NEW ZEALAND INSTITUTE OF ECONOMIC RESEARCH

Cost escalation forecasts

Frameworks, forecasts and forecast methods

NZIER report to Transpower, June 2014

Update of October 2013 report

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Summary

The purpose of this report is to provide forecasts of cost escalation and to describe the methodologies used to produce the forecasts. The forecasts are to be used in Transpower's base capital and operating expenditure proposal to the Commerce Commission.

Transpower's expenditure proposal will cover the five year period from 1 July 2015 to 30 June 2020.

The forecasts will be used to convert forecast expenditure in 2012/13 dollar values ('real' expenditure) to expenditure valued in the dollars of the forecast year ('nominal expenditure'). This conversion includes an adjustment for:

- changes in the Consumers Price Index (CPI)[1] reflecting economy-wide price increases plus
- 'real price effects' (RPE), reflecting the difference between CPI changes and changes in prices of inputs of particular relevance to Transpower.

The forecasts in this report are to inform the real price effects. All forecasts are inclusive of inflation.

We have:

- identified costs requiring RPE adjustment
- selected indices to benchmark RPE adjustment rates
- produced forecasts of the identified indices.

Frameworks

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

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
- are practical to produce and forecast.

Labour costs

Four categories of labour costs were identified for cost escalation based on the size of expenditure and similarity of cost drivers in each cost category.

[1] Changes in the CPI are forecast using the Commerce Commission's methodology, which involves extrapolation of Reserve Bank forecasts. See Commerce Commission (2012) 'Transpower Capital Expenditure Input Methodology Determination', 31 January 2012, clause 1.1.5.

These costs are indexed by Statistics New Zealand labour cost indices (LCIs). LCIs are chosen because they are adjusted for the composition of labour and therefore capture price effects and not quality changes.

The LCIs that are chosen are industry level indices. Industry level indices were chosen because they reflect costs faced by Transpower while being sufficiently high-level to capture market conditions.

'Operating expenditure grid labour - maintenance contractors' is indexed to the 'LCI, All industries' as Transpower's maintenance contracts are indexed on this basis.

The LCIs are forecast using econometric models which capture two effects:

- the extent to which trend labour costs tend to rise more quickly in some industries than in the economy as a whole
- cyclical cost pressures.

Labour cost escalation factors

Cost item	Applied to	Index measure	Forecast method	Growth[2] 2013-2020
Grid Opex Labour	Labour for Routine maintenance and maintenance projects portfolios	LCI All industries	Econometric time series model	2.2%
Grid Base Capex Labour	Labour for Grid Base Capex portfolios	LCI Construction	Econometric time series model	2.2%
IST labour	Labour for IST base capex and opex portfolios	LCI Professional and Technical Services industry	Econometric time series model	2.5%
Departmental labour	Departmental labour – excludes labour capitalised to projects	Labour cost index (LCI) for Electricity, Gas and Water industry (LCI EGW)	Econometric time series model	2.2%

Metals

Four metals are selected for escalation. These are presented as individual cost items because of their size and volatility.

International prices are chosen to index metals prices as these reflect general market conditions.

Forecasts of metals prices are based on futures market prices, mid-points of international consensus forecasts, and World Bank metals and minerals forecasts.

Construction costs

The Producers Price Index – Outputs (PPI-O) for Heavy and Civil Engineering has been selected for indexing construction costs. Construction costs are a large component of base capital expenditure. The selected price index is a generalised representation of the price of the specialist mixture of services provided by the civil construction industry for Transpower's capital works.

The PPI for Heavy and Civil Engineering is forecast using an econometric model which captures:

2 Average of annual growth rates.

- trend inflation due to trends in input costs
- cyclical cost pressures.

IST software and hardware

Information Services and Technology expenditure (IST) on hardware and software is indexed to the All groups CPI. The CPI is a very general measure of inflation. More specific indices do not adequately capture differences between price effects and quality changes. Prices tied to an exchange rate also require adjustment to account for exchange rate movements.

Metals and other cost escalation factors

Cost item	Applied to	Index measure	Forecast method	Growth 2013-2020, US dollars	Growth 2013-2020, NZ dollars[3]
Copper	Base capex and maintenance projects	LME copper price (US$/mt)	Futures prices and average of market consensus	-1.4%	1.2%
Aluminium	Base capex and maintenance projects	LME aluminium price (US$/mt)	Futures prices and average of market consensus	3.4%	6.1%
Steel	Base capex and maintenance projects	Hybrid of World Bank steel price index and Asia Hot-Rolled Coil (HRC) US$/t	Median of market consensus	4.8%	7.6%
Other metals	Base capex and maintenance projects	World Bank Metals & Mineral Price Index	World Bank forecast	0.5%	3.2%
Construction	Base capex and maintenance projects	Producers Price Index – Outputs, for Heavy and Civil Engineering Industry	Econometric time series model	--	3.9%
IST hardware and software	IST base capex and opex portfolios	All groups CPI	Extrapolation of RBNZ forecast	--	2.0%

3 Exchange rate assumptions, used to convert US dollar prices to NZ dollar prices, are an average of bank forecasts.

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1. Introduction

The purpose of this report is to provide forecasts of input cost inflation faced by Transpower and to describe the methodology used to produce the forecasts.[4]

The forecasts are to be used to inform Transpower's base capital and operating expenditure proposal to the Commerce Commission. Transpower's proposal will cover the five year regulatory control period between 1 July 2015 and 30 June 2020 (RCP2).[5]

Expenditure included in the RCP2 proposal is to be expressed in the dollars of the year in which the expenditure occurs ('nominal expenditure'). The forecasts will be used to convert forecast expenditure based on 2012/13 dollar values ('real' expenditure) to nominal values. This conversion includes an adjustment for:

- changes in the Consumers Price Index (CPI) reflecting economy-wide price increases plus
- 'real price effects', reflecting the difference between CPI changes and changes in input prices of particular relevance to Transpower.

The forecasts in this report are to inform real price effects.

Changes in the CPI are forecast using the Commerce Commission's methodology, which involves extrapolation of Reserve Bank forecasts.[6]

We have been asked to:

- identify Transpower's operating expenditure and base capital expenditure input costs to be considered for escalation
- find indexes that best measure cost escalation for those input costs
- forecast each index out to June year 2020.

The report is set out as follows:

- section 2 describes our analytical framework
- section 3 sets out costs identified for escalation
- section 4 discusses the indices used to analyse and forecast cost escalation
- section 5 provides forecasts of selected indices and documents forecast methods.

This version of our report updates a previous version dated October 2013. This version provides additional material in section 4.3.2 to clarify our advice on exchange rate adjustment of IST purchases and in section 5.2.1 to clarify the reasoning behind our chosen forecast method for metals prices.

4 The NZIER forecasts in this report were finalised on 31 July 2013 based on data available as at 17 July 2013. RBNZ CPI forecasts used in this report were released on 12 September 2013.

5 All references in this report to years are years ending 30 June unless otherwise stated. The proposal uses forecasts of cost escalation for the period leading up to RCP2, 1 July 2013 to 30 June 2015. Thus, the forecasts in this report are for the years ending 30 June from 2014 to 2020.

