Forecasting Business and Stock Market Cycles and Industry Growth

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About Us

- Founded in January 2013.
- Develop models to forecast reversals in the stock market cycle in the U.S., reversals in the business cycle in the U.S. and Canada, and real GDP and employment growth by industry in Canada.
- Five monthly Reports:
  - Outlook on the business cycle in the U.S. for next three months
  - Outlook on the business cycle in Canada for next three months
  - Outlook on the stock market cycle in the U.S. for next two months
  - Real GDP outlook for 35 industries in Canada for current and next year
  - Employment outlook for 32 industries in Canada for current and next year.
- A research paper is associated with each Report. The research papers can be obtained free from the website.
U.S. Business Cycle Model
Model

- The U.S. business cycle is characterised by two phases: expansion and recession.

- The static probit modeling approach is used to calculate the probability of a reversal in the U.S. business cycle between expansion and recession phases. Lagged values of the state of the business cycle or (and) lagged values of the probability function is (are) not included in the model.

- The model is estimated with monthly data from January 1962 and it includes a number of U.S. economic indicators, such as building permits, initial claims, consumer sentiment, and the yield curve.

- The predicted outcome for the business cycle is determined using the usual 50% threshold:
  
  - When the economy is an expansion, the model predicts a reversal to a recession if the probability is equals to or exceeds 50%.\(^1\) Otherwise, the model predicts that the expansion will continue.
  
  - When the economy is a recession, the model predicts a reversal to an expansion if the probability is equals to or falls below 50%.\(^1\) Otherwise, the model predicts that the recession will continue.

- Figure 1 (next slide) illustrates the monthly evolution of the probability of the U.S. being in a recession (identified by the blue line) along with the recession periods (grey shaded areas).

\(^1\) It is possible that an increase (decline) in the probability to above (below) 50% could be explained by a limited number of the model’s predictive variables. When the model signals of a reversal in the business cycle, the source of the change in the probability is investigated in order to reduce the risk of a false alarm.
Figure 1: Probability of the U.S. Being in a Recession\(^1\): January 1962 - December 2013
(probability, %)

Source: The Forecasting Advisor.
1. The in-sample probability were computed with the one-month ahead probit model. Shaded areas indicate recessions, as dated by the NBER.
Figure 2: Probability of the U.S. Being in a Recession: U.S. Business Cycle Model Versus Two Well-Know Specifications (probability, %)

Source: The Forecasting Advisor. Shaded areas indicate recessions.
Table 1  
Some Key Probit Estimation Output for the U.S. Business Cycle Model ¹

<table>
<thead>
<tr>
<th>Model</th>
<th>McFadden R-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>0.89</td>
</tr>
<tr>
<td>Alternative probit models:</td>
<td></td>
</tr>
<tr>
<td>Yield curve</td>
<td>0.32</td>
</tr>
<tr>
<td>Yield curve + stock market returns</td>
<td>0.40</td>
</tr>
<tr>
<td>Kauppi &amp; Saikkonen (2008)</td>
<td>0.20 to 0.58²</td>
</tr>
<tr>
<td>Wright (2006)</td>
<td>0.22 to 0.50</td>
</tr>
<tr>
<td>Nyberg (2013)</td>
<td>0.29 to 0.84²</td>
</tr>
<tr>
<td>Kauppi (2008)</td>
<td>0.23 to 0.68²</td>
</tr>
</tbody>
</table>

Prediction Evaluation  
(Success rate based on the 50% rule)

<table>
<thead>
<tr>
<th></th>
<th>In-Sample³</th>
<th>Out-of-Sample⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predicted / Total Recession Months</td>
<td>78 / 83</td>
<td>24 / 24</td>
</tr>
<tr>
<td></td>
<td>(94%)</td>
<td>(100%)</td>
</tr>
<tr>
<td>Predicted / Total Expansion Months</td>
<td>529 / 536</td>
<td>251 / 259</td>
</tr>
<tr>
<td></td>
<td>(99%)</td>
<td>(97%)</td>
</tr>
</tbody>
</table>

