Constructing NEO:
A Near-term Employment Outlook

Edda Claus

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Abstract

The goal of this paper was to create a short-term forecasting model for total employment in Canada. In an attempt to increase forecasting accuracy compared to typical forecasting models, a composite index of leading indicators of employment was created. The index performs very well in signalling cyclical changes in employment and was included, as an explanatory variable, in a quarterly indicator model of employment. One-quarter out-of-sample forecasts were generated over the period of 1993Q1 to 1999Q3. The model performs extremely well. The mean absolute forecast error over the testing period is only thirty-six per cent of the average quarterly changes in employment over that same period. The out-of-sample forecasts were also compared to forecasts of four alternative models. The indicator model clearly outperforms the alternative models in terms of forecasting performance and promises to be an effective tool for forecasting quarterly changes in Canadian employment.

Résumé

L'objectif de cette étude était de construire un modèle de prévision à court terme de l'emploi total au Canada. Afin de réduire l'erreur de prévision telle que révèlent les modèles traditionnels, j'ai créé un indice composite d'indicateurs avancés de l'emploi. L'indice signale clairement les changements cycliques dans l'emploi canadien. Je l'ai alors inclus, comme variable explicative, dans un modèle d'indicateur. Mes résultats empiriques montrent que la performance prédictive de ce modèle est très bonne. L'erreur moyenne absolue des prévisions hors échantillon un trimestre à l'avance pour la période de 1993T1 à 1999T3 n'est que trente-six pour cent de la variation moyenne de l'emploi au cours de cette même période. Pour mettre à l'épreuve la performance relative de mon modèle, j'ai comparé ces prévisions à ceux de quatre modèles alternatifs. Le modèle d'indicateur est clairement dominant au niveau des prévisions un trimestre à l'avance. Bref, le modèle indicateur pourrait devenir un outil très utile pour prédire, à court terme, les variations de l'emploi canadien.

Contents **Page**

1. Introduction

The purpose of this study was to create a near-term forecasting model of total employment in Canada.[1] In an attempt to increase forecasting accuracy, a composite index of leading indicators of employment was constructed. This index then served as an explanatory variable in a multivariate indicator model that was used to predicting future changes in employment in Canada.

An indicator model is a single equation multivariate model. Indicator models recognise that an economic series exhibits fluctuations as well as cyclical variations. The different stages of the cycle are approximated by a composite index of leading-, lagging-, or coincident indicators while other economic fluctuations are embodied in the remaining explanatory variables in the model. Usual econometric models cannot make this distinction.

A composite index of leading indicators of employment (LIE) was first constructed and included in the quarterly near-term outlook (NEO) model to capture the underlying cyclical aspect of employment growth in Canada. The two other explanatory variables in NEO, real commodity prices and the share of respondents expecting more jobs in the next six months from the Conference Board of Canada, are meant to embody non-cyclical changes in employment.

To assess the NEO, its forecast performance was compared with those of four benchmark models (an ARIMA and three VARs including a quarterly version of Paquet et al. (1999)). The indicator model clearly outperformed the four alternatives in terms of forecasting accuracy.

The paper is organised as follows. Part two outlines the components and construction of the composite index of leading indicators of employment. Part three discusses the components and construction of the quarterly indicator model of employment. Part four focuses on the forecasting performance of the indicator model relative to four benchmark models. Conclusions are presented in the fifth part.

2. Components and Construction of the Composite Index of Leading Indicators of Employment (LIE)

A composite index of leading indicators is the weighted average of a variety of leading indicators. It is designed to signal turning points of the economic variable it is leading. A composite index should be diversified. It should broadly cover various economic sectors with a minimum of duplication. Such an index therefore tends to be more reliable as a cyclical indicator than any of its components taken individually. Furthermore, much of the independent measurement error and other “noise” in the component series are smoothed out in the index. Hence, a composite index of leading indicators of employment can provide useful information on current and future changes in the reference variable.

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[1] Total employment includes all workers 15 years and older

A monthly instead of a quarterly composite index of leading indicators of employment (LIE) was constructed for two reasons. First, monthly data can reveal important leads and lags that might be lost at a quarterly frequency. Second, Canada's Labour Force Survey (LFS) data that were used for the total employment series are published with a very short lag relative to most economic time series. For example, data for the month of October are generally published in the first week of November. So, the third month in the quarter for those series, whose publication is not as timely, can be assumed unchanged from the second month and that estimate should be reasonably close to the actual quarterly observation. This allows the composite index to be updated even though the last month of the quarter has not been published for all components. This increases timeliness with little effect on accuracy.