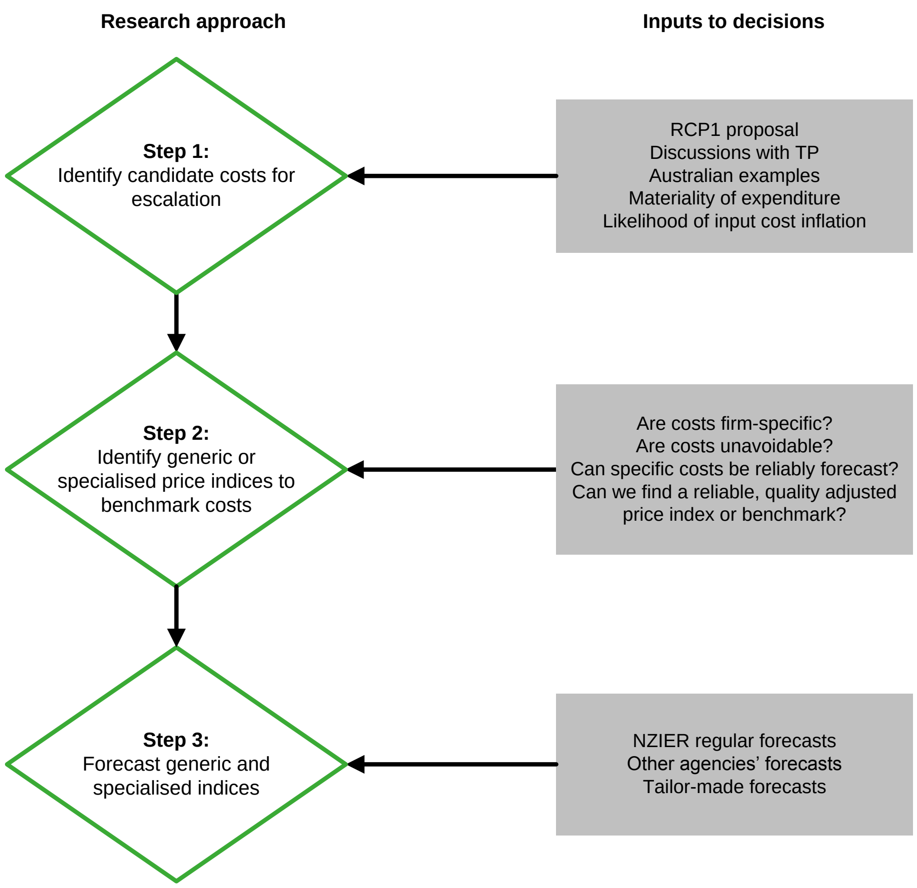
6 Commerce Commission (2012) 'Transpower Capital Expenditure Input Methodology Determination', 31 January 2012, clause 1.1.5

2. Cost escalation forecasting framework

Our framework for forecasting cost escalation factors for RCP2 is summarised in Figure 1. It consists of three steps:

- **Identifying categories of costs** to be subject to cost escalation analysis
- **Identifying indices of cost inflation** that can reasonably be used to understand historical and future inflationary pressure
- **Constructing forecasts** of the indices identified in step 2.

Figure 1 Forecasting framework



Source: NZIER

2.1. Identifying candidate costs

2.1.1. Guiding principles

The selection of costs for escalation is based on an assessment of materiality.

Materiality is assessed in terms of the value at risk from cost escalation. This is a function of a cost's:

- size
- similarity to other costs
- volatility.

Size means share of expenditure.

Similarity means categories of cost that can be reasonably grouped together based on being subject to similar cost escalation drivers.

The need to consider similarity also arises because:

- size is a function of the way that costs are categorised, for example:
  - labour costs may be small if parcelled into distinct functional categories or large if grouped into a single category
  - grouping unrelated costs together may make the costs seem large when in fact they are small and distinct and of limited materiality
- the risks of cost inflation may be correlated, for example shortages of particular categories of skilled labour will affect multiple functional cost categories.[7]

Volatility is an important consideration because risk comes from the potential size of changes to costs in addition to the size of costs.

2.2. Identifying cost indices

2.2.1. Guiding principles

The objective of this part of the forecasting framework is to identify benchmarks or reference prices that can be used to understand how cost inflation has occurred in the past and how it may evolve in the future. Four ideal attributes for any such indices or reference prices are that they:

- capture price effects and not quality changes
- reflect general market conditions
- are relevant to the firm's business and costs
- are practical to produce and forecast.

These attributes are not always correlated: indices don't always display all of the desired features, so some trade-offs are required.

[7] Grouping similar cost items also has the benefit of minimising the number of cost items that require analysis, increasing the tractability and transparency of the cost escalation process.

The most important element is that price and not quality effects are captured. For example, if a product of inferior quality comes to dominate the market then observed (unadjusted) market prices may fall and yet expenditure may need to increase if producers have to buy more of the product to offset declining quality. The reverse may also be true when quality improves.

Indices should ideally reflect general market conditions and unavoidable price inflation rather than specific price changes which can be avoided by substituting away from particular products. For example, if desktop phones are becoming more expensive a mobile phone might do the job for a lower price, in which case there is little value in adjusting for the rising cost of desktop phones.

The need for relevance may, however, commend specificity over generality. This will be the case where a company has a need for a particular product for which there is no technical alternative. These are rare but a commodity like copper provides one such example.

Where general indices are not relevant to Transpower's operations we employ alternative specific measures of price effects. Table 1 below summarises the high-level benefits and risks from choosing specific or general price measures.

The need for practicality reflects the ultimate objective of producing workable estimates of cost escalation. In some cases a cost may be observable and measurable but does not have a readily usable statistical history or widely used benchmark upon which to gauge cost trends and forecasts.

Table 1 Trading off generality and relevance

	Benefits	Risks
General measure	Reflects 'unavoidable' generalised cost inflation. Smooth out volatility of individual cost components.	May not adequately reflect a producer's input cost profile and may therefore *systematically* over- or under-compensate by including or putting too much weight on extraneous sources of cost inflation.
Specific measure	Ability to target/escalate very specific costs of particular or peculiar importance to the firm which are otherwise not accounted for by a general index.	May not adequately consider cost mitigation options so it does not necessarily reflect 'unavoidable' cost inflation.

Source: NZIER

3. Costs to be escalated

This section sets out the process we used to select costs to be escalated and the categories of operating and base capital expenditures selected for escalation.

3.1. Process for identifying costs for escalation

To identify material cost items and categories we:

- reviewed Transpower's aggregate recent and forecast operating and base capital expenditure
- considered costs commonly escalated in comparable Australian transmission providers
- sought the views of Transpower staff on key cost drivers, likely material categories of cost in the future and risky or volatile costs
- reviewed Transpower's proposal for RCP1 and supporting documentation
- examined the volatility of historical commodity price movements.

3.2. Operating expenditure to be escalated

For operating expenditure we determined that:

- labour-related costs are the largest expenditure item, and require escalation based on three different groupings with distinct cost drivers
  - IST maintenance and operations, consultants and contractors
  - grid maintenance contractors
  - 'other labour costs' comprising all other costs, principally departmental expenditure (direct personnel costs and third party costs)[8]
- lease costs (e.g. building and fibre leases) are not sufficiently material or volatile for escalation purposes
- insurance costs will be dealt with in a separate process.

[8] These are non-capitalised internal labour costs. IST and Grid operating expenditure is excluded.

3.3. Capital expenditure to be escalated

For capital expenditure we identified five material categories of cost requiring escalation:

- metals are collectively a material share of expenditure and the volatility of individual prices means that metals should be considered individually:
  - copper
  - aluminium
  - steel
  - other metals
- construction costs are a large share of expenditure and are commonly considered for escalation in Australia[9]
- grid labour costs are a material share of expenditure[10]
- IST labour costs are a material share of expenditure
- IST hardware and software costs are a material share of expenditure.

3.4. Cost categories for indexation and forecasting

The identification of costs shows common categories which cut across both capital expenditure and operating expenditure. The largest such category is labour costs. To promote clarity and comparability we have grouped costs according to:

- labour
  - grid operating expenditure labour
  - grid base capital expenditure labour
  - IST labour operating expenditure and base capital expenditure
  - departmental labour
- metals
  - copper
  - aluminium
  - steel
  - other metals
- other
  - construction costs
  - IST hardware and software.

These high-level cost categories are used to group results in sections 4 and 5.

[9] This cost category, referred to as 'civils/other' in RCP1, was not subject to RPE escalation in RCP1.

[10] Considered as a single category of cost, rather than split into components, due to practicality of matching costs and indices.

4. Choice of indices

This section sets out the indices chosen to benchmark input costs and the reasons these indices were chosen.

4.1. Labour cost indices

The indices we selected to benchmark costs are listed in Table 2. These were selected using the principles outlined in 2.1.1.

