The Leading Indicator of Employment

Background and Methodology

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Department of Labour
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CONTENTS

LIST OF TABLES

FOREWORD

A key role of the Department of Labour (the Department) is to improve the performance of the labour market. One of the ways we do this is by strengthening our knowledge base to provide the Department, Ministers, government agencies and other key stakeholders with authoritative labour market knowledge and insight.

The release of the Leading Indicator of Employment (LIoE) marks another step forward for the Department, adding a tool that enables us to estimate future changes in employment. The LIoE is designed to give an advanced signal of when employment (as measured by the Household Labour Force Survey) is likely to reach a peak or trough.

The key advantage of the LIoE is that it combines five different indicators to produce one overall message about future changes in the employment cycle. The LIoE tends to be more reliable than any of its components used individually, with much of the variability in the individual components smoothed out in the LIoE.

The development of the LIoE will enhance the capability for the Department to monitor labour market changes and improve the quality of information provided to the Government and public.

While the LIoE provides insight on likely changes in the employment cycle, its overall message will be enhanced by taking into account information from other labour market indicators.

We are grateful to the individuals and agencies that provided feedback during the development of the LIoE.

INTRODUCTION

The Leading Indicator of Employment (LIoE) is designed to give an advanced signal of when employment (as measured by the Household Labour Force Survey) is likely to reach a peak or trough.

A secondary function of the LIoE is to forecast employment growth for the subsequent three quarters. This is not the main purpose of the LIoE, but a forecast can provide some useful additional information on when the turning point is mostly likely to occur.

Economic activity and employment share similar characteristics, with both series having a cyclical pattern. Predicting changes in economic activity often involves a consideration of a range of indicators across the economy. The similarities in patterns between employment and economic activity are exploited in the construction of the LIoE.

The LIoE combines five indicators that broadly cover a range of sectors of the economy into one overall message and, in principle, offers a better view on turning points in the employment cycle compared to a single indicator. The use of single indicators of future employment is widespread, but no other New Zealand public sector institution is publishing a *composite* indicator at this stage.

The development of a LIoE for New Zealand is in line with other countries that maintain similar indicators. The Department of Education, Employment and Workplace Relations in Australia has developed and maintained a monthly LIoE for a number of years and publishes its result on their website.

The LIoE for New Zealand is based on a Treasury working paper by Claus and Claus (2002) and a report by Claus (2006). In early 2006 the Department commenced development of the LIoE. Since then, work has focused on the testing and enhancement of the LIoE before publicly releasing it. The development included consultations with a range of agencies including The Treasury, the Reserve Bank and Motu (an economic analysis agency in New Zealand).

Outline of the report structure

This report has three sections:

1. **Performance and accuracy of the LIoE.** The first section describes how well the LIoE has performed in picking turning points in the past.
2. **Methodology.** This section outlines the components used in the LIoE and how they are put together into one index. The second part of the methodology describes the forecasting component of the LIoE.
3. **Caveats.** This last section outlines the caveats when using the LIoE.

PERFORMANCE OF THE LEADING INDICATOR OF EMPLOYMENT

Before publishing the LIoE we have checked that it provided advanced signals of previous turning points in employment growth, and that its forecasting component gave accurate results compared to alternative forecasting methods. On both counts the LIoE has proven to be useful.

Definition of a turning point

A signal of a cyclical downturn (a turning point) is defined as two consecutive declines in the LIoE following at least two consecutive rises while a cyclical upturn is defined as two consecutive rises following at least two consecutive falls in the LIoE.

A peak in employment is defined as the quarter prior to at least two consecutive declines in employment and a trough is defined as the quarter prior to at least two consecutive increases in employment.

Picking turning points in employment growth

The LIoE has done well at providing advance signals of cyclical changes in employment in New Zealand. It gave signals of the 1987 and 1990 downturns with a lead of two quarters, the 1997 downturn with a lead of five quarters, and a four quarter advance warning of the short-lived two quarter downturn in employment over the last two quarters of 2006. The LIoE gave a signal of the most recent downturn in employment with a lead of three quarters.