2a. Components

When constructing a composite index of leading indicators, it is useful to start on a very broad basis and then drop variables that do not add any information. This way no potential information is excluded. As the overall level of employment is affected by different sectors, a large number of potential variables broadly covering the Canadian economy should be considered. So, for the construction of the LIE, 71 different series were considered. The complete list of these 71 series can be found in Appendix A. These can be divided into nine broad categories:

i. Aggregate economic activity indicators: As employment growth generally lags GDP growth, a rise or fall in these indicators should indicate future employment growth or contraction.

ii. Domestic consumption indicators: Much like aggregate economic activity, employment growth lags changes in domestic demand.

iii. Residential investment indicators: Residential investment series, such as residential building permits, are good indicators of changes in future construction activity. Construction is a very volatile part of total employment.

iv. Non-residential investment indicators: Non-residential investment is a very volatile part of GDP and hence it introduces volatility to total employment.

v. Consumer confidence indicators: Torgunrud (1999) showed that consumer confidence indicators, particularly the sub-components relating to expectations of future job growth, contain useful information for future employment growth in Canada.

vi. U.S. economic activity indicators: Canada is a very open economy, relying heavily on exports. Close to forty per cent of Canada's GDP are exports and over eighty per cent of those exports are destined to the U.S. market. Hence, U.S. economic activity is very important for Canadian growth. Via exports, higher growth in the U.S. ultimately translates into more jobs in Canada.

vii. Financial and monetary variables: The inclusion of monetary variables, such as interest rates and the money supply, should capture the effects of monetary conditions on the economy. Furthermore, as Canada is a net commodity exporter, a rise in commodity prices has a stimulating effect on the economy and hence on jobs. Canadian stock market indexes could contain information on future developments in the Canadian economy.

viii. U.S. financial and monetary indicators: As outlined earlier, developments in the United States are very important for the Canadian economy. These variables should give an indication for future developments South of the border that will eventually influence economic activity and job creation in Canada.

ix. Labour market indicators: The employment indicators, such as hours and those derived from surveys, should point to future changes in the labour market. Typically, hours rise prior to increases in total employment, as it is easier for employers to have employee's work over-time than to hire additional staff. As most workers are only willing to work over-time for a limited period of time, new staff is typically hired if the workload remains high for a prolonged period of time. Therefore, growth in hours often leads employment growth.

2b. Construction

The LIE was constructed using the National Bureau of Economic Research (NBER) approach. The algebraic operations can be found in Appendix C.

Table 1: Construction of the Composite Index of Leading Indicators

Composite Index of Leading Indicators of Employment
1. Selection and standardisation of all potential components 2. Weighting of selected components and cumulation into an index 3. Index standardisation and trend adjustment

Note: The description is taken in part from Zarnowitz and Boschan (1975)

The components of a composite index of leading indicators are selected with the help of a formal, detailed scoring system that places particular emphasis on cyclical timing compared to the reference series. Quarterly data, such as the Consumer Confidence Index and its components, and the Manpower Survey and its components, were transformed into monthly series using the cubic spline technique. First, all variables were transformed to ensure symmetrical treatment of positive and negative changes (Step 1 in Table 1). The transformation formula can be found in Appendix C. Second, all variables were considered one by one through regression and correlation analysis. The standardised employment growth was regressed on the standardised change of every variable at lag zero to twelve months. The correlation between the transformed employment and each transformed variable were also computed. A range of indexes was constructed including variables from each of the nine categories. Series were then added or deleted from the potential LIEs. The inclusion or exclusion of component series is not straight forward, partly because there is not necessarily a strong theoretical link between each of the series and employment growth. Hence series are often included because they perform well in relation to employment cycles, not because they are the operational counterparts of variables in an economic theory of employment cycles. However, there should be some economic rationale for including each series in the index (see section 1a). The inclusion or exclusion of each of the 71 series in question was primarily based on statistical significance, but I also took forecasting performance into consideration.

Building a composite index of leading indicators involves a certain degree of subjectivity when choosing the weights of the component series. For the LIE the maximum regression coefficient obtained from regressing employment on each series with lags zero to twelve months[2] was chosen as the criteria.[3] This led to the best results in terms of the indexes correlation with employment and forecasting performance (Step 2 in Table 1). I could have used equal weights for all components. However, it does not seem reasonable that building permits, for example, should have the same weight as a U.S. economic activity indicator. Furthermore, using equal weights drastically decreases the correlation between the LIE and employment and significantly worsens the forecasting performance of the indicator model.

The estimation period was March 1981 to September 1999.[4] Once the weights were determined, the composite index was normalised by dividing it by the sum of the weights.

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[2] This led to 71 * 13 = 923 bivariate regressions.

[3] All regressions revealed autocorrelated errors. All 923 regressions with an MA(2) and an MA(3) term to correct for autocorrelation were re-estimated. This led to white noise errors. The relative size of those coefficients used as weights in the LIE remained virtually unchanged compared to the coefficients generated without the MA terms. Therefore, as all seven component series maintained their relative importance in the index, using the adjusted coefficients had virtually no impact on the LIE and the forecast performance of the indicator model.

Again, for lags of zero to twelve months, I also considered the maximum regression R-squared, the maximum correlation and the maximum R-squared obtained from regressions that were adjusted for autocorrelation as weights for the composite index. But using these weights produced inferior results for the index and the indicator model.

[4] Both the LIE and the NEO were reconstructed using the revised Labour Force Survey data, released February 3, 2000.

