The impact of structural breaks on the stability of the out-of-sample predictive content of financial variables for Canada's real GDP growth: An encompassing approach

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Abstract: This paper investigates the timing, frequency and the impact of structural breaks on the stability of the predictive content of a large number of financial variables for Canada's output growth. The forecasts are evaluated over two identified out-of-sample regimes using both the equal accuracy and encompassing tests. The results have enabled us to classify all variables into four useful groups. Two of Canada's term spreads near the short-end of the yield curve belong to the group that exhibits strong and stable predictive content at long horizons that are most relevant to monetary policy providing an indication that the Bank of Canada should not discard these spreads from its list of closely watched information variables (JEL C52, C53, E44)

1. Introduction

The most useful financial indicators are those that exhibit a strong and stable ability to predict real activity over relatively long horizons. Such indicators may not exist in practice. As a second best strategy, we use the information gathered from a two-stage forecast evaluation strategy to identify and classify all financial variables into four useful groups: those whose predictive ability over Canada's real GDP growth has remained stable, has been enhanced, reduced but not eliminated, and completely eliminated by structural changes. This classification, it is hoped, will provide some guidance for monetary policy when deciding which set of financial indicators is more likely to be reliable in a given circumstance.

The past few years have witnessed a new round of intensive empirical reassessment of the information content of asset prices for future real activity, as measured for example by real GDP growth. The primary motivation for this reassessment has come from concerns raised by Stock and Watson (1996, 2003) about the pervasiveness of the impact of structural change on the stability of the relationship between financial variables and real activity in several advanced countries. Based on the evidence from their landmark investigation[1], Stock and Watson (2003), along with Thoma and Gray (1998), concluded that the ability of individual asset prices to forecast real activity has broken down since the mid-1980s, according to the mean squared forecast error criterion. Somewhat paradoxically, despite the apparent breakdown, many researchers including Stock and Watson (2003), Goodhart and Hofmann (2001), and Bernanke and Boivin (2003) have found that combinations of asset prices (weighted averages, composite financial indexes or factor models) are able to produce more reliable forecasts of real activity after the mid-1980s.

Rapach and Weber (2004) offer an explanation to the puzzle. They propose the idea that structural change may have reduced, but not eliminated, the ability of individual asset prices to forecast real activity within

[1]Based on a survey of 66 previous studies from seven advanced countries and their econometric investigation, Stock and Watson (2003) concluded that the forecasting ability of individual financial variables for real activity varies markedly both within and also across countries and, therefore, is not reliable.

countries[2]. This has necessitated the use of more powerful evaluation procedures for detecting the out-of-sample predictive ability of individual asset prices. They show that when the US variables examined by Stock and Watson (2003) are re-evaluated using the more powerful *encompassing* tests of Clark and McCracken (2001), many of these variables exhibit statistically significant abilities to predict US output growth over the same out-of-sample period (1985:1-1999:4) considered by Stock and Watson (2003). We extend the work of Rapach and Weber (2004) to the Canadian economy with two specific issues in mind. The first issue concerns the existence and the timing of structural breaks in relationships between individual financial variables and real activity in Canada. We conduct a detailed investigation of structural breaks in ARDL models linking Canada's real GDP growth to a large number of individual Canadian and US financial market variables, using the Quandt (1960) likelihood ratio (QLR) test as modified by Andrews (1993) and also the Bai and Perron (1989) testing procedures. We find evidence of widespread structural changes in the Canadian economy, with a concentration in the timing of a break across many ARDL models in the early-1970s (when Canada switched from a fixed to a flexible exchange rate regime) and a break across other ARDL models in the early and mid-1980s.

The second issue concerns the impact of structural breaks on the stability of the out-of-sample predictive ability of individual financial variables for real activity in Canada. Following Stock and Watson (2003), Clark and McCracken (2001, 2005), and Rapach and Weber (2004), we employ a complementary, two-stage empirical strategy to address this issue. In stage one, we generate a pair of recursive multi-steps (h = 1, 2, 4, 8 quarters) ahead forecasts of Canada's output growth, one based on the unrestricted ARDL model (that includes the financial variable) and one based on a restricted model (that excludes the financial variable), over two out-of-sample regimes 1973:4-1984:4 and 1985:1-2004:4, where the boundaries of the

[2]Djoudad, Selody and Wilkins (2005) offer an explanation for the observed cross-country instability in the predictive ability of asset prices. They argue that, as indicators of future economic activity, asset prices should dominate financial quantities in countries with highly-developed financial markets but not in countries where financial markets are underdeveloped and bank-centered. They formally test this hypothesis using data over the period 1990-2003 from 29 financially developed and less-developed countries but find no support for it.

regimes are chosen to (roughly) coincide with the documented structural breaks in the ARDL models. We then evaluate the stability of the forecasts over the two out-of-sample regimes, using both the equal forecast accuracy and the encompassing tests. In stage two, we conduct a simulation experiment to show that, once the structural break is explicitly incorporated into the data generating process, the encompassing tests used in stage one are indeed more powerful in identifying the true model than the MSE-based tests. This gives more credence to the findings of the paper in stage one.

Of course, the most useful financial indicators are those that exhibit a strong and stable ability to predict real activity over relatively long horizons. But such indicators may not exist in practice. As a second best strategy, we use the information gathered from the two-stage forecast evaluation strategy to identify and classify all financial variables into four useful groups: those whose predictive ability over Canada's real GDP growth has remained stable, has been enhanced, reduced but not eliminated, and completely eliminated by structural changes. This classification, it is hoped, will provide some guidance when deciding which set of financial indicators is more likely to be reliable in a given circumstance.

This paper is organized as follows. Section 2 provides a review of the literature on asset prices with respect to their informational content and a description of our data set, section 3 describes the forecasting and testing methodologies, section 4 presents the empirical results while section 5 concludes and gives avenues for future research.

2.1 Asset Prices: Recent Literature and the Choice of Variables

Since asset markets are typically forward-looking, data on assets prices are available on a timely and continuous basis and are not usually revised, policymakers naturally turn to asset prices for advance information about future real activity (Bernanke, 2004). But the extraction of useful information from asset prices has posed a difficult challenge. This is because asset prices are determined by a combination of fundamental and non-fundamental forces, making them noisy indicators of future economic activity. It is also because the relationships between asset prices and real activity are subject to structural changes due to financial innovations, changes in regulations, and monetary policy. Below we provide a brief review of the relevant empirical literature, both to help us choose the pertinent domestic and international variables and also to highlight the key empirical issues of interest to this paper. The review is organized under four headings, each covering a broad group of financial variables.

Group1: Interest Rates and Bond Yields. Central banks have come to rely on interest rates, almost to the exclusion of monetary aggregates, as instruments of monetary policy. Under this approach, monetary authorities directly control short-term nominal (and real) interest rates and indirectly alter long-term interest rates which consumers and investors actually pay[3], through their influence on private agents' expectations of future monetary policy decisions. Instability of the velocity of money, which makes monetary aggregates less useful as instrument of policy, is not a problem under the interest rate approach.