¹. The results for the U.S. business cycle model are from the one-month ahead probability model.
². The highest values are obtained with autoregressive and dynamic and autoregressive probit models.
Table 2
Performance of the Model in Predicting the Reversals in the Business Cycle in the U.S. since 1962¹

<table>
<thead>
<tr>
<th>Business Cycle Reference Dates²</th>
<th>Lead (-) / Lag(+) in Predicting the Start of the Recession (in months)</th>
<th>Lead(-) / Lag(+) in Predicting the Start of the Expansion (in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak</td>
<td>Trough</td>
<td></td>
</tr>
<tr>
<td>December 1969</td>
<td>November 1970</td>
<td>+1</td>
</tr>
<tr>
<td>November 1973</td>
<td>March 1975</td>
<td>+1</td>
</tr>
<tr>
<td>January 1980</td>
<td>July 1980</td>
<td>-2</td>
</tr>
<tr>
<td>July 1981</td>
<td>November 1982</td>
<td>-1</td>
</tr>
<tr>
<td>July 1990</td>
<td>March 1991</td>
<td>0</td>
</tr>
<tr>
<td>March 2001</td>
<td>November 2001</td>
<td>-1</td>
</tr>
<tr>
<td>December 2007</td>
<td>June 2009</td>
<td>-1</td>
</tr>
</tbody>
</table>

Average                   | -0.43                                          | +0.14                                          |

1. The results are based on the one-month ahead probability model.
2. The reference dates are from the NBER.
Figure 3: Probability of the U.S. Being in a Recession: 2008-2009 Episode\(^1\)

Source: The Forecasting Advisor.

1. In-sample probabilities from the one-month ahead probability model.
Figure 4: Probability of the U.S. Being in a Recession: 2001 Episode\(^1\)

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Source: The Forecasting Advisor.

1. In-sample probabilities from the one-month ahead probability model.
Figure 5: Probability of the U.S. Being in a Recession: 1990-1991 Episode¹

(%)  

Peak of the expansion in July 1990  
Signal with no lead/lag the start of a recession  
Trough of the recession in March 1991  
Signal with a lag of one month the start of an expansion  

Source: The Forecasting Advisor.  
¹ In-sample probabilities from the one-month ahead probability model.
Figure 6: Probability of the U.S. Being in a Recession: 1981-1982 Episode

(%)  

Source: The Forecasting Advisor.
1. In-sample probabilities from the one-month ahead probability model.
Figure 7: Probability of the U.S. Being in a Recession: 1980 Episode\(^1\)

Source: The Forecasting Advisor.

1. In-sample probabilities from the one-month ahead probability model.
Figure 8: Probability of the U.S. Being in a Recession: 1973-1975 Episode¹

(%) 100 90 80 70 60 50 40 30 20 10 0

Peak of the expansion in November 1973

Peak of the expansion in November 1973

Trough of the recession in March 1975

Source: The Forecasting Advisor.

¹ In-sample probabilities from the one-month ahead probability model.
Figure 9: Probability of the U.S. Being in a Recession: 1969-1970 Episode

%)

Peak of the expansion in December 1969
Signal with a lag of one month the start of a recession
Trough of the recession in November 1970
50% threshold

Source: The Forecasting Advisor.
1. In-sample probabilities from the one-month ahead probability model.
Out-of-Sample Forecasting Performance
Figure 10: Probability of the U.S. Being in a Recession: In- and Out-of-Sample Probabilities from January 1990 to December 2012

Source: The Forecasting Advisor. 1. The out-of-sample probabilities are computed with coefficients of the model estimated from January 1962 to December 1989. In-sample probabilities are computed from January 1962 to December 2012. * The shaded areas correspond to recessions.
Figure 11: Probability of the U.S. Being in a Recession: Out-of-Sample Probabilities from Three Models

Source: The Forecasting Advisor. 1. The out-of-sample probabilities are computed with coefficients of the model estimated from January 1962 to December 1989. In-sample probabilities are computed from January 1962 to December 2012.