The following raw LIE was chosen on grounds of statistical significance, economic theory and forecasting performance.

$$raw\ LIE = (w_1 h\dot{s}tart + w_2 ca\dot{r}hs + w_3 n\dot{r}bp + w_4 sh\dot{i}p + w_5 na\dot{p}mpi + w_6 \dot{M}1 + w_7 h\dot{w}i)/W$$

where:

hstart : Housing starts

carhs : Sum of unit sales of passenger cars and MLS unit sales of existing houses

nrbp : Real non-residential building permits

ship : Manufacturing shipments

napmpi : NAPM[5] production index

M1 : Real M1

hwi : Help-wanted index

w_i : Maximum regression coefficient of:

$emp_t = c_1 + c_2 X_{i,\ t-j}$, for i = 1 … 7, j = 0 … 12

where emp : total employment

X_i : i^{th} component variable

c_1 : constant

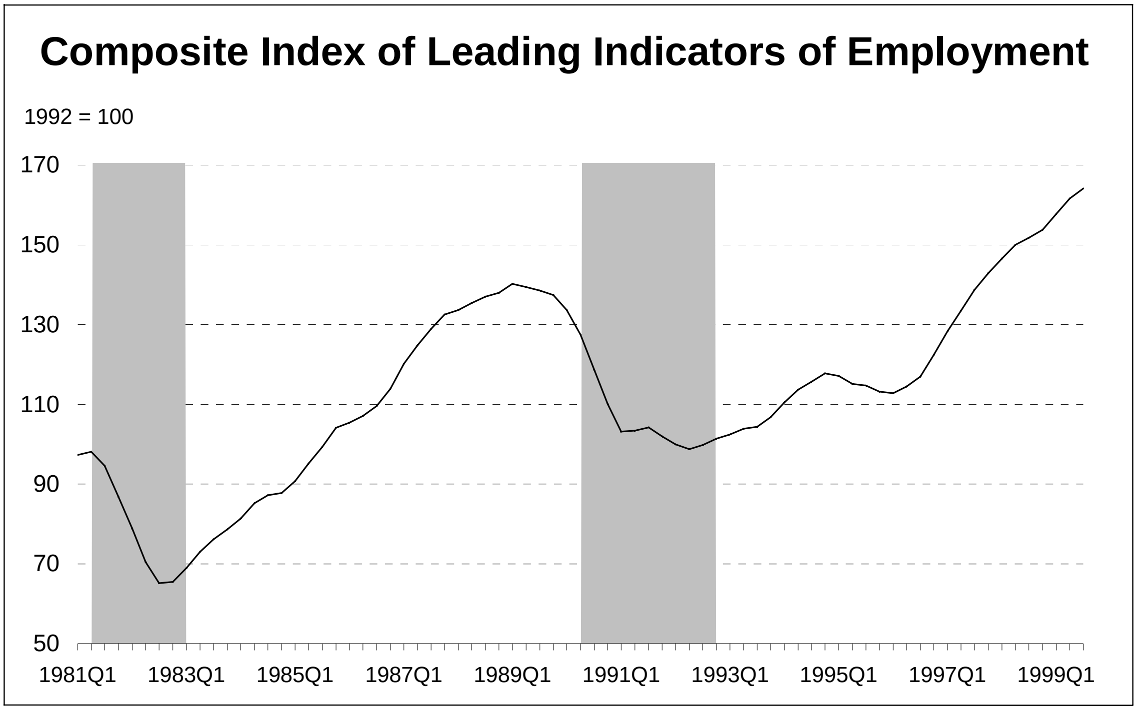
W : $W = \sum_{i=1}^{7} w_i$

All variables are standardised changes indicated by the "dot".

The raw index above was then standardised; its trend was adjusted to reflect trend employment growth and was set to 100 in 1992 (Step 3 in Table 1).

[5] National Association of Purchasing Management (NAPM)

Graph 1:



Graph 1 shows the performance of the LIE in relation to the cyclical downturns in employment[6] indicated by the shaded areas. The graph demonstrates that the composite index of leading indicators of employment is a very effective tool for signalling cyclical movements in Canadian employment. It leads all cyclical turns and exhibits only one false signal in 1995. Its inclusion in a quarterly forecasting model should therefore increase the model's accuracy considerably.

3. Construction of the Near-term Employment Outlook Model (NEO)

Employment in Canada varies greatly on a month-to-month basis. It is therefore extremely difficult to forecast monthly changes in employment. Hence, I built a quarterly indicator model, the Near-term Employment Outlook (NEO). Much like the approach to build the composite index of leading indicators, variables from different sectors of the Canadian economy were considered and chosen on grounds of statistical, theoretical and forecasting performance. Variables from seven different sectors were considered. The complete list of those sectors and the economic rationale for considering variables from each of them can be found in Appendix B.

[6] A cyclical downturn is defined as two consecutive quarters of negative growth.