Recent research shows that changes in short-term real interest rates are the primary channels for the transmission of monetary policy actions to aggregate spending in Canada (Duguay, 1994). This finding is supported by Bernanke and Blinder (1992), who show that the information contained in long-term rates tends to disappear once the short rates are also included in the model. But, to our knowledge, few studies have examined the issue of how structural changes have affected the stability of the predictive content of short and long-term interest rates. An important exception is Stock and Watson's (2003). The evidence from this multi-country study shows that, with the exception of Canada's 3-month t-bill rate, the out-of-sample predictive ability of other interest rates has sharply deteriorated after the mid-1980s.

Group2: Financial spreads. The reasons for the predictive ability of term spreads (the difference between long-term and short-term interest rates) for real activity are well known[4]. Our focus is on the impact of

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[3] Hamilton (2007) shows that a 1% change in the unanticipated component of the federal funds target rate has about ½% change on the 3-month t-bill rate and also a significant effect on the 10-year bond rate in the US.
[4] One reason is that, in a tightening cycle, monetary policy raises short-term rates and, via the expectations

structural breaks on the stability of the predictive ability of the entire range of Canadian and US term spreads (starting at the short-end and moving further out to the long-end of the two country's yield curves). Few studies have examined this issue. Harvey (1997), who does not explicitly account for structural change, reports that both the Canadian and US term spreads have predictive content for Canada's output growth. Atta-Mensah and Tkacz (2001) show that the yield spread is more effective in predicting Canadian recessions than booms. Stock and Watson (2003) report that structural breaks have impaired the predictive content of Canada's term spread much less than they have of other financial variables. Following Stock and Watson (2003), we also examine the performance of both Canadian and US default spreads (difference in interest rates on matched maturity debt with different degrees of default risk) as indicators of Canada's future output growth.

Group 3: Monetary and credit aggregates. Since the early 1980s, waves of financial innovations have enabled banks to introduce a variety of accounts that act as money substitutes, making it difficult to define money consistently over time. In response, central banks have introduced increasingly broader definitions of money (M0, M1, M2, M3) in the hope that the broader aggregates, because they incorporate a role for financial innovations, will display a more stable relationship to economic activity. But the balance of the empirical evidence to date, especially from the US, indicates that the links between monetary aggregates and future economic activity have broken down in recent decades.

In Canada, however, narrow monetary aggregates, such as M1, have performed well as indicators of near-term economic outlook (Bank of Canada, 1995). But the indicator properties of narrow money have shifted over time. Chan, et al. (2005) show that real M1+ (gross M1 plus chequable notice deposits) has become more informative than real M1 after 1993, when the removal of reserve requirements made

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hypothesis of the term structure also raises long-term rates, but by less than the rise in short rates. This narrows the yield spread and also slows future economic growth due to the higher interest rate levels. An alternative explanation is that an increase in the yield spread reflects market expectations of future economic growth, leading to an increase in borrowing and the supply of more long term bonds. This causes the long-term rates to rise relative to short rates.

demand and notice deposits virtually indistinguishable. By contrast, Siklos and Barton (2001) find empirical support for the idea that broad and composite monetary aggregates have a greater ability to predict real activity and inflation, using regime-switching models. We examine the impact of structural breaks on the performances of both narrow and broad money and also credit aggregates.

Group4: Other Asset Prices. The Bank of Canada also monitors exchange rates, stock prices and commodity prices for the value of the information they contain about future economic activity. The empirical link between exchange rates and real activity in Canada is confirmed by Duguay (1994) but the link between Stock prices and real activity seems tenuous (Dufour and Tessier, 2006). We also study the information content of the real price of oil, and Statistics Canada's composite leading index - a predominantly non-financial variable[5] - which has been found to contain useful information about Canada's output growth at the one-quarter horizon (Faroque and Veloce, 2008).

2.2 The Dataset

In light of the previous research described above, we initially assembled raw data for 33 nominal Canadian and US financial variables (including the leading index) and constructed an additional 36 variables, comprising of financial spreads, real interest rates, real monetary aggregates and other real asset prices. This gave us a total number of 69 potential indicators of Canada's future output growth. The raw data were either quarterly or monthly and were converted to quarterly frequency to match the frequency of Canada's real GDP - the forecasted variable. Except for the interest rates, raw data on all other series were seasonally adjusted. No further seasonal adjustments were made to any series. Each series was checked for unit roots using the ADF test. All interest rate levels (nominal and real), log level of monetary and credit aggregates, log levels of other variables were found to contain a single unit root and were differenced once to make them stationary[6]. All interest rate spreads were found to be stationary, implying

[5]The index is constructed from ten monthly series including real M1 money, housing index, business and personal service employment, stock price index, U.S. leading index, average work week, new orders for durables, shipments/inventories of finished goods, furniture and appliances and other durable goods sales.

[6] To save space, the unit root test results are not reported in the paper. They will be made available upon request.

that the levels of the long and short term interest rates are cointegrated. All four groups of financial variables, Canadian and US, definitions, transformations, availability and sources are reported in Table 1.

3. Forecasting Real Activity with Asset Prices in the presence of Structural Change

3.1. Models and Structural Change

In line with the extant literature[7], we study the information content of individual financial variables for Canada's future output growth using the ARDL growth models of the form,

$$z_{t+h} = \alpha_0 + \sum_{i=0}^{q_1-1} \beta_i \Delta y_{t-i} + \sum_{i=0}^{q_2-1} \delta_i x_{t-i} + \varepsilon_{t+h} \qquad (1)$$

where $z_{t+h} = \sum_{i=1}^{h} \Delta y_{t+i}$, $\Delta y_t = y_t - y_{t-1}$ and y_t is the logarithm of Canada's real GDP at time t and h is the forecast horizon, x_t is a stationary financial variable whose predictive ability for output growth is being assessed, and ε_{t+h} is a disturbance term. For h > 1, the errors ε_{t+h} are serially correlated because z_{t+h} will be overlapping. To account for this serial correlation, the estimation method uses the Newey and West (1987) heteroscedasticity and autocorrelation-consistent (HAC) covariance matrix.

We are interested in determining whether the financial variable x_t has an incremental, ex-ante ability to forecast Canada's future output growth at h = 1,2, 4, and 8 quarters-ahead forecast horizons. But, for the sake of comparison with previous research, we also consider the in-sample (full-sample) Granger causality test of the null hypothesis $\delta_0 = \ldots = \delta_{q_2-1} = 0$ in equation (1). This test compares the forecasting ability of the unrestricted ARDL model (1) with that of the restricted (nested) model

$$z_{t+h} = \alpha_0 + \sum_{i=0}^{q_1-1} \beta_i \Delta y_{t-i} + \varepsilon_{t+h} \qquad (2)$$

and can be implemented using either the small-sample F statistic or, the asymptotic Wald (chi-square) statistic. A rejection of this null hypothesis indicates that the financial variable x_t has an *incremental* in-sample ability to forecast Canada's future real GDP growth.