* The shaded areas correspond to recessions.
# Outlook on the Business Cycle in the U.S.

<table>
<thead>
<tr>
<th>Model's Forecast</th>
<th>Phase of the Business Cycle</th>
<th>Actual</th>
<th>Outlook&lt;sup&gt;1&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Probability of Being in a Recession</td>
<td>Expansion</td>
<td>0.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Predicted Outcome for the Business Cycle</td>
<td>Expansion to continue</td>
<td>Expansion to continue</td>
<td>Expansion to continue</td>
</tr>
</tbody>
</table>

1. The probabilities for February, March and April were computed on February 7, 2014.
Probability of the U.S. Being in a Recession (%)

Peak of expansion in December 2007

Trough of recession in June 2009

50% threshold

Signal a reversal to a recession

Signal a reversal to an expansion

Probabilities of 0% for February, March and April do not suggest an oncoming recession

Source: The Forecasting Advisor.
Canadian Business Cycle Model
Model

- In the model, the Canadian business cycle is characterised by two phases: an expansion or a recession.

- The static probit modeling approach is used to calculate the probability of a reversal in the Canadian business cycle between expansion and recession phases. Lagged values of the state of the business cycle or (and) lagged values of the probability function is (are) not included in the model.

- The model includes a number of economic indicators for Canada, such as building permits, new orders, consumer confidence, and the yield curve.

- The probability is calculated for a forecast horizon of one to three months.
  - For example, on September 17, 2013, we calculated a probability for the months of August, September, and October.

- The predicted outcome for the state of the economy is determined using the usual 50% threshold:
  - When an expansion exists, the model predicts a reversal to a recession if the probability is equal or greater than 50%. Otherwise, the model predicts that the expansion will continue.
  - When a recession exists, the model predicts a reversal to an expansion if the probability is equal or less than 50%. Otherwise, the model predicts that the recession will continue.

- Figure 1 (next slide) illustrates the monthly evolution of the probability for Canada of being in a recession (identified by the blue line) along with the recession periods (grey shaded areas) since January 1962.

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1. It is possible that one or very few explanatory variables of the model could explain the probability from rising from below to above 50%. In the future, when the model will give a signal of a reversal in the business cycle, the source of the change will be investigated in order to reduce as much as possible the risk of a making false signal.
Figure 1: Probability for Canada of Being in a Recession\(^1\): 1962-2012
(probability, %)

* See Table 1 for the reference dates for the business cycle. The shaded areas correspond to the recessions.
### Table 1
**Forecasting the Reversals in the Business Cycle in Canada since 1962**

<table>
<thead>
<tr>
<th>Business Cycle Reference Dates</th>
<th>Lead (-) / Lag(+) in Predicting the Start of the Recession (in months)</th>
<th>Lead(-) / Lag(+) in Predicting the Start of the Expansion (in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Peak</strong></td>
<td><strong>Trough</strong></td>
<td></td>
</tr>
<tr>
<td>December 1974</td>
<td>March 1975</td>
<td>0</td>
</tr>
<tr>
<td>January 1980</td>
<td>June 1980</td>
<td>0</td>
</tr>
<tr>
<td>June 1981</td>
<td>October 1982</td>
<td>0</td>
</tr>
<tr>
<td>March 1990</td>
<td>March 1991</td>
<td>0</td>
</tr>
<tr>
<td>October 2008</td>
<td>May 2009</td>
<td>0</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

1. The results are based on the one-month ahead probability model.
In-Sample Forecasting Performance
Figure 2: Probability for Canada of Being in a Recession: 2008-2009\(^1\)
(probability, %)