The model was estimated in first differences except for the bounded series, of course. Economic theory, statistical significance and forecasting performance led to the selection of the following model.

$$\Delta emp_t = \alpha_0 + \alpha_1 \Delta lie_{t-1} + \alpha_2 \Delta comp_{t-3} + \alpha_3 n3msa_{t-5} + \varepsilon_t$$

where:

emp :	Total employment in Canada, 15+
lie :	Composite index of leading indicators for employment
comp :	The Bank of Canada real commodity price index
n3msa :	The Conference Board's Survey of Consumer Confidence, per cent of respondents expecting more jobs in the next six months
α_0 :	Constant
ε :	White noise error

Table 3 outlines the regression results of the model. All variables are significant at the 5 per cent level. Seventy-nine per cent of the variation in employment is explained by the regression variables. The composite index of leading indicators clearly dominates the regression. All coefficients display the correct sign.

Table 3:

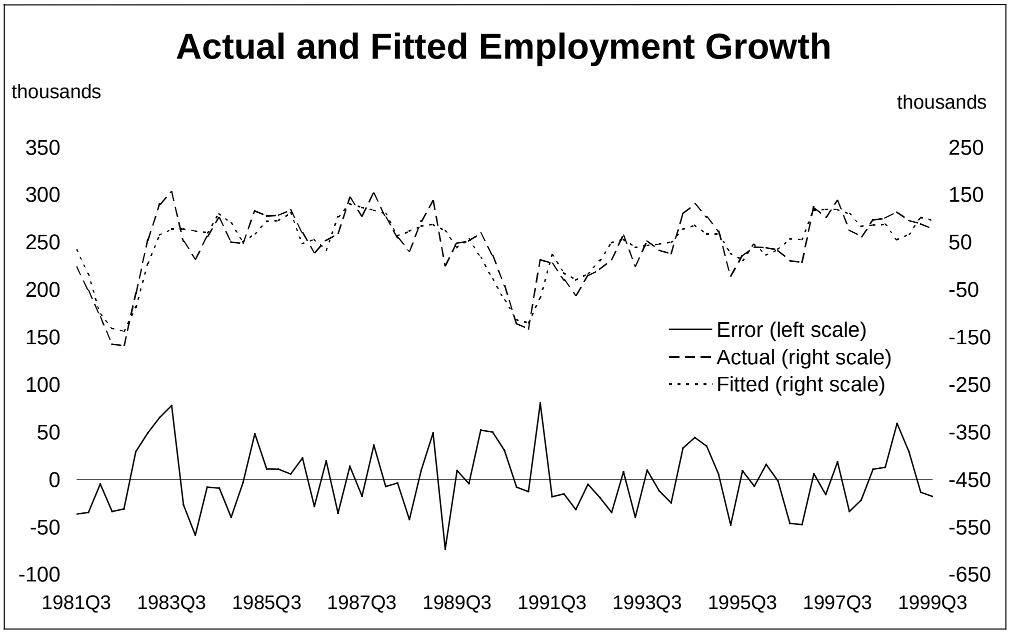
Dependent Variable: ΔEMP
Method: Least Squares
Date: 02/09/00 Time: 12:58
Sample: 1981Q3 1999Q3
Included observations: 73

Variable	Coefficient	Std. Error	t-Statistic	Prob.
α_0	-1.811874	15.23879	-0.118899	0.9057
ΔLIE(-1)	16.94166	1.086942	15.58654	0.0000
ΔCOMP(-3)	2.905456	0.879935	3.301899	0.0015
N3MSA(-5)	1.910104	0.760861	2.510452	0.0144

R-squared	0.791753	Mean dependent var	44.23105
Adjusted R-squared	0.782699	S.D. dependent var	72.40342
S.E. of regression	33.75128	Akaike info criterion	9.929150
Sum squared resid	78601.26	Schwarz criterion	10.05465
Log likelihood	-358.4140	F-statistic	87.44573
Durbin-Watson stat	1.654248	Prob(F-statistic)	0.000000

Graph 2 clearly illustrates that, in sample, the model fits employment growth in Canada very well. It identifies most turning points and produces white noise errors. Additional residual tests find no autocorrelation[7] and do not reject normality. Recursive stability tests reveal very stable coefficients over the entire estimation period.

Graph 2:



The indicator model is superior to a single equation multivariate model that contains the component series of the LIE. NEO was re-estimated excluding the LIE but including the help-wanted index, the NAPM production index and real M1, the three components with the largest weights in the LIE.[8] The fit and the forecasting performance of this re-estimated version were considerably worse than those of the indicator model.

4. Forecasting Performance of NEO

The selected indicator model was evaluated for its forecasting performance. Graph 3, a static simulation of employment between 1981Q3 and 1999Q3 and actual employment, shows that the model tracks actual employment growth very well. There are no systematic errors.