[7]Rapach and Weber (2004) use the specification given by equation (1), while Stock and Watson (2003) redefine z_{t+h} as $z_{t+h} = (400/h)\sum_{i=1}^{h} \Delta y_{t+i}$.

But Stock and Watson (2003) has cautioned that the correlation between the financial variable x_t and output growth in equation (1), as summed up by the coefficients $\sum_{i=0}^{q_2-1} \delta_i$, and also the sum of the autoregressive coefficients $\sum_{i=0}^{q_1-1} \beta_i$, may have been weakened or eliminated by structural breaks in the parameters. We, therefore, conduct a detailed investigation of the prevalence and the timing of structural breaks in the relationships between Canada's output growth and each of the individual financial market variables, using the one-step-ahead ARDL growth forecasting model [equation (1) for h = 1]

$$\Delta y_{t+1} = \alpha_0 + \sum_{i=0}^{q_1-1} \beta_i \Delta y_{t-i} + \sum_{i=0}^{q_2-1} \delta_i \, x_{t-i} + \varepsilon_{t+1} \qquad (3)$$

The econometrics tool-kit offers several tests for a single and also multiple breaks of unknown timing in the parameters of equation (3). One notable test is Quandt's (1960) likelihood ratio (QLR) test, as modified by Andrews (1993) and popularized by Stock's and Watson's (2003a) textbook presentation. The QLR statistic entails computing the heteroskedasticity-robust Wald statistic testing for a single break at a known date, then taking the maximum of those statistics over all possible break dates in the central 70 percent of the sample. An important advantage of the test over other available tests for structural breaks is that it has good power not just against a sudden break in the parameters but also against slowly drifting parameters. The asymptotic null distribution of the QLR statistic is derived by Andrews (1993) and a corrected table of critical values is provided in Stock and Watson (2003a).

We compute three versions of the QLR statistic using equation (3) and the SBC to choose the lag orders q_1 and q_2 (Table 1 reports the lag orders for all variables). The first, QLR1, tests whether the coefficients of equation (3) are jointly stable in the middle 70% of the full sample. The second, QLR2, tests whether a structural break occurs only in the intercept and the autoregressive coefficients, while maintaining that the coefficients of the financial variable are constant. The third, QLR3, tests whether a structural break occurs only in the coefficients of the financial variable and the intercept, while maintaining that the autoregressive coefficients are constant. We also test for multiple breaks in equation (3) using the Bai and Perron (1989) sequential procedure, with the maximum number of breaks set at four. Following Bai and Perron (2003), we first examine their UDmax and WDmax tests statistics. Conditional on both statistics being significant at the 5% level, indicating the presence of at least one break, we determine the number of breaks by examining their SupF(i+ 1 | i) test statistics, starting with SupF(2|1). The SupF(i+1 | i) statistic tests the null of i breaks against the alternative of i+1 breaks. Table 2 reports[8] the estimated QLR1, QLR2 and QLR3 statistics for the ARDL equations and their statistical significance at the 5% and the 1% levels. The table also summarizes the Bai-Perron test results, reporting the number of significant breaks and the Bai-Perron 90% confidence interval surrounding each break date. The results confirm that the relationships between financial variables and real activity in Canada have been to subject to widespread structural changes. Specifically, the QLR1 statistics show that there is a concentration in the timing of a break in the coefficients many ARDL models in the late 1960s and the early-1970s and a break in the coefficients of other ARDL models in the early and mid-1980s. The Bai-Perron statistics confirm that most of the relationships have been subject to a single break and also that the majority of the break dates identified by the QLR1 statistics are contained within the Bai-Perron 90% confidence intervals. The QLR2 and QLR3 statistics respectively show that the timing of the conditional breaks in the autoregressive coefficients (holding the coefficients of the financial variable constant) and the conditional breaks in the coefficients of the financial variable (holding the autoregressive coefficients constant) are also concentrated around the two break dates mentioned above.

3.2 Forecast Evaluation Methodology: Equal Accuracy and Encompassing Tests

The ability to detect one variable's out-of-sample predictive ability over another depends on (a) how the sample is split between the in-sample and the different out-of-sample portions relative to the observed structural breaks and (b) the power of the test used to evaluate the forecasts. Clark and McCracken (2005) show that the encompassing tests are more powerful than the MSE-based tests in detecting the correct

[8]Results for the nominal interest rates are similar those for the real interest rates and are not reported in Table 2.

model towards the end of the sample. Thus, it may be expected that these tests will be able to identify the financial variables whose predictive ability for Canada's output growth is reduced, but not eliminated by structural change, even when the MSE-based tests fail to do so.

In the spirit of Clark and McCracken (2005), we divide our sample into an in-sample (1961:1-1973:3) and an out-of-sample (1973:4-2004:4) portion, where the split date is chosen to roughly coincide with the first observed break across ARDL models in the early-1970s. Next we use the evidence of an observed break in the early and mid-1980s to further spilt the out-of-sample period into two periods:1973:4-1984:4 and 1985:1-2004. The object of the two out-of-sample periods is to see how structural changes have affected the predictive content of individual financial variables from the first to the second period.

For each financial variable, we estimate the unrestricted ARDL growth equation (1) and also the restricted equation (2) via ordinary least squares, using the first R of the T observations in our sample. Using the estimated parameters and the observations for x_{R-i} $(i = 0,..,q_2 - 1)$ and Δy_{R-i} $(i = 0,..,q_1 - 1)$, we construct a pair of h-step-ahead forecasts for z_{R+h} (h = 1, 2, 4, 8), one for each of the unrestricted and the restricted models. Next we add one more observation to the estimation sample and using the R+1 observations re-estimate the parameters of both models, and generate another pair of h-step-ahead forecasts, one for each model. This process is repeated until we reach the end of the available sample, leaving us with T-R-h+1 recursive out-of-sample forecasts, one for the unrestricted model and one for the restricted model. Because this strategy involves only information known at the time the forecasts are made, it simulates the situation of a forecaster in real time (except for data revisions).

To evaluate the forecasts, we first use the out-of-sample Theil's U metric, $\frac{RMSE_1}{RMSE_2}$, where $RMSE_1$ and $RMSE_2$ are the root mean squared forecast error for the unrestricted and the restricted model forecasts respectively. Clearly, if $\frac{RMSE_1}{RMSE_2}$ < 1, the unrestricted model forecasts are superior to the restricted model forecasts, indicating that x_t has an out-of-sample ability to forecast Canada's output growth. But it is possible that $RMSE_1 < RMSE_2$ purely by chance (due to sampling error). This can lead to incorrect inference about the predictive ability of the financial variable x_t. We, therefore, rely on two sets of formal tests to evaluate the out-of-sample forecasts: the equal accuracy (MSE-T, MSE-F) and the encompassing (ENC-T, ENC-NEW) tests. Below, we provide a brief non-technical summary of these tests.