Table 2 Labour cost indices

Cost item		Index measure
Grid Opex Labour	Labour for Routine maintenance and maintenance projects portfolios	LCI all industries
Grid Base Capex Labour	Labour for Grid Base Capex portfolios	LCI Construction
IST Labour	Labour for IST base capex and opex portfolios	LCI Professional and Technical Services industry
Departmental Labour	Departmental labour – excludes labour capitalised to projects	LCI Electricity, Gas and Water industry (LCI EGW)

Source: NZIER

Industry-based Labour Cost Index (LCI) measures are chosen to benchmark the different components of labour costs.[11] These indices are generalised measures of cost (price) increase for a fixed quality of labour.

We choose industry-specific LCI measures to ensure the indices reflect labour costs and market dynamics of relevance to cost escalation faced by Transpower:

- the Electricity Gas and Water industry (EGW) LCI is chosen to benchmark departmental labour because
  - a more general LCI would be too heavily weighted towards expertise of no relevance to Transpower
  - using more specific measures[12] would require multiple indices which would most likely not reflect general market conditions
  - available indices do not allow us to distinguish between changes in composition of labour versus changes in cost (price)
- the All industries LCI measure is chosen to benchmark grid operating labour because Transpower's maintenance contracts are currently indexed to the All industries LCI

11 This differs from RCP1 in the use of the Labour Cost Index (LCI) as the key measure of labour cost. Average weekly earnings (AWOTE) is not a good measure of cost escalation because it does not distinguish between changes in the composition of labour and changes in the price of labour. The LCI typically grows more slowly than AWOTE.

12 We considered whether, for example, it would be more reasonable to use a wage index specific to electrical engineers given the central and unavoidable importance of this occupation to Transpower's business.

- The Construction industry LCI is chosen for grid base capital expenditure labour because:
  - more general indices, such as the ‘All sector combined LCI’, are not relevant to construction-related costs as construction costs follow protracted investment cycles and not necessarily economy-wide labour cost inflation[13]
  - there are no readily available (more) specific indices which allow us to distinguish between changes in composition of labour versus changes in cost (price)
  - it captures competition for labour within the wider construction sector and thus captures general market conditions rather than, for example, occupation-specific measures
- the Professional and Technical Services industry LCI is chosen for benchmarking IST labour because
  - it captures cost escalation from competition amongst professional services industries for labour and thus captures general market conditions in the New Zealand labour market[14]
  - there are no readily available (more) specific indices which allow us to distinguish between changes in composition of labour versus changes in cost (price).

We note that if maintenance contractor costs were not contractually connected to the ‘All sector combined’ LCI we would have used the Construction industry LCI to index maintenance contractor costs. The Construction industry LCI typically grows more quickly than the ‘All sector combined’ LCI. This means that Transpower’s actual unit costs for maintenance contractors are expected to rise more slowly than our forecasts of input cost inflation. The expected difference between actual costs and inflation is, in effect, an expectation of increased efficiency.

We apply a single index to base grid capital expenditure labour costs. This differs from RCP1 where base capital expenditure labour costs were split into lines and stations. We have chosen not to differentiate between different capital expenditure labour costs. This is because data needed for analysing these different labour input costs is not readily available, would be costly to construct and is unlikely to be material.

13 The LCI EGW, another general cost index, was also considered but this index would be too heavily weighted towards labour of little relevance to Transpower’s capital expenditure. The LCI EGW includes, for example, back-office administrative labour costs.

14 We investigated whether an international labour cost index was warranted. However, Transpower advised that their IST wage costs were, in their experience, generally a function of domestic market conditions.

4.2. Metals

The indices we selected to benchmark metals costs are listed in Table 3. These were selected using the principles outlined in 2.1.1.

Table 3 Metals expenditure indices

Cost item	Index measure
Copper	LME copper price (US$/mt)
Aluminium	LME aluminium price (US$/mt)
Steel	Asia Hot-Rolled Coil (HRC) US$/t [15]
Other metals	World Bank Metals & Mineral Price Index

Source: NZIER

International prices are chosen to benchmark metals. These prices are sufficiently homogeneous as not to require quality adjustment, except where an index or 'basket' of metals is required to reflect general metals inflation (for use in relation to 'other metals').

4.2.1. Copper and aluminium

London Metals Exchange (LME) US dollar prices are used to benchmark prices for copper and aluminium. This is the most common global benchmark for these metals prices.

4.2.2. Steel

The Asia Hot-Rolled Coil price is selected to benchmark steel prices. This international index captures general market conditions by focussing on the influence that international market conditions and prices have on domestic prices over the longer term (as evidenced by the observation that domestic prices track import prices).[16] Using international benchmarks also recognises that domestic production of steel is by no means certain over the long term, especially as there is an excess of production capacity globally which will limit the viability of increased domestic production.[17]

4.2.3. Other metals

Other metals costs are benchmarked against the World Bank Metals and Minerals price index. Transpower buys a variety of metals in addition to those already

[15] Identifying an appropriate international benchmark price is complicated by the fact that steel is traded under long term contracts and there are few international publicly available spot or wholesale price benchmarks (as there are for copper and aluminium). In addition, benchmarks such as the Asian HRC price have limited histories. We have analysed historical movements in prices by constructing an index which combines the World Bank Steel price index with movements in the US dollar price of Hot-Rolled Coil in Asia. The World Bank series, which was discontinued in 2012, provides an excellent reference point for understanding long term prices (stretching back to the 1960s).

[16] This was noted in a report informing RCP1 cost escalation (BIS Shrapnel, 2010) and suggests going 'straight to the source' of cost escalation rather than using a domestic index such as the Producers Input Price index for sheet and fabricated metals used in RCP1.

[17] See Chairman's statement from the 73rd meeting of the OECD Steel Committee, December 2012.

mentioned above. This variety commends the use of a very general international benchmark which can capture broad changes in costs due to fundamental shifts in global supply and demand in the metals and minerals sector.

4.3. Other costs

Table 4 Other expenditure indices

Cost item	Index measure
Construction costs	Producers Price Index – Outputs, for Heavy and Civil Engineering Industry
IST hardware and software	All groups CPI

Source: NZIER

4.3.1. Construction costs

The Producers Price Index – Outputs (PPI-O) for Heavy and Civil Engineering has been selected for indexing construction costs. This index generally reflects the mixture of labour and materials provided by the civil construction industry for Transpower's capital works.

Including a specific index for this cost item is important as civil construction is subject to industry-specific cost pressures arising from there being limited supplier competition and the market being dominated by a few large buyers (mainly government entities such as the NZ Transport Agency).

4.3.2. IT software and hardware

For non-labour IST base capital expenditure costs we use the All groups CPI index. This is a choice which balances two opposing and extreme approaches.

The first approach would be the use of a computing equipment subcomponent of a quality adjusted price index such as the CPI. These indices rightly show a continual and rapid (10% per annum) decline in the quality adjusted costs of computing equipment. A continuation of this trend is likely.

The problem with this first extreme is that quality-adjusted measures can be irrelevant. For example, a doubling of computer processing speed (a doubling of quality) does little to improve word processing work. Buyers of computing equipment cannot necessarily choose older and lower quality versions for cheaper prices – either because they are not available or because the market sets evolving standards that are costly to avoid due to compatibility or interconnection issues. In some cases, prices for specialist equipment of relevance to a particular company may be rising but this is not captured in a generalised price index where quality adjusted costs make up the majority of the index.

The other alternative is to assume that all quality adjustment is irrelevant. This would lead to a rather extreme view of costs. The quality unadjusted price of computing equipment grew by around 10% per annum in the past 3 years, according to Statistics

New Zealand.[18] Using this sort of nominal measure to benchmark costs would violate the principal that costs should reflect price changes and not quality changes.

Our considered view is that neither of these two extremes is reasonable. It would be too costly to construct a bespoke index that better approximated the degree of 'unavoidable' cost escalation or general inflation relating to IT hardware. Accordingly, we recommend the use of a very general inflation measure, the All groups CPI.

Products sourced directly or indirectly from overseas, where costs are tied to an exchange rate, also require adjustment to account for exchange rate movements, in addition to CPI indexation, as these products are exposed to potentially large exchange rate movements.

Products which are exposed to potentially large exchange rate movements include specialised capital equipment, technical software and services supplied in conjunction with these products. International markets for these products are characterised by few suppliers and prices which are tied to prices denominated in currencies other than the New Zealand dollar.