- Peak of the expansion in October 2008
- Trough of the recession in May 2009

Source: The Forecasting Advisor.
1. One-month ahead probability.
Figure 3: Probability for Canada of Being in a Recession: 1990-1991\(^1\)

(probability, %)

Peak of the expansion in March 1990

Trough of the recession in March 1991

Signal with no lead/lag the start of the recession

Signal with no lead/lag the start of the expansion

Source: The Forecasting Advisor.
1. One-month ahead probability.
Figure 4: Probability for Canada of Being in a Recession: 1981-1982
(probability, %)

Source: The Forecasting Advisor.
1. One-month ahead probability.
Figure 5: Probability for Canada of Being in a Recession: 1980
(probability, %)

Peak of the expansion in January 1980
Signal with no lead/lag the start of the recession
Trough of the recession in June 1980
50% threshold

1. One-month ahead probability.

Source: The Forecasting Advisor.
Figure 6: Probability for Canada of Being in a Recession: 1975\(^1\) (probability, %)

Source: The Forecasting Advisor.
1. One-month ahead probability.
Out-of-Sample Forecasting Performance
Figure 7: Probability for Canada of Being in a Recession: In- and Out-of-Sample Probabilities from January 2000 to December 2012

(probability, %)

Source: The Forecasting Advisor.
1. The out-of-sample probabilities are computed with coefficients of the model estimated from January 1962 to December 1999. In-sample probabilities are computed from January 1962 to December 2012.
# Outlook on the Business Cycle in Canada

| Model's Forecast | Phase of the Business Cycle |  
|------------------|----------------------------|---
|                  | Actual                     | Outlook¹  
|                  | Expansion                  | Expansion    | Expansion     | Expansion    
| Probability of Being in a Recession | 0.0% | 0.0% | 0.0%  
| Predicted Outcome for the Business Cycle | Expansion to continue | Expansion to continue | Expansion to continue  

¹ The probabilities for February, March and April were computed on February 14, 2014.
Probability for Canada Being in a Recession

- Peak of the expansion in October 2008
- Trough of the recession in May 2009
- Signal in November a reversal to a recession
- Signal in May a reversal to an expansion
- Probabilities of 0% for January, February and March do not suggest an oncoming recession

Source: The Forecasting Advisor.
U.S. Stock Market Cycle Model
Introduction

- In contrast to forecasting the business cycle, there is only two studies to the best of our knowledge that have looked at the issue of forecasting the state of the stock market cycle in the U.S.

- The first study is from Chen (2009) and he evaluated the information content of various economic indicators in forecasting U.S. bear markets. With a static probit model, he showed that the yield curve and the inflation rate are the best predictors. Other good predictors are the unemployment rate, short-term interest rates, and industrial production.

- The second study is from Nyberg (2013). His results showed that the state of the U.S. stock market cycle is predictable in- and out-of-sample, but only when the lagged values of the state of the stock market cycle or (and) lagged values of the probability function is (are) included in the model. In other words, the autoregressive and dynamic autoregressive probit models outperform a static probit model in forecasting U.S. bear and bull markets.
The model

- The U.S. stock market is benchmarked with the S&P 500 index and the stock market is characterised by two phases: a bull or a bear market.

- The traditional probit modeling approach is used to calculate the probability of a reversal in the stock market cycle between bear and bull phases. Lagged values of the state of the stock market cycle or (and) lagged values of the probability function is (are) not included in the model.

- The model, which is estimated with monthly data from January 1964, includes a number of U.S. economic indicators, such as production, the unemployment rate and the inflation rate.

- The predicted outcome for the U.S. stock market is determined using the usual 50% threshold:
  - When a bull market exists, the model predicts a reversal to a bear market if the probability is equal to or exceeds 50%. Otherwise, the model predicts that the bull market will continue.
  - When a bear market exists, the model predicts a reversal to a bull market if the probability is equal to or falls below 50%. Otherwise, the model predicts that the bear market will continue.