Suppose the h-step-ahead forecast errors from the unrestricted equation 1 and the restricted equation 2 are $\{\hat{\varepsilon}_{1,t+h}\}_{t=R}^{T-h}$ and $\{\hat{\varepsilon}_{2,t+h}\}_{t=R}^{T-h}$ respectively. Letting $\hat{d}_{t+h} = \hat{\varepsilon}^2_{2,t+h} - \hat{\varepsilon}^2_{1,t+h}$,

$$M\hat{S}EF_i = (T-R-h+1)^{-1}\sum_{t=R}^{T-h}\hat{\varepsilon}^2_{i,t+h}\ (i=1,2)\ and\ \bar{d} = MSFE_2 - MSFE_1 = (T-R-h+1)^{-1}\sum_{t=R}^{T-h}\hat{d}_{t+h}$$

, the MSE-T statistic of Diebold and Mariano (1995) and the MSE-F statistic of Clark and McCracken (2001) respectively take the forms:

$$MSE-T = (T-R-h+1)^{1/2}\times\frac{\bar{d}}{\sqrt{\hat{S}_{dd}}} \qquad (4)$$

$$MSE-F = (T-R-h+1)\times\frac{\bar{d}}{M\hat{S}EF_1} \qquad (5)$$

where $\hat{S}_{dd}$ is the Newey-West (1987) heteroskedasticity- and autocorrelation-consistent (HAC) estimator of the variance of $\bar{d}$. Under the null hypothesis of equal forecasting ability, $MSFE_1 = MSFE_2$, so that $\bar{d}$ = 0, both MSE–T = 0 and also MSE-F = 0. The alternative hypothesis is that $MSFE_1 < MSFE_2$, and so $\bar{d} > 0$ and both MSE-T > 0 and also MSE-F > 0. So, both tests are one-sided (upper tail) tests. Clark and McCracken (2004) show that, under the null hypothesis and h = 1, both MSE-T and MSE-F statistics have non-normal limiting distributions. And for h > 1, they converge to non-normal distributions that also depend on two parameters of the data generating process: $\lim_{P,R\to} P/R$, where P = T-R, and q_2 - the number of excluded variables in the restricted model compared to the unrestricted model. They recommend basing inferences for MSE-T and MSE-F on a bootstrap procedure.

The tests of forecast encompassing exploit the concept of optimal composite forecasts. Consider forming the following optimal composite forecasts of the variable z_{t+h},

$$\hat{z}_{t+h} = w\hat{z}_{1,t+h} + (1-w)\hat{z}_{2,t+h} \qquad (6)$$

where, $\hat{z}_{1,t+h}$ and $\hat{z}_{2,t+h}$ are the out-of-sample forecasts of z_{t+h} from the unrestricted model (equation1) and the restricted model (equation2) respectively, and $0 \le w \le 1$. If w = 0, the restricted model forecasts are said to encompass the unrestricted model forecasts, because then the unrestricted model does not contain any new information in the construction of the optimal composite forecast that is not already contained in the restricted model. Alternatively, if w > 0, the restricted model does not encompass the unrestricted model because then the unrestricted model (that includes the financial variable) does contain new information in the formation of the optimal composite forecast.

Tests of forecast encompassing (ENC-T, ENC-NEW) test the null hypothesis w = 0, against the one-sided alternative hypothesis w > 0. They are based on the covariance between $\hat{\varepsilon}_{2,t+h}$ and ($\hat{\varepsilon}_{2,t+h} - \hat{\varepsilon}_{1,t+h}$).

Letting $\hat{c}_{t+h} = \hat{\varepsilon}_{2,t+h}(\hat{\varepsilon}_{2,t+h} - \hat{\varepsilon}_{1,t+h})$ and $\bar{c} = (T-R-h+1)^{-1}\sum_{t=R}^{T-h}\hat{c}_{t+h}$, the ENC-T test of Harvey et al. (1998) and the ENC-NEW test of Clark and McCracken (2001), respectively take the forms

$$ENC-T = (T-R-h+1)^{0.5} \times \frac{\bar{c}}{\sqrt{\hat{S}_{cc}}} \qquad (7)$$

and, $$ENC-NEW = (T-R-h+1) \times \frac{\bar{c}}{M\hat{S}FE_1} \qquad (8)$$

where $\hat{S}_{cc}$ is the HAC estimator of the variance of $\bar{c}$. Under the null hypothesis that the financial variable x_t has no predictive content for z_{t+h}, the population covariance between $\varepsilon_{1,t+h}$ and $\varepsilon_{2,t+h} - \varepsilon_{1,t+h}$ will be zero (the population forecast errors of the models will be exactly the same), so that $\bar{c} = 0$, and ENC-T = 0 and ENC-NEW = 0. Under the alternative hypothesis that x_t has predictive power, this covariance will be positive. Thus, both of the encompassing statistics are one-sided (upper-tail) tests. Clark and McCracken (2004) show that, for h > 1, these statistics have non-normal and non-pivotal limiting distributions so that inferences must be based on bootstrap procedures. The bootstrap procedure we use in the present study is the one employed Rapach and Weber (2004)[9] which, in turn, is a variant of the procedure used by Clark and McCracken (2004). An outline of this procedure is provided in the Appendix.

Now comparing the MSE-based tests (equations 4 and 5) to the ENC- tests (equations 7 and 8) it can be seen that if the restricted and the unrestricted model forecast errors have similar variances ($MSE_2 = MSE_1$), and are approximately uncorrelated, $\sum \varepsilon_{1,t+h}\varepsilon_{2,t+h} = 0$, then the MSE-based test statistics will be near zero, while the ENC-based statistics will be positive. In this case, the MSE statistics will be insignificant but the ENC statistics may well be significant. The significance of the ENC-tests reflects the fact that the unrestricted model forecasts must contain information not found in the restricted model.

4.1 Empirical Results

Table 3 reports the MSE-T, MSE-F, ENC-T and ENC-NEW statistics for Canada's real GDP growth for each financial variable over both out-of-sample regimes 1973:4-1984:4 and 1985:1-2004:4, at the h = 1, 2, 4 and 8-quarters-ahead forecast horizons. In addition, Table 3 reports the values of q_1 and q_2 in equation (1) selected by SIC, Theil's U and the in-sample Wald statistic. For the Wald statistic and the four out-of-sample statistics, p-values generated through the bootstrap procedure are given in parentheses. It can be seen from Table 3 that, according to the Wald statistic, the variables (DERATE, DRERATE, CANDSP, and GRBL) exhibit no predictive content in both out-of-sample period; variables (USSP1Y, USSP5Y, DRUSTBILL3, DRUSCP3M, DRUSFFO, DRUSAAA, and GM0) in only one of the two

[9] We thank Professors David Rapach and Christian Weber for their generosity in making their gauss codes for the bootstrap procedures freely available to interested users at: http://pages.slu.edu/faculty/rapachde/Research.htm

periods, and all of the other variables exhibit a significant predictive content for Canada's output growth at some horizon in both out-of-sample periods at the 5% level. These results support the view that in-sample predictive ability is relatively easy to find because the usual F-test/Wald test indicates Granger causality or predictive ability if it exists in any part of the sample.