[18] Unpublished calculations provided by personal correspondence. Statistics New Zealand provided us with an estimate of the average quality adjustment for laptops and PCs which averaged 20% per annum between 2008 and 2011. From this we infer that nominal price increases have been in the order of 10% per annum.

5. Forecasts

This section describes our forecasts of the indices selected for benchmarking input cost escalation and the methods used to produce the forecasts.

5.1. Summary

Forecasts of the indices to be used for cost escalation are summarised in Table 5 and Table 6. Forecast time series of indices are provided in Appendix A.

Table 5 Forecast growth rates for labour cost indices

Growth rates are average annual growth.

Cost item	Index measure	Growth 2013-2020
Grid Opex Labour	LCI all industries	2.2%
Grid Base Capex Labour	LCI Construction	2.2%
IST Labour	LCI Professional and Technical Services industry	2.5%
Departmental labour	LCI Electricity, Gas and Water industry (LCI EGW)	2.2%

Source: NZIER

Table 6 Forecast growth rates for metals and other cost indices

Growth rates, in US dollars and in NZ dollars, are average annual growth over 7 years to 2020.

Cost item	Index measure	Growth 2013-2020, US dollars	Growth 2013-2020, NZ dollars
Copper	LME copper price (US$/mt)	-1.4%	1.2%
Aluminium	LME aluminium price (US$/mt)	3.4%	6.1%
Steel	Hybrid of World Bank steel price index and Asia Hot-Rolled Coil (HRC) US$/t	4.8%	7.6%
Other metals	World Bank Metals & Mineral Price Index	0.5%	3.2%
Construction costs	Producers Price Index – Outputs, for Heavy and Civil Engineering Industry	--	3.9%
IST hardware and software	All groups CPI	--	2.0%

Source: NZIER

The forecasts follow two general methods:

- for international metals prices we use international benchmarks such as futures prices, market consensus and World Bank forecasts

- for Labour Cost Indices and Producer Price Indices we use econometric models that connect cost escalation to domestic economy-wide trends

These methods are described in more detail in sub-sections 5.2 to 5.4 below.

5.2. Metals

The forecast method for metals prices involves using:

- futures markets prices for copper and aluminium prices 1 to 2 years ahead (futures prices are not available for steel)
- average consensus forecasts for
  - steel prices
  - copper and aluminium prices beyond futures market horizons
- World Bank forecasts to forecast the World Bank metals and minerals price index.

Forecasts have been moderated using World Bank and OECD global income growth forecasts to check that long term market positions are in line with fundamentals and to adjust the forecasts where this is not the case. The only adjustment we have made is to remove the effect of an outlier from the long run consensus steel price forecasts. We do this by using consensus median forecasts, instead of the average.

The general outlook for metals prices is flat global price growth for some time (in US dollars), at least compared to the past decade, albeit with some variation across the different metals prices we have forecast.

Table 7 Metals prices and forecasts, average growth rates

	Copper		Aluminium		Steel		Other metals	
	US$	NZ$	US$	NZ$	US$	NZ$	US$	NZ$
Last 15 years	12.2%	10.1%	3.3%	2.1%	6.9%	5.4%	9.4%	7.4%
Last 10 years	21.5%	13.9%	6.0%	-0.6%	13.5%	6.9%	16.1%	8.5%
2013-2020[19]	-1.4%	1.2%	3.4%	6.1%	4.8%	7.6%	0.5%	3.2%

Source: NZIER, World Bank, Consensus Economics, LME

5.2.1. Reasoning behind chosen forecast method

Consensus forecasts and forecast averaging

The mid-point of consensus forecasts are used to forecast prices on the grounds that these reflect a variety of different perspectives and forecast methods and consequently embody more information and better formed expectations than the forecasts of a single forecaster.

[19] 7 year average.

This is of particular importance for international forecasts where factors that affect prices differ across a large number of economies (such as differences in energy prices which are an important factor in steel and aluminium prices).

There is an extensive academic literature in econometrics and forecasting showing that combining forecast models or averaging over forecasts provides superior forecast accuracy to other methods:

> *Considerable literature has accumulated over the years regarding the combination of forecasts. The primary conclusion of this line of research is that forecast accuracy can be substantially improved through the combination of multiple individual forecasts. Furthermore, simple combination methods often work reasonably well relative to more complex combinations.*
>
> – Armstrong, J. (2001) 'Combining Forecasts' in Armstrong, J.(ed.) *Principles of Forecasting: A Handbook for Researchers and Practitioners*, Kluwer Academic Publishers.

The most widely cited paper in this literature dates back nearly 50 years[20] and the practice predates that paper by more than a hundred years. It is now a matter of convention that combining forecasts is a good approach for producing robust forecasts.[21]

To be precise, individual forecasts or forecasting methods may outperform combined forecasts in any given period – after the fact. Before the fact, the 'best' forecast or forecast approach is not known. A strategy of choosing combined forecasts has the highest probability of the lowest forecast error on average.[22]

Futures prices used for copper and aluminium price forecasts

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.[23]

Futures prices are useful for this because 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.

[20] Bates, J. and C. Granger (1969) 'Combining Forecasts', *Journal of the Operational Research Society,* no. 20, pp. 451–468.

[21] The reasons for superior performance, the uses of averaging and the techniques for combining forecast models remain an area of active research. See e.g. collected papers contributed to the Reserve Bank of New Zealand's 2008 workshop on *Nowcasting with Model Combination* *http://www.rbnz.govt.nz/research_and_publications/seminars_and_workshops/december2008/3421588.html*.

[22] See e.g. McKnees, S. (1992) 'The uses and abuses of "consensus" forecasts', *Journal of Forecasting*, no.11, pp. 703-710.

[23] Futures prices were used for forecasts from September 2013 to December 2015. Futures prices were not available beyond this period – hence the use of Consensus forecasts to extend forecasts to 2020.

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.[24] 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.[25]

Alternative forecast methods

More sophisticated approaches are possible but it is unclear if they would deliver improved forecasts for our purposes.[26] This is partly because the forecast period we are most interested in is outside the range for which we have futures prices (nominal commodity prices for the period 2015 to 2020). In effect, the futures prices provide a bridge between current spot prices and longer term prices which we forecast using Consensus forecasts.

We could have used consensus forecasts for the entire forecast period however futures prices have the benefit of being the result of large numbers of market positions and thus, implicitly, combining a large amount of information on current and near term market conditions.

In principle, futures prices could have been extrapolated beyond the end of the futures price data series instead of using consensus forecasts. One way to do this would be to assume that the end of the futures price series reflects the long run equilibrium for spot prices plus a margin to cover holding costs. This approach is based on a no-arbitrage condition.

We did not extrapolate futures prices based on the no arbitrage condition because prices over the long term are affected by a range of policy and supply and demand factors (such as trends in energy subsidies, wages and population growth) which will not be fully factored into shorter term futures prices. Using Consensus forecasts is a method which captures these kinds of long term 'structural' factors.

Extrapolating futures prices would also not resolve forecast error problems. For example, any risk premium associated with holding futures contracts will be largest over the long term as this is where differences between supply of futures and demand for futures are likely to be largest. This means that longer term futures prices are likely to be a biased estimator.

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24 These two competing effects come from conceptual models of futures prices (see e.g. Fama, E, and K. French (1987) 'Commodity Futures Prices: Some Evidence on Forecast Power, Premiums, and the Theory of Storage.' *Journal of Business*, 60(1), pp. 55-73).

25 Improvements in forecast performance are shown to be strongest when there is a large deviation between current spot prices and futures prices. See Reeve, T. and R. Vigfusson (2011) 'Evaluating the Forecasting Performance of Commodity Futures Prices', Board of Governors of the Federal Reserve System, International Finance Discussion Paper, No. 1025, August 12 2011, available at SSRN: http://ssrn.com/abstract=1912969.

26 In addition, more sophisticated methods would certainly have been more costly to produce and would be more difficult for others to understand. Transparency in forecast methods is useful whenever the forecasts need to be understood and scrutinised by others – as is the case for the forecasts contained in our October 2013 report.

It is also the case that long run global interest rates would have to be forecast and such a forecast, while often assumed to be a single stable number, would be subject to forecast error.