- Figure 1 (next slide) illustrates the monthly evolution of the probability of the S&P 500 index being in a bear market (blue line), the bear market periods (grey shaded areas) and the level of the S&P 500 (red line) since January 1964.

1. It is possible that an increase (decline) in the probability to above (below) 50% could be explained by a limited number of the model’s explanatory variables. In the future, when the model signals a reversal in the state of the stock market cycle, the source of the change in the probability will be investigated in order to reduce the risk of a false alarm.
Figure 1: Probability of the S&P 500 Index Being in a Bear Market¹: 1964-2012

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).
1. In-sample probabilities from the one-month ahead regression probit model.
* See Table 1 for reference dates for the stock market cycle.
### Table 1
Some Key Probit Estimation Output for the U.S. Stock Market Cycle Model

<table>
<thead>
<tr>
<th>Model</th>
<th>McFadden R-square</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Stock Market Cycle Model</td>
<td>0.79</td>
</tr>
<tr>
<td><strong>Alternative probit models:</strong></td>
<td></td>
</tr>
<tr>
<td>Chen (2009)</td>
<td></td>
</tr>
<tr>
<td>Nyberg (2013)</td>
<td></td>
</tr>
<tr>
<td><strong>Prediction Evaluation</strong></td>
<td></td>
</tr>
<tr>
<td>(Success rate based on the 50% rule)</td>
<td></td>
</tr>
<tr>
<td><strong>Predicted / Total Bear Market Months</strong></td>
<td></td>
</tr>
<tr>
<td>126 / 139 (91%)</td>
<td>35 / 43 (81%)</td>
</tr>
<tr>
<td><strong>Predicted / Total Bull Market Months</strong></td>
<td></td>
</tr>
<tr>
<td>446 / 456 (98%)</td>
<td>82 / 89 (92%)</td>
</tr>
</tbody>
</table>

1. The results are from the one-month ahead probability model.
2. Based on the static probit model approach.
3. The last two values comes from an autoregressive and a dynamic/autoregressive probit model.
**Table 2**

Performance of the Model in Forecasting the Reversals to Bear and Bull Markets in the S&P 500 Index since 1966

<table>
<thead>
<tr>
<th>Actual start of the bear market</th>
<th>Signal of a shift to a bear market</th>
<th># of months before (-) or after (+) the actual start of a bear market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb. 1966</td>
<td>Apr. 1966</td>
<td>+2</td>
</tr>
<tr>
<td>Dec. 1980</td>
<td>Dec. 1980</td>
<td>0</td>
</tr>
<tr>
<td>Sep. 1987</td>
<td>Nov. 1987</td>
<td>+2</td>
</tr>
<tr>
<td>Jul. 1990</td>
<td>Jul. 1990</td>
<td>0</td>
</tr>
<tr>
<td>Nov. 2007</td>
<td>Sep. 2007</td>
<td>-2</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>-0.7</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actual start of the bull market</th>
<th>Signal of a shift to a bull market</th>
<th># of months before (-) or after (+) the actual start of a bull market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nov. 1966</td>
<td>Nov. 1966</td>
<td>0</td>
</tr>
<tr>
<td>Jan. 1975</td>
<td>Jan. 1975</td>
<td>0</td>
</tr>
<tr>
<td>Apr. 1978</td>
<td>Dec. 1977</td>
<td>-4</td>
</tr>
<tr>
<td>Aug. 1982</td>
<td>May 1982</td>
<td>-3</td>
</tr>
<tr>
<td>Nov. 1990</td>
<td>Dec. 1990</td>
<td>+1</td>
</tr>
<tr>
<td>Apr. 2009</td>
<td>Apr. 2009</td>
<td>0</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td><strong>-0.9</strong></td>
</tr>
</tbody>
</table>

1. There are no official reference dates for the start and the end of bear markets for the S&P 500 price index. A bear market is generally defined as a decline of about 20% or more spread in a broad market index over a period of at least two months (see Tables 2 and 3 at the end of the document for the duration and percentage change in all the bear and bull markets since 1966). The dates reported in Table 1 correspond to those available in the economic literature.