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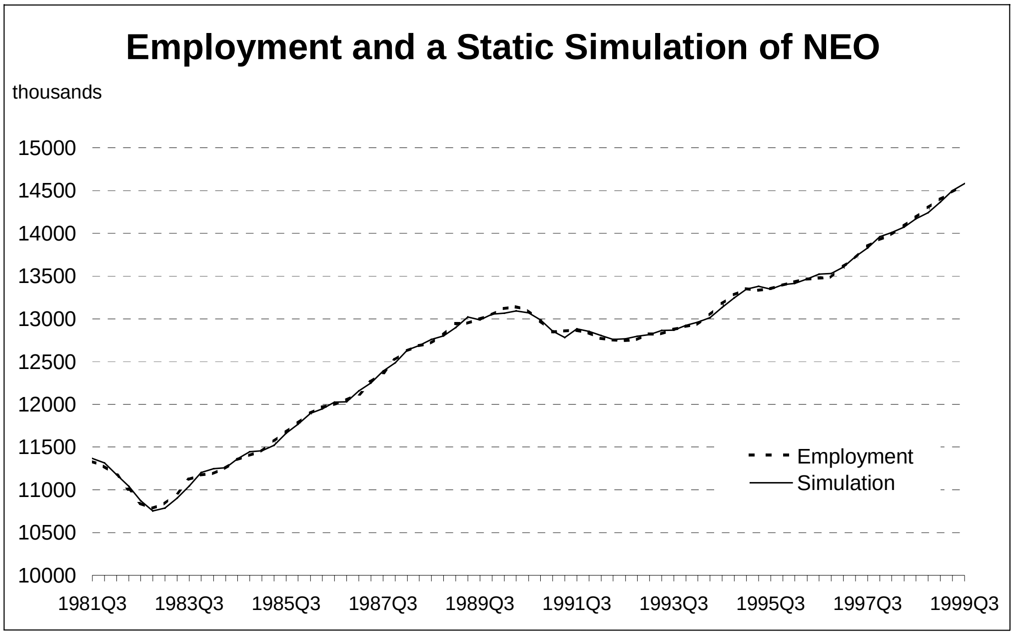
[7] The regression residuals are not autocorrelated despite of what the Durbin-Watson statistic indicates.

[8] Considerations for parsimony and concerns of overspecification led to the inclusion of three rather than all the seven variables of the LIE.

Graph 3:



In order to assess how well NEO performs in comparison to other models, four alternatives were considered: (a) a univariate ARIMA (1,1,0), (b) a simple VAR including the LIE, (c) a simple VAR including the help-wanted index and (d) the Paquet et al. model[9] (the monthly VAR model was transferred into a quarterly VAR). The Paquet et al. model is a four-variable VAR that includes the level of employment, the help-wanted index, the natural logarithm of Statistics Canada's composite index of leading indicators of the Canadian economy and the slope of the yield curve, defined as the difference between the 3-month Treasury-Bill rate and the yield on a 10-year and over Federal government bond. The lag lengths of the three VARs were determined by minimising the Schwarz information criterion.

In order to make sensible comparisons with the Paquet et al. model, the same specification was used for NEO and the other three benchmark models. All five models were estimated over the 1983Q1 to 1992Q4 specification sample. Then, one-quarter out-of-sample forecasts were constructed over the 1993Q1 to 1999Q3 period using a fixed specification 10-year rolling window approach. This led to 27 one-quarter forecasts. This forecast exercise enabled me to compare the relative forecasting performance of NEO compared to the four benchmark models. Table 4 presents the mean absolute forecast error (MAE), the root mean squared forecast error (RMSE) and the U-Theil inequality coefficient of each model. The smaller the values of the MAE and the RMSE, the more accurate, on average,

9 In their 1999 paper, Fauvel, Paquet and Zimmermann from Université du Québec à Montréal construct various models to forecast employment. The authors create univariate (ARIMA), multivariate vector autoregressive (VAR) and multivariate indicator models. Among those three classes of models, Paquet et al. conclude that the VAR model tends to lead to the best forecasts of total employment in Canada over the January 1993 to September 1998 period.

the forecast. The smaller the value of the U-Theil, the better the model performs compared to a naïve model of no-change over the testing sample.

Table 4: Performance of NEO

	MAE	RMSE	U-Theil
NEO	24.1	30.8	0.39
ARIMA (1, 1, 0)	29.7	40.4	0.51
VAR (employment, LIE)	32.2	38.2	0.48
VAR (employment, HWI)	34.3	42.7	0.54
VAR (Paquet et al.)	31.1	39.3	0.50

Table 4 indicates that NEO clearly outperforms the four benchmark models. Its MAE, RMSE and U-Theil are significantly lower than those of any other of the four alternatives. Its MAE is 19 per cent lower than that of the ARIMA model and 23 per cent lower than that of the Paquet et al. model. Its RMSE is 24 per cent and 22 per cent lower than that of the ARIMA and the Paquet et al. model respectively. Its U-Theil is also significantly lower. It is the only model whose RMSE is 60 per cent smaller than that of the naïve model of no change. ARIMA models are very powerful forecasting tools at short forecast horizons. The fact that NEO beats an ARIMA model indicates the statistical strength of the model. But NEO is also a more attractive forecasting tool, as, unlike ARIMA models, NEO is theoretically intuitive.