But the out-of-sample results tell a very different story. The relative MSFE metric (Theil's U) indicates a great divergence in the predictive ability of individual financial variables between the first and the second out-of-sample periods. For many of the variables and horizons, U < 1 in period 1 but U > 1 in period 2, indicating a substantial deterioration in predictive ability after the mid-1980s, akin to the findings of Stock and Watson (2003) and Rapach and Weber (2004) for the US economy. But the results in table 3 also differ in substantive ways from those for the US economy. First, while the US studies report U > 1 for almost 100% of the variables and horizons in period 2, indicating a general predictive failure after the mid-1980s, Table 3 shows that the predictive ability of several financial variables for Canada's real GDP growth has been unaffected or even enhanced by structural change after the mid-1980s.

Consider, for example, the first differences of Canada's real interest rates, as a group[10]. Since forecasts for each of these ten variables is reported for four different horizons, there are a total of forty (variable times horizon) forecast cells in this group. The proportion of these forty forecast cells in which U < 1 in period 2 is 13% (compared to 58% in period 1), indicating that a few of these interest rates have retained an ability to predict Canada's output growth at some horizons after the mid-1980s. In fact, the proportion of the forecast cells for which U < 1 in period 2 is considerably higher for the other groups in Table 3. They are 25% for the first differences of the US real interest rates in period 2 (compared to 81% in period 1), 29% for the growth in nominal and real monetary aggregates in period 2 (compared to 63% in period 1), 34% for 'other variables' as a group in period 2 (compared to 50% in period 1), and a remarkable 85% for

[10] The results for each nominal interest rate were found to be similar to the results for the corresponding real interest rate and are not reported in Table 3, to save space. They will be made available upon request.

Canada's financial spreads in period 2 (compared to 65% in period 1). It should be noted that U < 1 in period 2 may mean one of two things: either the predictive ability of the variable in question has remained unchanged or it has been enhanced in period 2 compared to period 1. Similarly, U > 1 in period 2 may either mean that the predictive ability of the variable is eliminated in period 2, or it has been reduced, but not eliminated, so that detection requires a more powerful test than the U metric. Given the potential diversity of the impact of structural change, our analysis attempts to identify and classify all financial variables under investigation into one of four useful groups: variables whose predictive content for Canada's real GDP growth has remained unaffected, been enhanced, reduced but not eliminated, and eliminated by structural change.

To help achieve a relatively unambiguous classification, we rely on the evidence from the least powerful (MSE-T) and the most powerful (ENC-NEW) of the out-of-sample tests[11]. Following Rapach and Weber (2004) we assess predictive ability for each statistic at the 10% significance level. Given these benchmarks, a financial variable's predictive ability is deemed insensitive to structural change under one of three conditions: if the variable exhibits (i) zero or no predictive ability at any horizon (p-value > 0.1 for both MSE-T and ENC-NEW) in both out-of-sample periods, or (ii) weak (but statistically significant) and stable predictive ability (p-value > 0.1 for MSE-T but < 0.1 for ENC-NEW) for one or more horizons in both periods or, (iii) a strong and stable predictive ability for one or more horizons in both periods (p-value < 0.1 for both MSE-T and ENC-NEW). Variables with no predictive content in both periods [category (i)] include the growth in real bank loan, GRBL, and changes in the Canada-US (nominal and real) exchange rates DERATE, DRERATE. At first glance, this finding about exchange rates may seem surprising, but it is consistent with Duguay (1994), who shows that a great deal of prior 'smoothing' is necessary before a significant effect of exchange rates on Canada's output growth emerges. Category (ii)

[11] The power ranking of the out-of-sample tests as reported by Clark and McCracken (2005) is: MSE-T < MSE-F < ENC-T < ENC-NEW. Our classification of financial variables relies on the inferences implied by the least powerful (MSE-T) and the most powerful (ENC-NEW) statistics, so as to minimize potential conflicts whereby the less powerful test is significant but the more powerful test is not significant.

includes only the first difference of the US 10-year real bond rate DRUSGB10Y, which exhibits a weak but stable ability to predict Canada's real GDP growth at horizon h = 2 and also h = 8.

The most useful financial indicators are the ones that exhibit a strong and stable predictive content for Canada's future real GDP growth [category (iii)]. These include two of Canada's term spreads at the short end of the yield curve: Government of Canada 1-3 year bond yield minus the 3-month t-bill rate (CANSPGB1T3) and Government of Canada 3-5 year bond yield minus the 3-month t-bill rate (CANSPGB3T5). What is remarkable about these two financial spreads is that, besides being strong and insensitive to structural change, their predictive ability over Canada's real GDP growth extends over short (h = 1, 2) and also long horizons (h = 4, 8). This result complements the recent finding by Rudebusch and Williams (2007) that the yield curve has the greatest real-time ability to distinguish between expansions and recessions several quarters in advance.

An unexpected finding is that changes in the smoothed version of Statistics Canada's composite index of leading indicators (GCLISM) - a non-financial variable - also exhibits a strong and stable predictive content for Canada's real GDP growth [category (iii)]. The evidence shows that the index has significant predictive content at all four forecast horizons (h = 1, 2, 4, 8).

The second group consists of financial variables whose predictive ability has been enhanced after the mid-1980s. Variable in this group are identified in one of two ways: if the variable exhibits (i) weak but statistically significant predictive content in period 1 ($p > 0.1$ for MSE-T but < 0.1 for ENC-NEW) and a strong and easily detectable predictive content in period 2 ($p < 0.1$ for both MSE-T and ENC-NEW) for one or more horizons or, (ii) zero predictive content in period 1 at all horizons ($p > 0.1$ for both tests) and positive predictive content (weak or strong) in period 2 at one or more horizons ($p< 0.1$ for both tests or $p <0.1$ for MSE-T). Variables in category (i) include changes in the US federal funds rate DRUSFFO, US 3-month commercial paper rate DRUSCP3M, and the t-bill rate DRUSTBILL3, while the only variable in category (ii) is Canada's default spread (CANDSP) .

The third group includes financial variables whose predictive ability has been reduced, but not eliminated, by structural change. Variables in this group exhibit a strong and easily detectable predictive ability in period 1 ($p < 0.1$ for both MSE-T and ENC-NEW) at one or more horizons, and a weaker but statistically significant predictive ability in period 2 ($p > 0.1$ for MSE-T but < 0.1 for ENC-NEW). This group includes the first differences of all ten of Canada's real interest rates, including the short rates that are directly controlled by the Bank of Canada and also the long-term rates that are determined in the bond markets. This group also includes the first differences of the US medium and long-term real interest rates DRUSGB5Y, DRUSGB10Y, DRUSGB20Y, Canada's term spreads at around the middle of the yield curve CANSPGB5T10, CANSPGB10+, growth in Canada's narrow monetary aggregates, GRM0, GRM1 and the growth in nominal and real stock prices GTSE300 and GRTSE300.