2. The signals were determined using the usual 50% threshold.
In-Sample Forecasting Performance
Figure 2: Probability of the S&P 500 Index Being in a Bear Market,¹ 2007-2009

(probability, %)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹ In-sample probabilities from the one-month ahead probability model.
Figure 3: Probability of the S&P 500 Index Being in a Bear Market,¹ 2000-2002

(probability, %)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹. In-sample probabilities from the one-month ahead probability model.
Figure 4: Probability of the S&P 500 Index Being in a Bear Market,¹ 1990

(probability, %) (index)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹ In-sample probabilities from the one-month ahead probability model.
Figure 5: Probability of the S&P 500 Index Being in a Bear Market,¹ 1987

(probability, %)  (index)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹. In-sample probabilities from the one-month ahead probability model.
Figure 6: Probability of the S&P 500 Index Being in a Bear Market,¹ 1980-1982

(probability, %)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹. In-sample probabilities from the one-month ahead probability model.
Figure 7: Probability of the S&P 500 Index Being in a Bear Market,¹ 1976-1978

(probability, %)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹ In-sample probabilities from the one-month ahead probability model.
Figure 8: Probability of the S&P 500 Index Being in a Bear Market,\(^1\) 1973-1975

(probability, %) (index)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

1. In-sample probabilities from the one-month ahead probability model.
Figure 9: Probability of the S&P 500 Index Being in a Bear Market,¹ 1969-1970
(probability, %)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹. In-sample probabilities from the one-month ahead probability model.
Figure 10: Probability of the S&P 500 Index Being in a Bear Market,¹ 1966

(probability, %)

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability).

¹In-sample probabilities from the one-month ahead probability model.
Out-of-Sample Forecasting Performance
Figure 11: Probability of the S&P 500 Index Being in a Bear Market¹: In- and Out-of-Sample Probabilities from January 2000 to December 2010²

Sources: Federal Reserve Bank of St-Louis Fred Database (S&P 500 index) and The Forecasting Advisor (probability). 1. One-month ahead probability. 2. The out-of-sample probabilities were computed with coefficients estimated from January 1964 to December 1999 and the in-sample probabilities with coefficients estimated from January 1964 to December 2012.
## Outlook on the Stock Market Cycle in the U.S.

<table>
<thead>
<tr>
<th>Model's Forecast</th>
<th>Probability of Being in a Bear Market</th>
<th>Predicted Outcome for the Stock Market</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bull market</td>
<td>0.0%</td>
<td>Bull market will continue</td>
</tr>
<tr>
<td>Bull market</td>
<td>0.3%</td>
<td>Bull market will continue</td>
</tr>
</tbody>
</table>

1. The probabilities were computed on February 7, 2014.
Probability of the S&P 500 Index Being in a Bear Market

- October 2007 peak
- March 2009 trough
- 50% threshold
- Signal a reversal to a bear market
- Signal a reversal to a bull market
- Probabilities of 0.0% for February and March do not suggest a reversal to a bear market

Source: The Forecasting Advisor.
Forecasting Canadian Real GDP and Employment by Industry

Robert Lamy
The Forecasting Advisor
www.theforecastingadvisor.com
Forecasting Real GDP by Industry in Canada
The general form of the GDP equation by industry is presented below:

\[ GDP^i_t = f(D_{t-i}, EXR_t, V_t, GDP^i_{t-1}) \]

where

- \( GDP^i \) is the value of real gross domestic product (GDP) for the industry \( i \)
- \( D \) is a vector of long-term determinants of real GDP in the industry \( i \), such as foreign/domestic economic activity.
- \( EXR \) is the Canada-US real exchange rate
- \( V \) is a vector of short-term determinants of real GDP for the industry \( i \), such as the rate of growth in foreign/domestic economic activity.
- \( GDP^i \) is the value of real GDP for the industry \( i \) at time \( t-1 \)
For the goods-producing sector, there is an equation for each of the following industry:

- Agriculture, forestry, fishing, and trapping (NAICS 11); Oil and gas extraction and mining (NAICS 21)
- Utility (NAICS 22); Construction (NAICS 23)
- Food (NAICS 311); Beverage and tobacco products (NAICS 312)
- Textile, clothing and leather (NAICS 313, 314, 315, 316)
- Wood product (NAICS 321); Paper (NAICS 322)
- Printing (NAICS 323)
- Petroleum and coal product (NAICS 324); Chemical (NAICS 325)
- Plastic and rubber products (NAICS 326)
- Non-metallic mineral products (NAICS 327)
- Primary metal (NAICS 331); Fabricated metal product (NAICS 332)
- Machinery (NAICS 333)
- Computer and electronic product (NAICS 334)
- Electrical equipment and appliance (NAICS 335)
- Automotive industry (NAICS 3361, 3362, 3363)
- Other transportation equipment (NAICS 3364, 3365, 3366, 3369)
- Furniture (NAICS 337, 339)
For the services-producing sector, there is an equation for each of the following industry:

- Wholesale trade (NAICS 41); Retail trade (NAICS 44, 45)
- Transportation and warehousing (NAICS 48, 49)
- Information and cultural industries (NAICS 51)
- Finance and insurance, real estate, rental and leasing (NAICS 52, 53)
- Professional, scientific, and technical services (NAICS 54)
- Management and administration and support (NAICS 55, 56)
- Educational services (NAICS 61); Heath care and social services (NAICS 62)
- Arts, entertainment, and recreation (NAICS 71)
- Accommodation and food services (NAICS 72)
- Public administration (NAICS 91); Other services (NAICS 81)

The equations generate a projection of GDP for each of the thirty-five industries for the current year and the following year.
## Properties

Impact of a Change in Demand and the Exchange Rate on Real GDP by Sector and Industry

<table>
<thead>
<tr>
<th>Sector</th>
<th>Impact of 1% Increase in Foreign and Domestic Economic Activity</th>
<th>Impact of 10% Appreciation of the Canadian Dollar against the U.S. Dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods sector</td>
<td>0.9%</td>
<td>-3.4%</td>
</tr>
<tr>
<td>Primary</td>
<td>0.5%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Construction¹</td>
<td>0.8%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1.0%</td>
<td>-6.5%</td>
</tr>
<tr>
<td>Services sector</td>
<td>0.8%</td>
<td>0.0%</td>
</tr>
<tr>
<td>All Industry</td>
<td>0.9%</td>
<td>-1.1%</td>
</tr>
</tbody>
</table>

¹ Includes the utility industry.
Forecasting Performance

Real GDP Growth in All Industry

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Real GDP Growth in the Primary Industry (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Real GDP Growth in the Manufacturing Industry (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Real GDP Growth in the Goods Sector (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Real GDP Growth in the Services Sector (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Real GDP Growth in Oil and Gas and Mining Industry: In-Sample Forecasting Performance

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Real GDP Growth in Motor Vehicle Industry: In-Sample Forecasting Performance

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Real GDP Growth in the Retail Trade Industry: In-Sample Forecasting Performance

( % )

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Employment by Industry in Canada
Core Drivers

- In the long-term, employment by industry is determined by a number of economic variables, such as:
  - Foreign and domestic economic activity
  - Canada-U.S. exchange rate
  - World commodity prices

- In the short-term, employment by industry is influenced by the changes in the variables listed above plus economic uncertainty (proxy by the change in the unemployment rate).
The general form of the employment equation by industry is presented below:

\[ E^i_t = f(D^i_{t-i}, EXR_t, V_t, E^i_{t-1}) \]

where
- \( E^i \) is employment in the industry \( i \)
- \( D \) is a vector of long-term determinants of employment in the industry \( i \), such as foreign/domestic economic activity
- \( EXR \) is the Canada-U.S. real exchange rate
- \( V \) is a vector of short-term determinants of employment in the industry \( i \), such as the rate of growth in foreign/domestic economic activity
- \( E^i \) is employment in the industry \( i \) at time \( t-1 \)
For the goods-producing sector, there is an equation for each of the following industry:

- Agriculture, forestry, fishing, and trapping (NAICS 11);
- Mining, quarrying, and oil and gas extraction (NAICS 21)
- Utility (NAICS 22); Construction (NAICS 23)
- Food and beverage and tobacco product manufacturing (NAICS 311, 312)
- Textile mills, textile product mills, clothing and leather allied product manufacturing (NAICS 313, 314, 315, 316)
- Wood product manufacturing (NAICS 321); Paper manufacturing (NAICS 322)
- Printing and related support activities (NAICS 323)
- Petroleum and coal product manufacturing (NAICS 324); Chemical manufacturing (NAICS 325)
- Plastic and rubber products manufacturing (NAICS 326)
- Non-metallic mineral product manufacturing (NAICS 327)
- Primary metal manufacturing (NAICS 331);
- Fabricated metal product manufacturing (NAICS 332)
- Machinery manufacturing (NAICS 333);
- Computer and electronic product manufacturing (NAICS 334)
- Electrical equipment and appliance manufacturing (NAICS 335)
- Motor vehicle and parts manufacturing (NAICS 3361, 3362, 3363)
- Other transportation equipment manufacturing (NAICS 3364, 3365, 3366, 3369)
- Furniture and miscellaneous manufacturing (NAICS 337, 339)
For the services-producing sector, there is an equation for each of the following industry:

- Trade (NAICS 41, 44, 45)
- Transportation and warehousing (NAICS 48, 49)
- Information and cultural industries and arts, entertainment, and recreation (NAICS 51, 71)
- Finance and insurance, real estate, rental and leasing (NAICS 52, 53)
- Professional, scientific, and technical services (NAICS 54)
- Management and administration and support (NAICS 55, 56)
- Educational services (NAICS 61); Heath care and social services (NAICS 62)
  Accommodation and food services (NAICS 72)
- Public administration (NAICS 91); Other services (NAICS 81)

The equations generate a projection of employment for each of the thirty-two industries for the current year and the following year.
## Properties

Impact of a Change in Demand and the Exchange Rate on Employment by Sector and Industry

<table>
<thead>
<tr>
<th>Sector</th>
<th>Impact of 1% Increase in Foreign and Domestic Economic Activity</th>
<th>Impact of 10% Appreciation of the Canadian Dollar against the U.S. Dollar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goods sector</td>
<td>0.4%</td>
<td>-4.7%</td>
</tr>
<tr>
<td>Primary</td>
<td>0.0%</td>
<td>-2.3%</td>
</tr>
<tr>
<td>Construction¹</td>
<td>0.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>0.3%</td>
<td>-7.4%</td>
</tr>
<tr>
<td>Services sector</td>
<td>0.4%</td>
<td>0.0%</td>
</tr>
<tr>
<td>All industry</td>
<td>0.4%</td>
<td>-1.2%</td>
</tr>
</tbody>
</table>

¹ Includes the utility industry.
Forecasting Performance

Employment Growth in All Industry (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Employment Growth in the Primary Industry (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Employment Growth in the Manufacturing Industry (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Employment Growth in the Goods Sector (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Forecasting Performance

Employment Growth in the Services Sector (%)

- Actual
- Dynamic simulation
- Static simulation

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Employment Growth in Oil and Gas and Mining Industry: In-Sample Forecasting Performance (%)

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Employment Growth in Automotive Industry: In-Sample Forecasting Performance

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Employment Growth in the Trade Industry: In-Sample Forecasting Performance

Sources: Statistics Canada (actual data) and The Forecasting Advisor (simulation).
Thanks!