Table 5: Confusion Matrices

NEO		**VAR (employment, LIE)**		**VAR (Paquet et al.)**	
22	2	24	2	23	2
3	0	1	0	2	0
ARIMA (1, 1, 0)		**VAR (employment, HWI)**			
22	2	23	2		
3	0	2	0		

Table 5 shows the 2x2 confusion matrices for all five models. The confusion matrix records the proportion of times a model gives correct and incorrect directional predictions over the testing sample. Its upper (lower) diagonal element records the number of actual moves in the series that were up (down) while the predicted changes were up (down). Its lower-left (upper-right) off-diagonal element records the number of actual moves in the series that were up (down) while the predicted changes were down (up).[10] Given the difficulty of forecasting total employment in Canada, all models do relatively well. The Paquet et al. model has four false signals, only slightly better than the NEO and the ARIMA with five false signals each. Given that there have been only two quarterly decreases of employment over the testing period, namely in the second quarter of 1993 and the second quarter of 1995, it is difficult to draw solid conclusions from the confusion matrices. None of the five models predicted those falls. One can only make a meaningful statement on the forecasting

[10] Paquet et al. (1999), p. 19

performance of the five models when there has been at least one full employment cycle. That would give a better indication how well the models predict actual cyclical changes in employment.

5. Concluding Remarks

This study set out to construct a short-term forecasting model for total employment in Canada. In an attempt to improve forecasting performance compared to standard econometric models, a composite index of leading indicators for employment was built to include in the forecasting model. The index performs very well in signalling cyclical changes in employment.

A quarterly indicator model (NEO) that includes that composite index of leading indicators of employment was then constructed. One-quarter out-of-sample forecasts were generated over the period of 1993Q1 to 1999Q3 and compared to those of four benchmark models. The indicator model clearly outperformed the four alternatives (an ARIMA and three VARs including a quarterly version of the Paquet et al. VAR) in terms of forecasting accuracy.

The near-term employment outlook model therefore appears to be an effective tool for forecasting one-quarter ahead changes in Canadian employment.

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Appendix A

Composite Index of Leading Indicators of Employment in Canada

	Variable	Description	Employment Cycles: Lead 81:8	Lead 82:12	Lead 90:04	Lead 92:4	Lag 81:8	Lag 82:12	Lag 90:04	Lag 92:4	Coinciding 81:8	Coinciding 82:12	Coinciding 90:04	Coinciding 92:4
x1	D0980595	Total employment, 15+												
Domestic Activity Indicators														
x2	i0056001	Real GDP at factor cost, SA	4	11	1	13								
x3	D0100031	Smoothed Statistics Canada Composite Leading Indicator	1	3	2	12								
x4	calei	Robert Lamy's index of Canadian economic activity	9	5	17	1								
Consumption Indicators														
x5	d0658216	Retail sales, Canada, total, all stores, SA (note: data only start in Jan '81)	NA	NA	1	15	NA	NA			NA	NA		
x6	MVEH_PCARSSA	Total motor vehicle sales, SA		11	7		3			48				
x7	pcarssa	Unit sales of passenger cars, data provided by Robert Lamy		11	7		3			48				
Residential Investment Indicators														
x8	D0846139	Residential building permits in values		6	3	15	4							
x9	bpr86	Residential building permits, data provided by Robert Lamy		6	3	15	4							
x10	Hstarts_Allsam	Housing starts	4	3	7	14								
x11	MLS_UNITSMSA	MLS sales (note: data only start in Jan '80)	4	7	15	24								
x12	unitsmsa	MLS unit sales of existing houses, data provided by Robert Lamy	23	7	5	27								
x13	pcarshs	Sum of Unit sales of passenger cars (pcarssa) and MLS unit sales of existing houses (unitsmsa), data provided by Robert Lamy	4	5	7	16								
Non Residential Investment Indicators														
x14	D0846140	Non residential building permits in values			8		3	4		20				
x15	bpnr86	non residential building permits, data provided by Robert Lamy			14		3	4		20				
x16	D0318284	Ratio of total inventory owned to shipments, all manfacturing industries					8	73	11	33				

x17	stoir	Sales to inventory ratio, data provided by Robert Lamy	32	8	27	13						
x18	D0315351	Shipments, estimated values of goods, all manufacturing industries, sa	1	11	14	13						
x19	D0315351 + (1-L) D0318159	Total production, all manufacturing industries (note: data only start in Feb '81)	2		11	13						0
Confidence Indicators												
x20	cbisa	Consumer confidence index, national	26	6	34	16						
x21	n3msa	Consumer confidence index, respondents expect more jobs in the next six months	29	6	25	16						
x22	n3fsa	Consumer confidence index, respondents expect fewer jobs in the next six months					10	12	8	32		
U.S. Economic Activity Indicators												
x23	ipus	US industrial production, total index	1		12	13						0
x24	leadus	Conference Board composite leading indicator for US, 1992 = 100	4	9	22	15						
x25	coinus	Conference Board coincident leading indicator for US, 1992 = 100				1			3		0	0
x26	D0099950	Statistics Canada composit leading index for US, 1967 = 100	29	11		15			3			
x27	uslei	Robert Lamy's leading indicator of US economic activity	43	4	3	3						
x28	napmus	Purchasing Managers' Index National Association of Purchasing Management (NAPM)	9	7	29	15						
x29	napmipus	Production Index	9	13	29	15						
x30	napmnous	New Orders Index	9	13	39	15						
x31	napmdlus	Deliveries Index	28	31	22	41						
x32	napmiius	Inventories Index	8	7	21	10						
x33	napmetus	Employment Index	9	7	29	13						
x34	napmcpus	Commodity Price Index	25	9	3	11						
x35	napmimus	Imports Index	NA	NA	3	17	NA	NA			NA	NA
x36	napmexus	New Export Orders Index										
x37	helpus	U.S. Help Wanted Index										