5.2.2. Copper prices

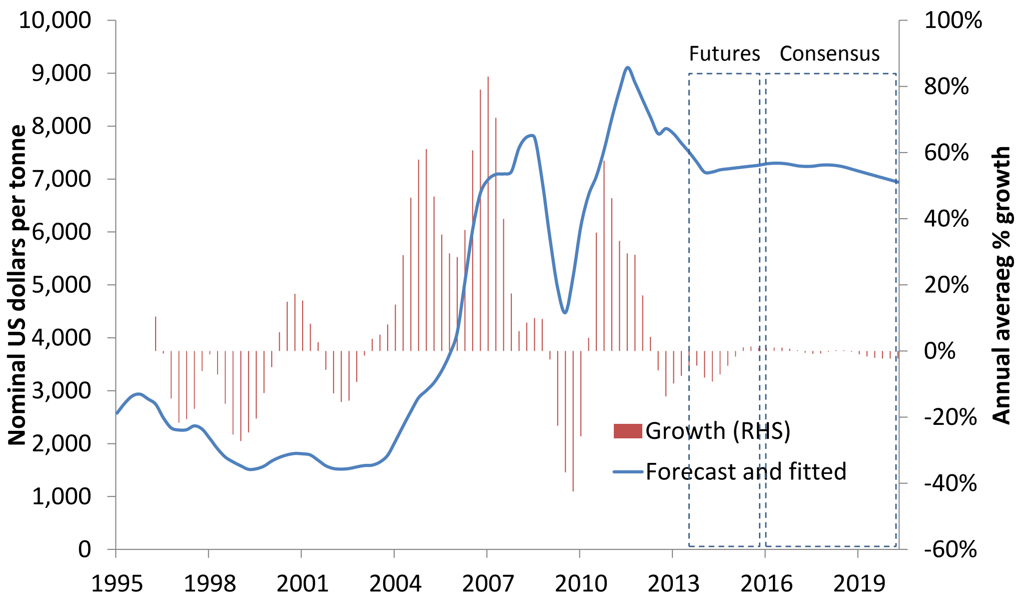
Copper prices are forecast using:

- the average of June 2013 settlement prices for copper futures on the London metals exchange for the September 2013 quarter through to the December quarter 2015
- percentage changes in the copper price according to the average of Consensus Economics consensus forecasts for March 2016 through to June 2020.

Futures market prices (2013-16) are soft to declining and have been for some time. This is linked to an expected softening in growth in manufacturing in China and a rebalancing of the Chinese economy away from investment-led growth (China currently consumes 45% of world metal production).

There is, however, a risk of transient price increases due to perennial industrial relations problems and the location of production in some politically and economically unstable countries. These risks can be seen in past price movements such as the lift in prices in 2011. Record prices in 2011 reflected resurgent demand after the global financial crisis at the same time as supply constraints caused by a combination of industrial conflicts, power shortages, and adverse weather conditions in South America and Indonesia. These kinds of supply shocks are not incorporated into the forecast because they cannot reasonably be predicted.

Figure 2 Copper price forecast



Source: NZIER, Consensus Economics, LME

5.2.3. Aluminium prices

Aluminium prices are forecast using:

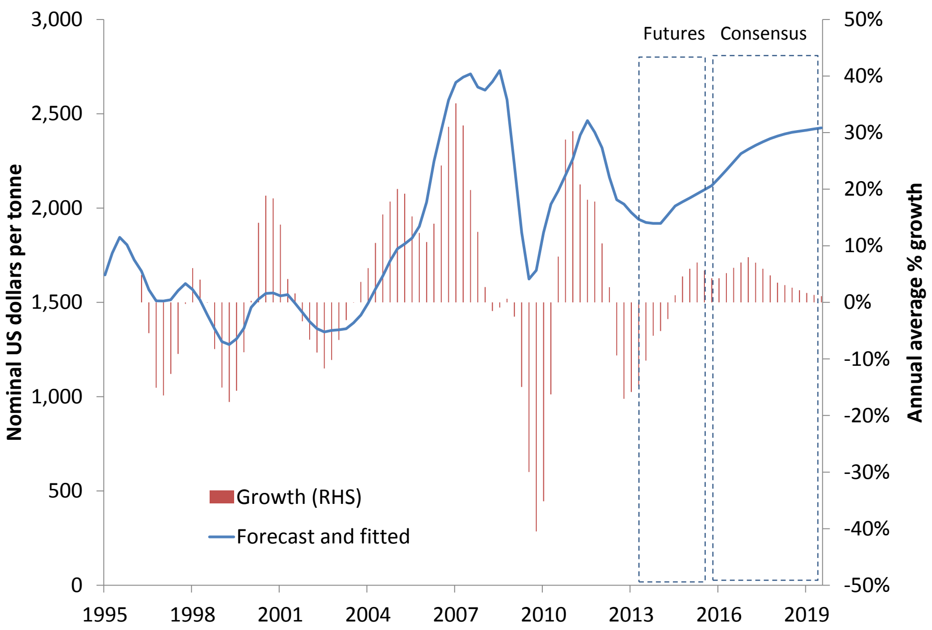
- the average of June 2013 settlement prices for aluminium futures on the London metals exchange for the September 2013 quarter through to the December quarter 2015
- percentage changes in the aluminium price according to the average of Consensus Economics consensus forecasts for March 2016 through to June 2020.

Price declines in 2012 have levelled off this year with a small US dollar increase in the year to June 2013. Futures markets have for some time been pricing in a recovery from unsustainably low prices in 2012.

The World Bank has also reported that aluminium demand is being supported by persistently high copper prices driving a shift from copper to aluminium in cables and wiring.

Long term prices are expected to rise partly because prices are underpinned by energy costs and other long term rising inflationary pressures (due to high energy content in production relative to other metals).

Figure 3 Aluminium price forecast

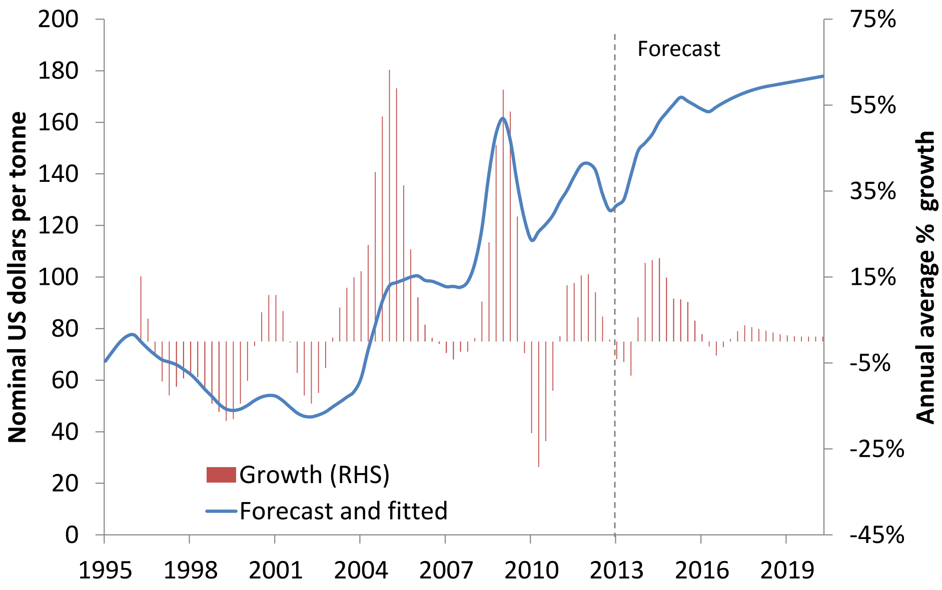


Source: NZIER, Consensus Economics, LME

5.2.4. Steel prices

Steel prices are forecast using consensus median prices. We use the consensus median rather than average to remove the effects of a single extreme forecast. Steel prices have been in decline for much of the past year but are forecast to recover in Asia. This broadly reflects a view that the demand for consumer appliances and other products will continue to grow strongly in Asia and thus support increased prices, at least for stainless steel.

Figure 4 Steel price forecast



Source: NZIER, Consensus Economics.