There is a risk of an occasional false signal of a turning point in employment. The LIoE gave a false signal of a downturn in employment in 2000, and again in 2002/3.

The forecasting component

Every quarter the forecasting component of the LIoE is compared with two benchmark econometric models. The forecasting errors of the LIoE have so far been smaller (better) than the comparison models. These forecasting errors are closely monitored every quarter.

Further details on the performance of the forecasting component are provided in the methodology section.

METHODOLOGY

Components included in the LIoE

The selection of the five components is described by Claus (2006). The selection of the components was on based on:

- the degree to which they are affected by the same shocks that affect employment;
- the degree to which the component series leads employment;
- their statistical significance;
- the timing and stability of publication; and
- their forecasting performance.

In total 97 component series were tested - they are listed in Appendix A and the sources of the five components used are listed in Table 1. The final component series were selected by first including series broadly covering different sectors of the New Zealand economy and then replacing them with different series or dropping them if they did not add information.

The components selected in the LIoE are the ANZ Commodity Price Index (in New Zealand dollars), labour as a limiting factor from the Quarterly Survey of Business Opinion (QSBO), permanent and long-term (PLT) arrivals, the Southern Oscillation Index and the New Zealand Share Price Index. Series from the QSBO and PLT arrivals are seasonally adjusted using the X12 method developed at the U.S Census Bureau. All series are then standardised so that they can be added together to form a single series.

ANZ Commodity Price Index (New Zealand dollars)

New Zealand is a small open economy that is heavily reliant on exports and so foreign economic activity is important for New Zealand's economic growth. Strong growth in our trading partners ultimately translates into more jobs in New Zealand. One measure of world demand is commodity prices. New Zealand remains a large commodity exporter and a rise (or fall) in its commodity prices due to strong (weak) world demand has stimulating (depressing) effects on the New Zealand economy and hence jobs.

Quarterly Survey of Business Opinion – labour as a limiting factor

Labour as a limiting factor from the Quarterly Survey of Business Opinion is used as an indicator of future hiring activity.[1]

Permanent and long-term arrivals

Immigration is a potentially important indicator of domestic activity in New Zealand and hence employment. Immigration in New Zealand tends to be pro-cyclical. During the mid-1990s and early 2000s, for example, an increase in permanent long-term migration has been associated with demand pressures, a residential construction upswing and an increase in employment.

[1] While this indicator is not directly linked to firms hiring activity, other labour market indicators from the QSBO were tested but the performance of the LIoE did not improve.

New Zealand Share Price Index

Share price indices can be seen as an indicator of financial wealth and associated demand pressures and performance of the economy.

Southern Oscillation Index

Variables indicating weather conditions may also lead to changes in domestic activity with adverse weather conditions putting downward pressure on agricultural and other output (such as electricity generation) and associated employment.

The Southern Oscillation Index (SOI) is based on the difference in air pressure between Darwin in Australia and Tahiti in French Polynesia. Persistent positive values are associated with La Niña conditions, which have a weak impact on climate in New Zealand with more rain in the northeast of the North Island caused by more north-easterly winds. El Niño conditions are often indicated by a period of negative SOI values, which are usually accompanied by more westerly winds that can lead to more rain in the west and drought in the east. A lower index is expected to have a negative influence on employment because El Niño conditions can have a strong negative impact on agricultural output and employment.

Concordance method

We adopt the concordance approach used by Claus (2006) to compile a composite index or the LIoE. The weights of the relevant components are based on the number of quarters that they (and their lags) and the employment series move in the same direction.

For each component, a concordance statistic is constructed for one to four[2] lags and the maximum value of the four lags is then chosen. For example, over the observation period (June 1986 – June 2008), PLT arrivals posted 60 changes that had the same direction of change as employment in the next quarter. This means that the raw weight for migration is 60. Similarly, the Southern Oscillation Index posted 47 changes that had the same direction as employment four quarters later leading to a raw weight of 47.