Financial and Monetary Indicators													
x38	B0014013	Gvt of Canada marketable Bonds, average yield, over ten years					1	4	5	21			0
x39	B0014059	Treasury Bills, 1 month,						3	1	20	0		
x40	B0014060	Treasury Bills, 3 month,						4	1	21	0		
x41	B0014061	Treasury Bills, 6 month,	1					4		21			0
x42	B0014062	Treasury Bills, 1 year	1					4		21			0
x43	B0014013 - B0014059	Gvt of Canada marketable Bonds, average yield, over ten years - Treasury Bills, 1 month	11	24	29	23							
x44	B0014013 - B0014060	Gvt of Canada marketable Bonds, average yield, over ten years - Treasury Bills, 3 months	13	24	30	22							
x45	B0014013 - B0014061	Gvt of Canada marketable Bonds, average yield, over ten years - Treasury Bills, 6 months	13	16	37	22							
x46	B0014013 - B0014062	Gvt of Canada marketable Bonds, average yield, over ten years - Treasury Bills, 1 year (note: data only start in Jan '80)	13	17	37	22							
x47	B0001627 / P0100000	Real M1, millions of dollars	33	4	19	14							
x48	B0002033 / P0100000	Real M2, millions of dollars (where P0100000 = all items consumer price index, 1992=100)				15	3	88	95				
x49	B0003300	Bank of Canada Commodity price index, 1982=100, U.S. dollar terms, total index	3					43	6	15			
x50	B0003301	Bank of Canada Commodity price index, 1982=100, U.S. dollar terms, total index excluding energy	18		15	15		29					
x51	comp_fin_tot	Department of Finance Commodity price index, 1997=100, U.S. dollar terms, total index	13					43	6	15			
x52	comp_fin_xen	Department of Finance Commodity price index, 1997=100, U.S. dollar terms, total index excluding energy	18	11	13	4							

x53	B0004237 / P0100000	Real TSE 300 stock price index, close, Wednesday averages (where P0100000 = all items consumer price index, 1992=100)	9	6	33	27								
x54	B0004245 / P0100000	Real TSE 35 stock price index, close, Wednesday averages (where P0100000 = all items consumer price index, 1992=100)					10	8	6	20				
U.S. Financial and Monetary Indicators														
x55	rgt3mwus	U.S. Treasury notes, three months, monthly, Wednesday closing averages constant maturities	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
x56	rgt10yus	U.S. Treasury notes, 10-year monthly, Wednesday closing averages constant maturities					1	5	5	9				
x57	m1us / cpiuus	M1, millions of dollars (where: all items consumer price index, 1983=100)	39	11	21	15								
x58	B0004220 / cpiuus	Dow Jones Industrials (30) (where: all items consumer price index, 1983=100)	9	5		27			1					
x59	B0004291 / cpiuus	Standard & Poor's (500), 1941-1943 = 10 (where: all items consumer price index, 1983=100)		5	32	27	3							
Labour Market Indicators														
x60	hwi6180new + D0738862	Canadian Help-Wanted Index (1960 - ….)	3	3	13									0
x61	manuinc	Quarterly Business Conditions Survey, manufacturing industries, share of manufactureres that state that their workforce would increase over the next three months												
x62	D0099959	Average work week, manufacturing, smoothed (from business leading indicators for Canada, created by Statistics Canada)			12	10					0	0		
x63	D0980662	Actual hours (worked in the LFS reference week, not monthly data), total, SA	6	1	9					4				
x64	D0980678	Usual hours, all jobs, SA		1							0		0	0

x65	D0980679	Usual hours, all jobs employees, SA					1					0	0	0
x66	D0980680	Average usual hours, all jobs, SA	33		8	15		2						
x67	D0980681	Average usual hours, all jobs employees, SA	1	5	8	13								
x68	decreasing	Share of employers predicting staff decreases, Manpower Survey (note: data only start in Jan '78)					4	42	50	38				
x69	increasing	Share of employers predicting staff increases, Manpower Survey	5	3	10					8				
x70	dontknow	Share of employers predicting staff that don't know, Manpower Survey	26					48	92.6	56				
x71	nochange	Share of employers predicting no change in staff, Manpower Survey					25	72	93.3	20				
x72	netchange	net change, Manpower Survey	5		10	10						0		