The final group consists of financial variables whose predictive content for Canada's output growth has been eliminated by structural change after the mid-1980s. A variable is included in this group if it exhibits (i) weak but statistically significant predictive ability in period 1 at one or more horizons ($p > 0.1$ for MSE-T but $p < 0.1$ for ENC-NEW) and no predictive content at any horizon in period 2 ($p > 0.1$ for both MSE-T and ENC-NEW) or (ii) strong predictive content in period 1 at one or more horizons ($p < 0.1$ for MSE-T and ENC-NEW) but no predictive content at any horizon in period 2 ($p > 0.1$ for MSE-T and ENC-NEW). Category (i) includes only the US 5,10 and 20-year term spreads USSP5Y, USSP10Y and USSP20Y and category (ii) includes changes in Moody's real triple-A and double-A rates DRUSAAA, DRUSBAA, US term-spreads USSP3M, USSP1Y and US default spread USDSP. These results are not inconsistent with the finding of Hassapis (2003) who uses non-parametric methods to show that, over the period 1966-2000, the long-run feedback from the US term spreads to Canada's output growth has been, generally, weaker than the feedback from Canadian term spreads.

4.2. Power Simulations

Our empirical strategy thus far has revealed that many of the financial variables that, according to the relative MSFE metric, have no predictive content for Canada's output growth after the mid-1980s, exhibit a significant predictive ability after the mid-1980s, according to the encompassing tests. A natural explanation is that structural changes have reduced, but not eliminated, the predictive ability of these variables after the mid-1980s. But this interpretation stipulates that, once the identified structural break is explicitly incorporated in the data generating process, it should be possible to demonstrate that the encompassing tests do indeed have more power in identifying the true model.

Following Clark and McCracken (2005), we conduct a Monte Carlo experiment in an attempt to make this demonstration. We choose from Group 3 the financial spread CANSPGB5T10, whose predictive ability we know has been reduced but not eliminated by structural change after the mid-1980s. We refer to this variable as S. We estimate an ARDL (1, 2) model between S and Canada's real GDP growth, with the break date for this model (from Table 2) incorporated at 1982:1. The results are as follows:

$$\begin{array}{lllll} \Delta y_t = & .8752 - .0606\,\Delta y_{t-1} & -.1902 S_{t-1} & +.4837 S_{t-2} & +\varepsilon_t \quad t \le 1982{:}1 \\ (SE) & (.15) \quad (.13) & (.13) & (.15) & \end{array} \tag{11}$$

$$\begin{array}{ll} Sum\ of\ S\ coeffs = & .2934 \\ (SE) & (.07) \end{array}$$

$$\begin{array}{lllll} \Delta y_t = & .2685 + .4078\,\Delta y_{t-1} & +.0721 S_{t-1} & +.0751 S_{t-2} & +\varepsilon_t \quad t > 1982{:}1 \\ (SE) & (.12) \quad (.12) & (.09) & (.10) & \end{array} \tag{12}$$

$$\begin{array}{ll} Sum\ of\ S\ coeffs = & .1471 \\ (SE) & (.04) \end{array}$$

Note that the sum of the coefficients on S is significant in both regimes but the sum is smaller in the second compared to the first regime. Thus, S should have some predictive ability remaining after 1982:1. We generate a bootstrap sample of 199 simulated observations for Canada's real GDP growth and the term-spread S, using equations (11), (12) and the Appendix equation (10). We use the sample to compute the MSE-T, MSE-F, ENC-T and ENC-NEW statistics over the out-of-sample period 1985:1-2004:4, and compute a p-value for each statistic using the bootstrap procedure described in the appendix. We repeat this process 1000 times, so that we have 1000 p-values for each statistic. Power of each statistic is the proportion of p-values that are less than or equal to 0.10.

Table 4 reports the proportion of the p-values for each out-of-sample statistic that are less than or equal to 0.10. The results clearly show that the ENC statistics are substantially more powerful that the MSE statistics, especially at the horizons of 1 and 2 quarters. For example, at h = 1, the MSE-T and MSE-F statistics are rarely able to reject the null hypothesis of no forecasting ability over the out-of-sample period 1985:1-2004:4 (rejection rates of 0.025 and 0.052 respectively), but the ENC-T and ENC-NEW statistics reject the null hypothesis quite frequently (rejection rates of 0.518 and 0.830 respectively). At the longer horizons of 4 and 8 quarters, only the ENC-NEW statistic remains more powerful than the MSE statistics. This pattern of rejection is consistent with the results in Table 3 regarding the forecasting ability of the variable CANSPGB5T10. These results, together with the simulation-based evidence documented by Rapach and Weber (2004), bolster Clark's and McCracken's (2005) claim that encompassing tests (especially the ENC-NEW statistic) are required to detect forecasting ability in the presence of a structural break that occurs near the start of the out-of-sample forecasting period and that reduces, but does not eliminate, a financial variable's ability to forecast future real activity.

5. Discussion and Conclusions

We investigate the timing, frequency and the impact of structural breaks on the stability of the out-of-sample predictive content of a large number of financial variables for Canada's output growth, using ARDL growth models and state-of-the-art econometric methodologies. The forecasts are evaluated over two identified out-of-sample regimes (1973:4-1984:4 and 1985:1-2004:4) using both the equal forecast accuracy and encompassing tests. Several notable results have emerged from the study.

First, we find evidence of widespread structural changes in the Canadian economy, justifying the concerns raised by Stock and Watson (2003). The relationships between Canada's real GDP growth and many individual financial variables have been subject to a single break, with a heavy concentration in the timing of a break in the late 1960s and the early 1970s (around the time when Canada moved from a fixed to a flexible exchange rate regime) and a break in other such relationships in the early and mid-1980s.

Second, we find that the predictive ability of many financial variables for Canada's real GDP growth has broken down after the mid-1980s, according to the relative MSFE metric. But we also find that many of the same variables continue to exhibit a statistically significant predictive ability after the mid-1980s, according to the more powerful encompassing tests. These findings support the view that the reason why combinations of asset prices are found to produce more reliable forecasts of real activity after the mid-1980s, despite an apparent breakdown in the forecasting ability of individual asset prices, is that structural changes have reduced, but not eliminated, the predictive content of individual variables.

The list of variables whose predictive ability for Canada's real GDP growth has deteriorated after the mid-1980s, but not eliminated, is interesting. It includes the first differences of all ten of Canada's real interest rates - both short term rates that are directly controlled by the Bank of Canada and also the long term rates that are determined in the bond markets, but are indirectly influenced by the Bank's policy, through the mechanism of private agents' expectations of future monetary policy decisions. It also includes the growth in Canada's narrow real monetary aggregates and stock prices. The fact that the variables in this group continue to exhibit a statistically significant, albeit a weaker, ability to anticipate Canada's output growth at the 2 and also 8-quarter horizons, should be good grounds for the Bank of Canada not to discard them from the list of closely watched information variables.