At the same time, persistent over-supply of steel-making capacity, a current increase in inventories of iron ore and higher efficiencies in new plant are all likely to keep prices from growing rapidly in the longer term – especially as demand growth is not going to be anywhere near as strong as in the 2000s with growth in investment in China expected to moderate from unprecedented highs.

5.3. Labour cost indices

Our Labour Cost Index forecasts are summarised in Table 8 and Figure 5.

Table 8 Labour cost index forecasts, average growth rates

	Electricity Gas and Water industry	Construction Industry	Professional Services Industry[27]	All industries
Last 15 years	2.4%	2.4%	na	2.3%
Last 10 years	2.7%	2.8%	2.6%	2.5%
2013-2020[28]	2.2%	2.2%	2.5%	2.2%

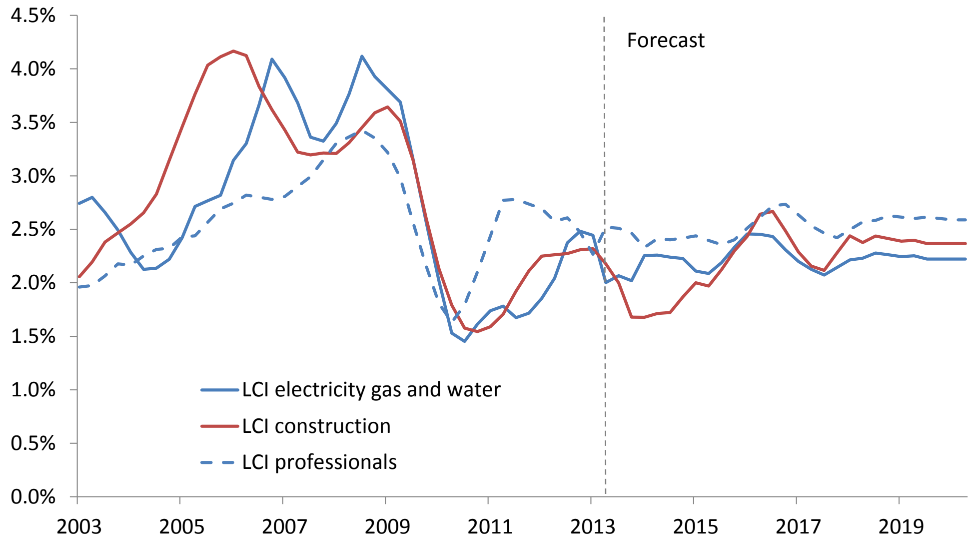
Source: NZIER, Statistics New Zealand

[27] This series is a new series starting in 2009. It has been back-cast from 2009 to 2001 using movements in the (now defunct) business services LCI in order to provide historical context for this table (not in the forecast model). There is no comparable index for providing context for years prior to 2001.

[28] 7 year average.

Figure 5 Labour cost index forecasts

Average annual percent growth



Source: NZIER, Statistics New Zealand

5.3.1. Forecast inputs

The labour cost forecast models make use of three inputs from NZIER's regular forecasts and forecast models[29]:

- forecasts of the all-sectors, all salary and wage rates LCI, described in 5.3.2 below
- 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.

Important points of context are:

- over the forecast horizon economy-wide inflationary pressure, including labour cost pressure, will be strongest over the next two years
- the top of the current cycle is expected to arrive in 2015
- economic growth will be slower over the next decade compared to the average of the past decade because of an ageing population and slowing labour force growth.

[29] These are exogenous to the forecasts provided here for cost escalation purposes.

5.3.2. 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, such as droughts.

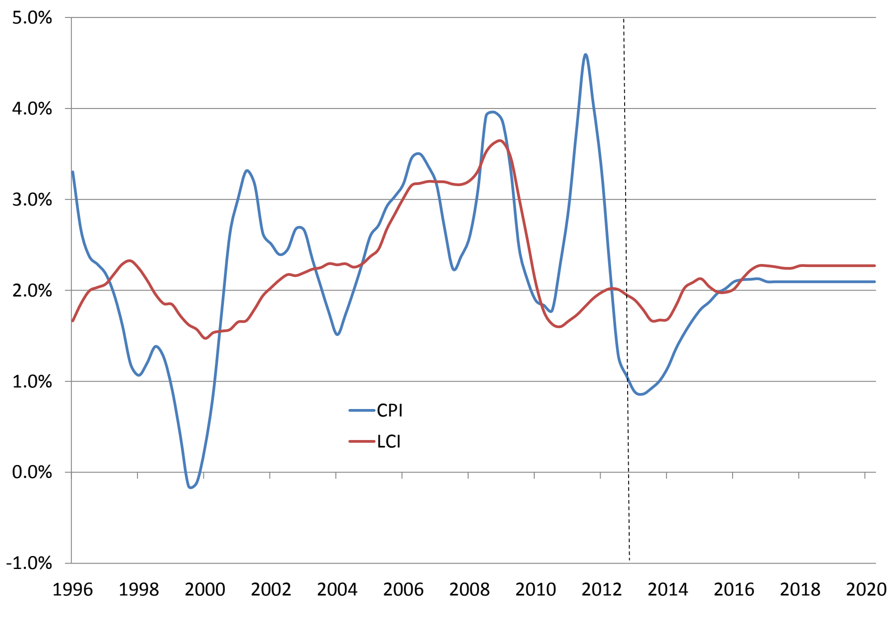
The forecast can be accurately described as having both a long term trend component and a cyclical component. The trend component is forecast using the relationship between CPI inflation and overall wage inflation. See, for example, Figure 6 which charts historical and forecast movements in the CPI and the LCI.[30] The trend component of the forecast has labour cost inflation rising 0.07% faster than CPI inflation.

Cycles around the trend reflect fluctuations in the output gap (actual growth in output in the economy relative to growth in productive capacity). These fluctuations affect labour costs by affecting wage demands and the proportion of wage cost that comes from overtime rates.

Forecast cycles also incorporate delayed effects of rising labour demand on unemployment and employment and subsequently wage inflation. Growth in the LCI lags rising labour demand by 18 to 24 months.

Figure 6 Relationship between the LCI and the CPI

Annual average percentage change



Source: NZIER

[30] Note that recent widening gaps between the LCI and CPI trends are affected by one off increases in the GST rate and consequently a large spike in the CPI. This one off change has not affected the LCI in any material way. The effect of the GST increases is excluded from our forecasts.

5.3.3. LCI 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 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.

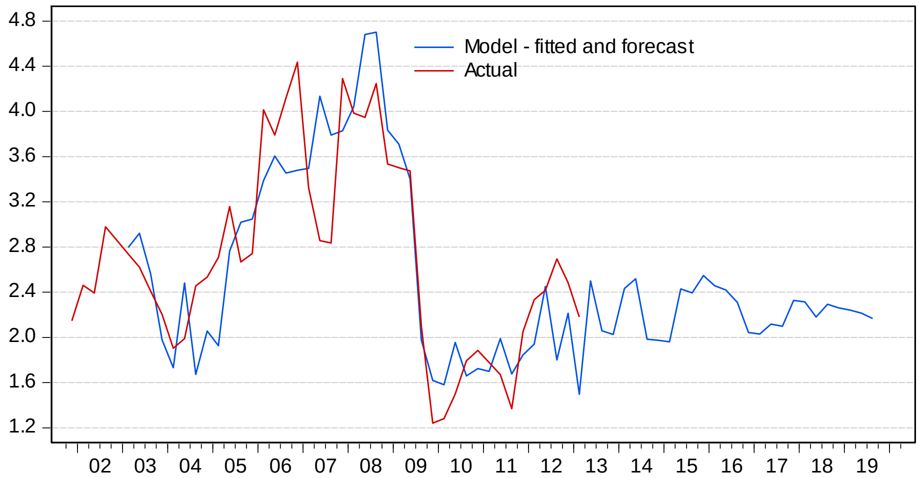
Output gaps, for EGW and all other sectors forecast here, are constructed from a (Hoddrick Prescott) filtered trend of industry activity around which cycles can be measured. These cycles dissipate over time leaving our forecasts to be based on long term trends.