The normalised and final weight of each component series is simply the raw weight divided by the sum of all weights. For example, for arrivals the normalised weight is 0.221 (= 60 ÷ 271). Table 2 below shows all weights used. The last step in the construction of the LIoE is to standardise the index and set it to 100 in 1992. For more technical notes on how the LIoE is constructed please refer to Appendix B.

[2] The maximum of four lags is chosen because leads of more than one year are typically hard to establish.

Table 1: Sources of data

Variables	Source
Total employment	Statistics New Zealand: Household Labour Force Survey
Labour as a limiting factor	New Zealand Institute of Economic Research: Quarterly Survey of Business Opinion
PLT arrivals	Statistics New Zealand: External migration
Southern Oscillation Index	Australian Bureau of Methodology http://www.bom.gov.au/climate/current/soihtm1.shtml
New Zealand Share Price Index	Yahoo NZX Capital Index http://finance.yahoo.com/q/hp?s=^NZCI&a=00&b=5&c=2000&d=00&e=21&f=2010&g=m
ANZ Commodity Price Index (NZD)	ANZ http://www.anz.co.nz/commercial-institutional/economic-markets-research/commodity-price-index/

Table 2: Weights of component series in the LIoE

Variables	Weights
Labour as a limiting factor	22.5%
PLT arrivals	22.1%
Southern Oscillation Index	17.3%
New Zealand Share Price Index	19.2%
ANZ Commodity Price Index (NZD)	18.8%

Note: The weights and the components will be reviewed on an annual basis.

Forecasting component of the LIoE

A secondary function of the LIoE is to produce short-term forecasts for the size of employment growth. Employment growth can be forecast for the following three quarters. For further technical detail of the forecasting component of the LIoE please refer to Appendix C.

Every quarter the forecasting error of the LIoE is compared with two benchmark models, an ARIMA model and a two variable VAR model that includes the LIoE and employment growth.

Table 3 shows the forecasting errors for the three models. Overall Table 3 shows that the LIoE is performing better than the chosen benchmark models, and is therefore useful in forecasting quarterly employment growth.

Table 3: Forecasting performance of the Leading Indicator of Employment and benchmark models, 1996Q3-2010Q1

	MAE	RMSE	U-Theil
LIoE	0.4879	0.6392	0.8194
ARIMA	0.5462	0.6713	0.8606
VAR incl. LIoE	0.6015	0.7464	0.9568

Notes:

- RMSE: Root Mean Squared Forecasting Error, the smaller the error the better the forecasting ability
- MAE: Mean Absolute Forecasting Error MAE, the smaller the error the better the forecasting ability
- U-Theil: Theil Inequality Index, the smaller the value the better the model performs compared to a naïve forecast of no change

CAVEATS

The LIoE is only one indicator of turning points in the employment cycle. It should be used as an analytical tool along with other labour market indicators. Users of the LIoE must also be aware that historical relationships between the LIoE and employment can vary from time to time. Judgements about the future changes in employment derived from the LIoE should therefore be qualified appropriately. Additionally, the lead time of the LIoE is not constant; the average lead time is usually between two to four quarters.

REFERENCES

Auerbach, A. (1982), 'The index of leading indicators: "Measurement without theory"', Review of Economics and Statistics 64(4), 589—595.

Claus, E. (2006), 'Two Leading indexes of New Zealand employment', Report prepared for the New Zealand Department of Labour, Centre for Applied Macroeconomic Analysis, Australian National University.

Claus, E. and Claus, I. (2002), 'How many jobs? A leading indicator model of New Zealand employment', New Zealand Treasury Working Paper 02/13.

