Building maintenance | PPI Outputs 'Non-Residential Property Operation'.* PPI-O All industries used for forecasts |
| | Building services | PPI Outputs 'Non-Residential Property Operation'.* PPI-O All industries used for forecasts |
| **Hybrid** | Site leases | PPI - Published output commodities 'Rent of commercial land and buildings' |
| | Fibre leases | USA Producer Price Index by Industry: Fiber Optic Cable Manufacturing |

Source: NZIER