The LCI trend model shows the LCI EGW grows at rates around 30% faster than economy-wide labour costs.[31]

A comparison of the model fit against the data is provided in Figure 7 and the fitted model statistics are provided in Table 10 in Appendix B.

Figure 7 LCI EGW – model fit and forecast

Annualised growth rates



Source: NZIER

5.3.4. LCI Construction 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

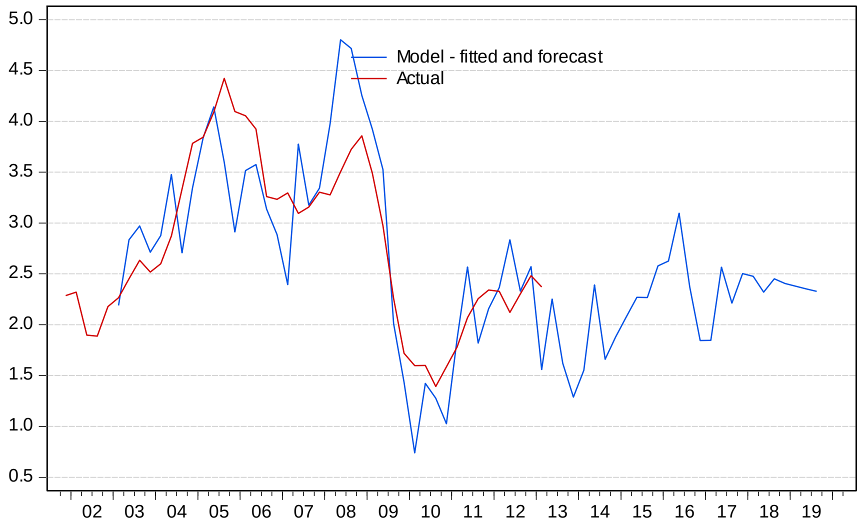
[31] Growth in the LCI EGW is a function of two competing effects. Population growth increases demand for services and this puts pressure on costs. At the same time, population growth increases labour supply and this reduces cost pressure. Our model results show that the demand effect predominates. That is, population growth increases cost pressure.

- a model of short run and cyclical movements in the 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 150% 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. The fit of the model is illustrated in Figure 8 and model statistics are set out in Table 11 in Appendix B.

Figure 8 LCI Construction – model fit and forecast

Annualised growth rates



Source: NZIER

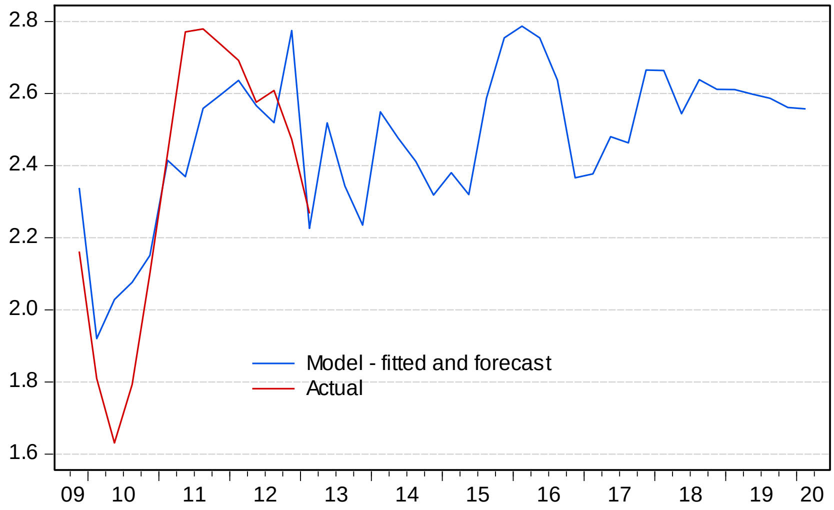
5.3.5. LCI Professional and Technical Services model

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. Cyclical movements have not been modelled as historical data for this series is too short to estimate cycles. Model fit is shown in Figure 9 and the model equation is detailed in Table 12 in Appendix B.

The model for forecasting the professional services sector LCI suggests the index will grow at 128% of the general LCI rate.

Figure 9 Trend in the LCI professional and technical services – model fit and forecast

Annual growth rate



Source: NZIER

5.4. PPI outputs: Heavy and Civil Engineering

The PPI-outputs index for heavy and civil engineering is forecast using an econometric model with two parts:

- a model of the long term trend in the PPI-outputs index for Heavy and Civil Engineering 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 professional services sector output gap.

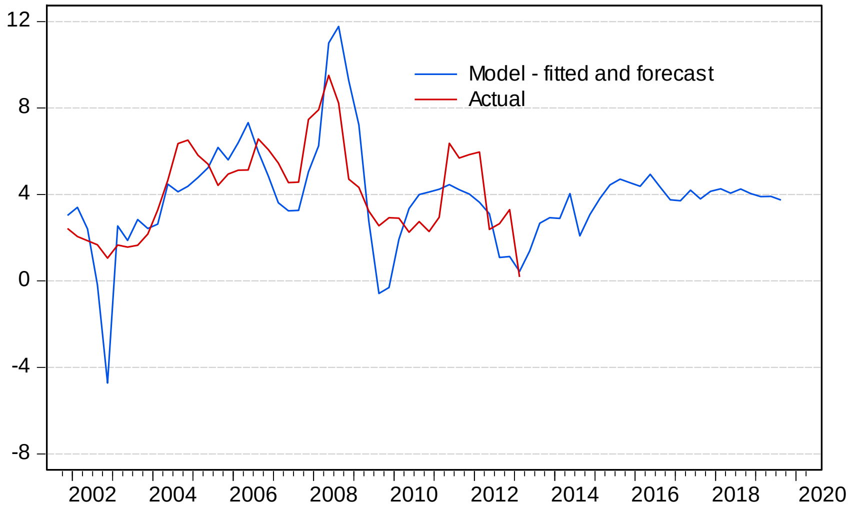
The forecast inputs described in 5.3.1 are used to enable forecasting of these model relationships.

Output prices in the heavy and civil engineering industry have traditionally grown much more rapidly than general inflation in the economy and our model-based forecast shows this trend will continue. Costs are expected to grow by 3.9% p.a. on average, 0.6% lower than the 4.5% growth of the past decade and nearly double general inflation (CPI) of 2.0%.

The model statistics are detailed in Table 13 in Appendix B and the model fit is illustrated in Figure 10.

Figure 10 PPI output Heavy and Civil Engineering – model fit and forecast

Annualised growth rates



Source: NZIER

5.5. CPI and foreign exchange forecasts

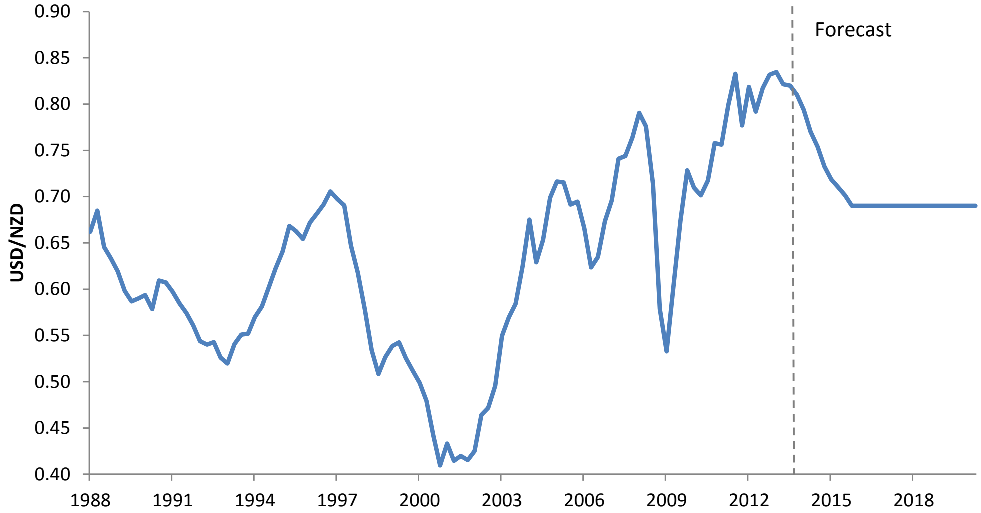
Forecasts of the (All group) CPI, used to translate our forecasts to RPE rates, follow the Commerce Commission method.[32] This involves the use of RBNZ CPI forecasts from the most recent Monetary Policy Statement (MPS). The MPS forecasts are no longer than two years. To obtain longer forecasts the Commission's method uses constant average growth rates from the last 4 quarters of the RBNZ MPS statements.[33]

An exchange rate forecast is used to convert international (US dollar) prices to New Zealand dollar prices. This forecast consists of an average of market forecasts. A chart of this foreign exchange forecast is provided in Figure 11.