Appendix B

Variables from Seven Sectors Were Considered for the Construction of the NEO Model

i. Aggregate economic activity: As outlined above, employment growth generally lags GDP growth. Hence a rise or fall in these indicators should indicate future employment growth or contraction.

ii. Supply-side variables: Supply-side indicators, such as capacity utilisation, should lead changes in employment growth.

iii. Monetary, financial and fiscal variables: Again, as outlined above, the monetary variables indicate how stimulating monetary policy is and the financial variables indicate the growth outlook of the economy. Fiscal variables, such as the Government's deficit as a share of GDP, indicate future monetary conditions with a rising deficit as a share of GDP indicating rising interest rates and a rising surplus as a share of GDP indicating future lower taxes or rising government spending or a combination of both.

iv. Prices and cost variables: Price series are expected to capture the positive (negative) effects of low (high) inflation. Commodity prices indices were again considered reflecting the large dependence on commodities of the Canadian economy. Labour cost variables were considered to take into consideration the negative effect of rising real labour cost on employment (particularly in light of the productivity slow-down over the past twenty years).

v. The Manpower Survey: As outlined above, employment indicators should point to future changes in the labour market.

vi. The Conference Board's Survey of Business Confidence: These supply-side indictors should contain important information on the future state of the economy and hence employment growth.

vii. The Conference Board's Survey of Consumer Confidence: As outlined earlier, Torgunrud (1999) showed that the consumer confidence index and its components, particularly those relating to employment growth, have significant predictive power for consumer spending and employment growth.

Appendix C

Construction of a Composite Index of Leading Indicators
Algebraic Description of the NBER Approach

The NBER approach of constructing a cyclical indicator, such as a composite index of leading indicators, requires several algebraic operations on both the individual components and the composite index. The construction of a cyclical indicator is done in three main steps.

1. Standardisation and weighting of the selected individual components;
2. Standardisation and cumulation of the composite values;
3. Calculation of the trend-adjust composite index.

The following illustrates algebraically how the composite index of leading indicators of employment in Canada was constructed.

1. Standardisation and weighting of selected individual components

The first step is to calculate month-to-month symmetrical percentage changes for each selected individual component of the composite index.

$$[1.1] \qquad \dot{Y}_t^j = 200 * (X_t^j - X_{t-1}^j)/(X_t^j + X_{t-1}^j)$$

where X^j is a selected individual component.

For components that contain zero or negative values and for components that are already in percentage form or in ratio form, the formula below is used:

$$[1.2] \qquad \Delta Y_t^j = 200 * (X_t^j - X_{t-1}^j)$$

The next algebraic operation is the standardisation of the selected individual components transformed in [1.1] or [1.2]. The objective of this operation is to prevent a volatile component to dominate the change in the composite index. Each selected component that was transformed with formula [1.1] or [1.2] is standardised by dividing it by its historical average without regard to sign.

$$[1.3] \qquad S_t^j = \dot{Y}_t^j \;/\; \sum \left| \dot{Y}_t^j \right| / (n-1) \qquad or$$

$$S_t^j = \Delta Y_t^j \;/\; \sum \left| \Delta Y_t^j \right| / (n-1)$$

The third algebraic operation combines the S^j into a composite variable. One way to aggregate the components S^j is to assume equal weights. However, a number of alternative methods are available to determine the weighting scheme that reflect better the relationship and the importance of each component with the reference cycle. For example, the U.S. Department of Commerce has used the following methodology. A scoring system was used to estimate the weight of each selected component of the composite index. The weight is derived qualitatively from a scoring system based on seven economic and statistical criteria: economic significance, statistical adequacy, cyclical timing, conformity, smoothness, timeliness and revisions. In contrast to that method, a quantitative method was used in this study to determine the individual weight. Based on bivariate regression of the standardised percentage change of the reference series on each standardised component, I choose the maximum estimated coefficient at lag k as a weight. The weighted average of the components S^j is then computed using the equation below

$$[1.4] \qquad I_t^j = \sum w^j * S_t^j$$

where I_t is the raw composite values and w^j the individual weight normalised to sum to one.

2. Standardisation and cumulation of the composite value

The purpose of this step is to transform the raw composite value I_t so it has the same historical average (without regard to the sign) as the reference series. The standardised composite value is obtained as follows:

$$[1.5] \qquad I_t^s = I_t \; / \; \{[\sum |I_t^j| / (n-1)] / [\sum |R_t^j| / (n-1)]\}$$

where I^s_t is the standardised composite value and R^j is the symmetrical percentage change of the reference series. The standardised composite value I^s_t is then transformed into an index form using the formula below

$$[1.6] \qquad CI_t^S = I_{t-1}^S * (200 + I_t^S) / (200 - I_t^S)$$

where CI^S_t is the composite index. The composite index CI^S_t is transformed in the next step so that it exhibits the same long-term trend as the reference series.

3. Trend-adjustment of the composite indexes

The purpose of this last stage in the construction process is to facilitate the visual comparison of the composite index with the reference series. The objective of the trend-adjustment is to make the trend of the composite index equal to the trend of the reference series. To achieve this, I subtracted the trend of the composite index and added in the trend of the reference series.