APPENDIX A: DATA AND DATA SOURCES

In total, 97 variables or component series were considered in the construction of the composite index or the Leading Indicator of Employment. These are:

Labour market indicators

hours worked from the Household Labour Force Survey

unemployment rate from the Household Labour Force Survey

labour force participation rate from the Household Labour Force Survey

ANZ job vacancies total number of advertisements

ANZ job vacancies — newspaper advertisements

ANZ job vacancies — web advertisements

ANZ job vacancies, spliced - three cities (Auckland, Wellington, Canterbury)

Quarterly Survey of business opinion (QSBO)

QSBO: difficulty of finding skilled labour (net % of firms)

QSBO: difficulty of finding unskilled labour (net % of firms)

QSBO: number of employees expected in the next three months (net % of firms)

QSBO: labour as a limiting factor to increasing turnover (% of firms)

QSBO: number of employees experienced in the past three months (net % of firms)

QSBO: overtime worked in the past three months (net % of firms)

QSBO: overtime worked expected in the next three months (net % of firms)

Domestic activity indicators

company tax receipts (net of refunds, $)

permanent and long-term migration — net actuals

external migration – total number of arrivals

long-term migration – total number of arrivals

new number of dwelling consents

total number of dwellings

REINZ number of dwelling sales

food price index

number of livestock slaughter

total electricity generation: sales to customers (Offtake in GWh)

total number of new vehicle car registrations

southern oscillation index

Trade indicators

value of merchandise imports

value of merchandise exports

number of overseas visitors arrivals

West Texas intermediate oil price

Foreign activity indicators and commodity prices

US S&P500 equity price index

Australian equity price index: all ords

MSCI equity price index — Australia

MSCI equity price index — World

MSCI equity price index — United States

Top 5 trading partners real growth (quarter on quarter)

ANZ commodity price index

CRB commodity price index

Economist commodity price index — total

Economist commodity price index — industrials

Economist commodity price index — non food agriculture

Economist commodity price index — metals

Economist commodity price index — food

Goldman Sachs commodity price index — total

Goldman Sachs commodity price index — agriculture

Goldman Sachs commodity price index — livestock

Dubai oil price

Brent oil price

Consumer and business confidence indicators

Quarterly Survey of business opinion (QSBO)

QSBO: general business situation (net % of firms)

QSBO: limiting factor — capital (net % of firms)

QSBO: limiting factor — other (net % of firms)

QSBO: new investment — buildings (net % of firms)

QSBO: new investment — plant and machinery (net % of firms)

QSBO: average costs experienced in the past three months (net % of firms)

QSBO: average selling price in the past three months (net % of firms)

QSBO: profitability experienced over the past three months (net % of firms)

QSBO: average costs expected in the next three months (net % of firms)

QSBO: profitability expected in the next three months (net % of firms)

QSBO: Capacity Utilisation of Manufacturers and Builders (net % of firms)

Financial and monetary variables

1 year government bond yield (annual % interest rates)

2 year government bond yield (annual % interest rates)

5 year government bond yield (annual % interest rates)

10 year government bond yield (annual % interest rates)

30 day bank bill yield (annual % interest rates)

60 day bank bill yield (annual % interest rates)

90 day bank bill yield (annual % interest rates)

10 year government bond yield - 5 year government bond yield (annual % interest rates)

10 year government bond yield - 2 year government bond yield (annual % interest rates)

10 year government bond yield - 1 year government bond yield (annual % interest rates)

10 year government bond yield - 90 day bank bill yield (annual % interest rates)

10 year government bond yield - 60 day bank bill yield (annual % interest rates)

10 year government bond yield - 30 day bank bill yield (annual % interest rates)

5 year government bond yield - 2 year government bond yield (annual % interest rates)

5 year government bond yield - 1 year government bond yield (annual % interest rates)

5 year government bond yield -90 day bank bill yield (annual % interest rates)

5 year government bond yield - 60 day bank bill yield (annual % interest rates)

5 year government bond yield - 30 day bank bill yield (annual % interest rates)

call rate (annual % interest rates)