Third, there is considerable heterogeneity in the impact of structural change on the ability of individual financial variables to forecast Canada's output growth. Unlike the US evidence which points to a general breakdown in predictive ability of most financial variables after the mid-1980s, we find that ability of some financial variables for Canada's output growth has remained impervious to structural change, and of yet others, improved after the mid-1980s. Variables in the former group include two of Canada's term spreads at the short end of the yield curve (CANSPGB1T3, and CANSPGB3T5) and the smoothed version of Statistics Canada's composite leading index (GCLISM). What is remarkable about these three indicators is that, besides being strong and insensitive to structural change, their predictive ability over Canada's real GDP growth extends over both and long forecast horizons (h = 1, 2, 4, 8-quarters ahead) – the longer horizons (h = 4 and 8) being the most relevant to monetary policy. Notably, predictive content of changes in the US short-term real interest rates has been enhanced after the mid-1980s.

The results of this paper are conditional on the bivarate ARDL models used in the paper. A more stringent test of the information content of individual financial variables would call for multivariate extensions of these models, encompassing all fundamental determinants of the fluctuations in Canada's output growth, e.g., as in the Duguay (1994) model. It would also be interesting to see whether the somewhat unexpected long-horizon predictive content of Statistics Canada's leading index found in this paper persists in such extended models – a topic for future research.

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Appendix: The Bootstrap Procedure

The Rapach and Weber (2004) bootstrap procedure used in this paper is implemented in several steps. In step 1, we assume that the variables Δy_t and x_t are generated under the null hypothesis that the financial variable x_t has no forecasting ability over the real GDP growth $\Delta y_{t,}$ by the following process,

$$\Delta y_t = a_0 + \sum_{i=1}^{p_1} a_i \Delta y_{t-i} + e_{1,t} \qquad (9)$$

$$x_t = b_0 + \sum_{i=1}^{p_2} b_i \Delta y_{t-i} + \sum_{i=1}^{p_3} c_i \, x_{t-i} + e_{2,t} \qquad (10)$$

where the disturbance vector $e_t = (e_{1,t}, e_{2,t})$ is assumed to be independently and identically distributed with covariance matrix Σ . In step 2, we estimate equations (9) and (10) by OLS using data from the full sample and the lag orders (p_1, p_2, p_3) are selected by using the SIC. The OLS residuals from the equations are $\{\hat{e}_{1,t}, \hat{e}_{2,t}\}_{t=1}^{T}$. In step 3, we randomly draw with replacement T + 50 times from the OLS residuals, giving us a pseudo-series of disturbance terms $\{\hat{e}_t^*\}_{t=1}^{T+50}$. The residuals are drawn simultaneously to ensure that any contemporaneous correlation between disturbances present in the original sample are preserved. In step 4, using the residuals $\{\hat{e}_t^*\}_{t=1}^{T+50}$, the OLS coefficient estimates, equations (9) and (10) and setting the initial lagged observations for Δy_t and x_t equal to zero, we build up a pseudo-sample of T+50 observations for Δy_t and x_t, $\{\Delta y_t^*, x_t^*\}_{t=1}^{T+50}$. We drop the first 50-p transient start-up observations, leaving us with a pseudo-sample of T+ p observations, where p = max$\{p_1, p_2, p_3\}$, matching the size of the original sample (including the initial lagged variables). In the final step, for the pseudo-sample we calculate each of the four out-of-sample test statistics already described in section 3 of the paper. We repeat this process 1000 times, giving us an empirical distribution for each of the test statistics. For each test statistic, the p-value is computed as the proportion of the bootstrap statistics greater than the statistic computed using the original sample.

Table 1: Series Descriptions

Series Label	Series Transformation	Series Description	ARDL (q_1, q_2) model q_1	q_2
GROUP 1: Interest rates and Bond yields: **US Nominal Interest Rates**				
DUSFFO	Δ	Fed funds rate, USFFO	1	1
DUSTBILL3	Δ	3-month US t-bill rate, USTBILL3	1	1
DUSCP3M	Δ	3-month paper rate, USCP3M	1	1
DUSAAA	Δ	Moody's AAA rate, USAAA	1	1
DUSBAA	Δ	Moody's BAA rate, USBAA	1	1
DUSGB1Y	Δ	1-year US bond rate, USGB1Y	1	1
DUSGB5Y	Δ	5-year US bond rate, USGB5Y	1	1
DUSGB10Y	Δ	10-year US bond rate, USGB10Y	1	1
DUSGB20Y	Δ	20-year US bond rate, USGB20Y	1	1
		Canadian Nominal Interest Rates		
DCANBRATE	Δ	Canada’s Bank rate, CANBRATE	1	1
DCANTBILL3	Δ	3-month t-bill rate, CANTBILL3	1	1
DCANTBILL6	Δ	6-month t-bill rate, CANTBILL6	1	1
DCANCP1M	Δ	1-month paper rate, CANCP1M	1	1
DCANCP3M	Δ	3-month paper rate, CANCP3M	1	1
DCANBPR	Δ	Business prime rate, CANBPR	1	2
DCANGB1T3	Δ	1-3 year bond rate, CANGB1T3	1	1
DCANGB3T5	Δ	3-5 year bond rate, CANGB3T5	1	1
DCANGB5T10	Δ	5-10 year bond rate, CANGB5T10	1	1
DCANGB10$^+$	Δ	over 10-year bond rate, CANGB10+	1	1
		US Real Interest Rates		
DRUSFFO	Δ	USFFO – US CPI inflation	1	1
DRUSTBILL3	Δ	USTBILL3 – US CPI inflation	1	1
DRUSCP3M	Δ	USCP3M - US CPI inflation	1	1
DRUSAAA	Δ	USAAA – US CPI inflation	1	1
DRUSBAA	Δ	USBAA - US CPI inflation	1	1
DRUSGB1Y	Δ	USGB1Y- US CPI inflation	1	1
DRUSGB5Y	Δ	USGB5Y – US CPI inflation	1	1
DRUSGB10Y	Δ	USGB10Y – US CPI inflation	1	1
DRUSGB20Y	Δ	USGB20Y – US CPI inflation	1	1
		Canada's Real Interest Rates		
DRCANBRATE	Δ	CANBRATE – CAN CPI inflation	1	1
DRCANTBILL3	Δ	CANTBILL3 – CAN CPI inflation	1	1
DRCANTBILL6	Δ	CANTBILL6 – CAN CPI inflation	1	1
DRCANCP1M	Δ	CANCP1M – CAN CPI inflation	1	1
DRCANCP3M	Δ	CANCP3M – CAN CPI inflation	1	1
DRCANBPR	Δ	CANBPR – CAN CPI inflation	1	1
DRCANGB1T3	Δ	CANGB1T3 – CAN CPI inflation	1	1
DRCANGB3T5	Δ	CANGB3T5 – CAN CPI inflation	1	1
DRCANGB5T10	Δ	CANGB5T10 – CAN CPI inflation	1	1
DRCANGB10$^+$	Δ	CANGB10$^+$ – CAN CPI inflation	1	1