[32] Commerce Commission (2012) 'Transpower Capital Expenditure Input Methodology Determination', 31 January 2012, clause 1.1.5.

[33] Note that this approach means that long term CPI forecasts have the potential to vary significantly. For example, between the December 2012 MPS and the June 2013 MPS the last 4 quarters of the RBNZ's forecast moved up from 1.8% to 2.2%, reflecting different points in the cycle at which the MPS forecasts were being produced.

Figure 11 Exchange rate forecast



Source: RBNZ, Transpower

Appendix A Time series forecasts of indices

Table 9 Forecast indices, annual average percentage changes

June year, 2013=1. The 7 year average is arithmetic average of annual average growth rate. Growth figures are inclusive of CPI inflation.

Cost item	Index measure	2013	2014	2015	2016	2017	2018	2019	2020	7 year average
Grid Opex Labour	LCI All groups	1.8%	1.8%	2.0%	2.1%	2.3%	2.3%	2.3%	2.3%	2.2%
IST labour	LCI Professional and Technical Services industry	2.5%	2.4%	2.4%	2.6%	2.5%	2.6%	2.6%	2.6%	2.5%
Departmental labour	Labour cost index (LCI) for Electricity, Gas and Water industry (LCI EGW)	2.0%	2.3%	2.1%	2.5%	2.1%	2.2%	2.3%	2.2%	2.2%
Grid Base Capex Labour	LCI Construction	2.2%	1.7%	2.0%	2.6%	2.2%	2.4%	2.4%	2.4%	2.2%
Copper	LME copper price (US$/mt)	-6.0%	-7.1%	1.3%	1.0%	-0.8%	0.2%	-2.1%	-2.3%	-1.4%
Aluminium	LME aluminium price (US$/mt)	-10.3%	1.3%	5.6%	6.1%	5.9%	2.6%	1.1%	1.0%	3.4%
Steel	Hybrid of World Bank steel price index and Asia Hot-Rolled Coil (HRC) US$/t	-8.0%	19.4%	9.2%	-3.3%	3.8%	2.1%	1.1%	1.1%	4.8%
Other metals	World Bank Metals & Mineral Price Index	-7.3%	-4.7%	3.8%	1.9%	0.7%	0.6%	0.6%	0.6%	0.5%
Construction	Producers Price Index – Outputs, for Heavy and Civil Engineering Industry	1.0%	3.1%	3.4%	4.6%	4.0%	4.1%	4.0%	3.9%	3.9%
IST hardware and software	All groups CPI	0.9%	1.4%	1.9%	2.1%	2.1%	2.1%	2.1%	2.1%	2.0%
IST hardware and software – exchange rate adjusted	All groups CPI (US$ index)	-1.6%	4.5%	10.6%	7.0%	2.5%	2.1%	2.1%	2.1%	3.7%
Copper, NZ$	LME copper price (NZ$/mt)	-8.3%	-4.0%	11.0%	6.2%	-0.4%	0.2%	-2.1%	-2.3%	1.2%
Aluminium, NZ$	LME aluminium price (NZ$/mt)	-12.4%	4.6%	15.7%	11.6%	6.4%	2.6%	1.1%	1.0%	6.1%
Steel, NZ$	Asia Hot-Rolled Coil (HRC) NZ$/t	-10.2%	23.3%	19.7%	1.7%	4.2%	2.1%	1.1%	1.1%	7.6%
Other metals, NZ$	World Bank Metals & Mineral Price Index (NZ$)	-9.5%	-1.5%	13.8%	7.2%	1.1%	0.6%	0.6%	0.6%	3.2%
Foreign exchange US$/NZ$ (level)	Average of NZ banks' forecasts[34]	0.82	0.82	0.75	0.70	0.69	0.69	0.69	0.69	0.73
Foreign exchange US$/NZ$ growth rate	Average of NZ banks' forecasts	2.5%	-3.2%	-8.7%	-4.9%	-0.4%	0.0%	0.0%	0.0%	-2.5%

Source: NZIER

[34] Source: Transpower. 2013 value is the forecast value used for this report.

Appendix B Econometric model statistics

Table 10 LCI EGW model

Trend equation

Dependent Variable: LN(LCI_EGW) Method: Fully Modified Least Squares (FMOLS) Sample (adjusted): 1994Q1 2013Q1				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
LN(LCI_All)	1.4	0.1	15.8	0.0
LN(Population(-4))	-0.7	0.2	-4.1	0.0
C	8.2	2.0	4.0	0.0
R-squared	0.998124	Mean dependent var		6.743118
Adjusted R-squared	0.998073	S.D. dependent var		0.131081

Cycle equation

Dependent Variable: Residual from trend equation Method: Least Squares Sample (adjusted): 1994Q4 2013Q1				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
NetMigration(-4)	1.7E-07	3.9E-08	4.2E+00	1.0E-04
EGWGap(-3)	2.3E-02	1.2E-02	1.9E+00	6.6E-02
AR(1)	9.6E-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		0.0057

Source: NZIER

Table 11 LCI construction model

Trend equation

Dependent Variable: LN(LCI_Construction) Method: Fully Modified Least Squares (FMOLS) Sample (adjusted): 1997Q1 2013Q1				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
LN(LCI_All)	1.5	0.1	23.1	0.0
LN(Population(-16))	-0.9	0.1	-6.8	0.0
C	10.5	1.6	6.5	0.0
R-squared	0.999	Mean dependent var		6.8
Adjusted R-squared	0.999	S.D. dependent var		0.1

Cycle equation

Dependent Variable: Residual of trend equation Method: Least Squares Sample (adjusted): 1997Q2 2013Q1				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
ConstructionGap	0.012	0.006	1.851	0.069
NetMigration(-4)	-0.0000001	0.000	-3.870	0.000
AR(1)	0.867	0.041	20.979	0.000
R-squared	0.905	Mean dependent var		0.000
Adjusted R-squared	0.902	S.D. dependent var		0.004

Source: NZIER

Table 12 LCI Professional and technical services model

Dependent Variable: LN(LCI_Professional) Method: Dynamic Least Squares (DOLS) Sample (adjusted): 2008Q4 2013Q1				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
LN(LCI_All)	1.28	0.02	56.21	0.00
C	-1.95	0.16	-12.33	0.00
R-squared	0.997	Mean dependent var		6.95
Adjusted R-squared	0.996	S.D. dependent var		0.03

Source: NZIER

Table 13 PPI heavy and civil engineering outputs model

Trend equation

Dependent Variable: LN(PPI_CIVIL) Method: Fully Modified Least Squares (FMOLS) Sample (adjusted): 1995Q1 2013Q1				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
LN(PPI_inputs)	0.62	0.14	4.56	0.00
LN(LCI_construction)	0.77	0.17	4.55	0.00
C	-2.67	0.28	-9.39	0.00
R-squared	0.99	Mean dependent var		6.6
Adjusted R-squared	0.99	S.D. dependent var		0.2

Cycle equation

Dependent Variable: Residual of trend equation Method: Least Squares Sample (adjusted): 1995Q2 2013Q1				
Explanatory variable	Coefficient	Std. Error	t-Statistic	Prob.
ConstructionGap	-0.04	0.0	-1.8	0.07
ProfessionalGap	-0.09	0.1	-1.7	0.09
NetMigration(-4)	0.0000002	0.0	1.6	0.11
AR(1)	0.94	0.0	30.5	0.00
R-squared	0.94	Mean dependent var		0.00
Adjusted R-squared	0.94	S.D. dependent var		0.02

Source: NZIER