NZD/AUD exchange rate: average 11am

NZD/USD exchange rate: average 11am

trade weighted index (TWI)

trade weighted index (TWI) / consumer price index (CPI)

total billings on New Zealand credit cards / CPI ($)

total advances on credit cards outstanding / CPI ($)

notes and coins held by the public / CPI ($)

Monetary aggregates M1 to M3

- M1 / CPI ($)
- M2 / CPI ($)
- M3 / CPI ($)

private sector credit ($)

resident private sector credit ($)

domestic credit ($)

resident domestic credit ($)

New Zealand stock exchange index, top 10 companies

APPENDIX B: CONSTRUCTION OF COMPOSITE INDEX OF LEADING INDICATORS (CLAUS, 2006)

The first part of constructing a composite index of two (or more) series is to calculate quarter-to-quarter symmetrical (i.e. relative to the midpoint) percentage changes for each individual component Y_t^j of the composite index:

(1) $$Y_t^j = \frac{\left(X_t^j - X_{t-1}^j\right)}{\left(X_t^j + X_{t-1}^j\right)/2} = 200 * \frac{\left(X_t^j - X_{t-1}^j\right)}{\left(X_t^j + X_{t-1}^j\right)}$$

Where X_t^j is the original series of component *j* at time *t*. For series that contain zero or negative values, or that are already in index or percentage form, the following is used instead:

(2) $$Y_t^j = X_t^j - X_{t-1}^j$$

For series that are a difference of two series, or a ratio, we use:

(3) $$Y_t^j = X_t^j$$

The next step is to standardize the transformed series so as to prevent a volatile component from dominating changes in the composite index by dividing the transformed series of equations (1) – (3) above by its historical average without regard to sign.

(4) $$S_t^j = \frac{Y_t^j}{\frac{1}{T-1}\sum_{t=1}^{T}\left|Y_t^j\right|}$$

The transformed and standardized series can be combined into a composite index by

(5) $$I_t = \sum_{j=1}^{J} \omega^j S_t^j$$

Where I_t is the composite value, ω^j the individual weight of each series normalised to sum to unit value and *J* is the number of series included in the composite index. The weights could be determined by average value over the period *T*.

The next step is to transform the composite value I_t so that it has the same historical average as the reference series by calculating:

(6) $$I_t^s = \frac{I_t}{\left(\sum_{t=1}^{T}\left|I_t\right| \Big/ T-1\right) \Big/ \left(\sum_{t=1}^{T}\left|E_t\right| \Big/ T-1\right)} = \frac{I_t}{\left(\sum_{t=1}^{T}\left|I_t\right|\right) \Big/ \left(\sum_{t=1}^{T}\left|E_t\right|\right)}$$

Where E_t is the symmetrical percentage change of the reference employment series which can, in a final step, be transformed into a standardized composite index, CI_t.

(7) $$CI_t = \frac{CI^s_{t-1}\left(200 + I^s_t\right)}{\left(200 - I^s_t\right)}$$

since

$$I^s_t = \frac{200 * \left(CI^j_t - CI^j_{t-1}\right)}{\left(CI^j_t + CI^j_{t-1}\right)}$$

APPENDIX C: FORECASTING TECHNICAL DETAILS (CLAUS, 2006)

The forecasting model was estimated using ordinary least squares. Following Auerbach (1982), the model includes lags of the index and past employment growth. The approach of broad to specific in the selection of lags of the index and past employment growth was used. Statistical significance and residual based tests led to the selection of the following specification:

$$\Delta emp_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i \Delta lienz1_{t-i} + \alpha_5 \Delta emp_{t-3} + \varepsilon_t$$

Where $\Delta emp_{t-i}, \Delta lienz1_{t-i}$ indicate the growth rate of employment and index at lag i. α_0 and α_j, $j = 1,...5$ are coefficients and ε_t is white noise error.

The composite index forecasting model includes one to four lags of the index and employment growth lagged three quarters.

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