GROUP 2: Term and Default Spreads				
		Canada's Term and Default Spreads		
CANSPGB1T3	Level	CANGB1T3 - CANTBILL3	1	2
CANSPGB3T5	Level	CANGB3T5 - CANTBILL3	1	2
CANSPGB5T10	Level	CANGB5t10 - CANTBILL3	1	2
CANSPGB10^{+}	Level	CANGB10 - CANTBILL3	1	1
CANDSP	Level	CANCP3M - CANTBILL3	1	1
		US Term and Default Spreads		
USSP1Y	Level	USGB1Y - USTBILL3	1	1
USSP5Y	Level	USGB5Y - USTBILL3	1	2
USSP10Y	Level	USGB10Y - USTBILL3	1	2
USSP20Y	Level	USGB20Y - USTBILL3	1	2
USSP3M	Level	AAANA - USTBILL3	1	1
USDSP	Level	USCP3M - USTBILL3	1	1
GROUP 3: Canada's Monetary and Credit Aggregates				
		Canada's Nominal Money and Credit Growth		
GM0	Δln	M0 money (monetary base)	1	1
GM1	Δln	M1 money supply	1	1
GM2	Δln	M2 money supply	1	1
GM3	Δln	M3 money supply	1	1
GBL	Δln	Total bankloans	1	1
GCB	Δln	Business loans	1	1
		Canada's Real Money and Credit Growth		
GRM0	Δln	Real M0 money	1	2
GRM1	Δln	Real M1 money	1	1
GRM2	Δln	Real M2 money	1	1
GRM3	Δln	Real M3 money	1	2
GRBL	Δln	Total real bankloans	1	1
GRCB	Δln	Real business loans	1	2
GROUP 4: Other Financial and Non-Financial Variables				
DERATE	Δ	CAN-US nominal exch. rate	1	1
DC6RATE	Δ	Trade-weighted exch. rate	1	1
DRERATE	Δ	CAN-US real exch. rate	1	1
GTSE300	Δln	Nominal TSE300 index	1	1
GRTSE300	Δln	Real TSE300 index	1	1
GRPOIL	Δln	Real price of oil	1	1
GCOMPI	Δln	Commodity price index	1	1
GCLISM	Δln	Composite leading index	1	1
y	Δln	Canada's real GDP		

Notes: *Except for GM2, GRM2 (1968:2-2004:4), GM3, GRM3 (1970:2-2004:4) and DC6RATE (1970:2-2004:4), all other series begin in 1961:1 and end in 2004:4. The SBC lag orders reported here are used only in the structural breaks tests using full-sample data. All data are derived from three primary sources: Statistics Canada's CANSIM, Bank of Canada, and Federal Reserve Economic Data (FRED) at http://Research.stlouisfed.org/fred2.*

Table 2: QLR test for a single break and Bai-Perron sequential test for multiple breaks in the coefficients of the ARDL (p, q) model for Canada's real GDP growth.

Indicator Variable	Sample	QLR1	BREAK DATE	QLR2	BREAK DATE	QLR3	BREAK DATE	Bai-Perron 90% CI
GROUP 1: INTEREST RATES AND BOND YIELDS: DIFFERENCES IN US REAL INTEREST RATES								
DRUSFFO	1961:2-2004:4	11.8**	1973:4	6.4*	1981:4	6.4*	1974:3	1972:1-1975:1
DRUSTBILL3	1961:2-2004:4	9.7**	1973:4	5.5*	1974:3	10.6**	1974:4	1972:2-1975:1
DRUSCP3M	1961:2-2004:4	9.8**	1974:4	6.3*	1981:4	7.5*	1974:4	1971:4-1977:4
DRUSAAA	1961:2-2004:4	8.4**	1974:1	11.4**	1974:2	10.2**	1969:1	1971:1-1977:3
DRUSBAA	1961:2-2004:4	9.8**	1974:3	11.5**	1974:2	9.6*	1969:1	1971:4-1977:4
DRUSGB1Y	1961:2-2004:4	8.9**	1974:3	6.1*	1974:3	7.9*	1974:4	1970:3-1975:4
DRUSGB5Y	1961:2-2004:4	6.5*	1987:2	6.8*	1974:3	8.3*	1968:3	1983:2-1989:2
DRUSGB10Y	1961:2-2004:4	7.7**	1969:1	11.0**	1974:2	10.4**	1969:1	1968:3-1977:4
DRUSGB20Y	1961:2-2004:4	7.9**	1969:1	11.2**	1974:2	10.6**	1969:1	1968:4-1976:4
DIFFERENCES IN CANADIAN REAL INTEREST RATES								
DRCANBRATE	1961:2-2004:4	9.7**	1977:4	7.7*	1981:4	5.5*	1971:3	1972:1-1978:4
DRCANTBILL3	1961:2-2004:4	7.6**	1974:2	5.3*	1981:3	7.3*	1971:3	1972:2-1975:2
DRCANTBILL6	1961:2-2004:4	10.9**	1969:1	5.4*	1981:4	6.7*	1971:3	1968:3-1975:3
DRCANCP1M	1961:2-2004:4	11.9**	1968:4	10.6**	1974:2	7.4*	1998:2	1967:3-1974:4
DRCANCP3M	1961:2-2004:4	11.9**	1969:1	4.9*	1974:3	5.5*	1998:2	1968:1-1975:1
DRCANBPR	1961:2-2004:4	9.9**	1977:4	6.2*	1981:4	11.3**	1971:3	1973:3-1978:1
DRCANGB1T3	1961:2-2004:4	8.7**	1972:4	6.1*	1981:3	5.1*	1968:4	1973:1-1975:3
DRCANGB3T5	1961:2-2004:4	9.4**	1968:4	6.8*	1981:3	4.9*	1971:3	1967:3-1976:1 1980:2-1983:4
DRCANGB5T10	1961:2-2004:4	9.4**	1968:3	6.3*	1981:3	7.9*	1971:3	1967:4-1975:2 1980:2-1983:4
DRCANGB10T+	1961:2-2004:4	13.1**	1972:4	18.0**	1981:2*	15:1**	1968:3	1972:2-1975:2
GROUP 2: TERM AND DEFAULT SPREADS								
CANADIAN TERM AND DEFAULT SPREADS								
CANSPGB1T3	1961:2-2004:4	8.9**	1981:1	10.6**	1981:4	7.9*	1995:1	1980:1-1986:2
CANSPGB3T5	1961:2-2004:4	9.3**	1982:2	10.5**	1981:1	8.7*	1991:1	1980:2-1986:3
CANSPGB5T10	1961:2-2004:4	11.1**	1982:1	10.6**	1981:1	10.4**	1991:1	1980:1-1985:1
CANSPGB10+	1961:2-2004:4	12.2**	1982:1	11.5**	1969:4	9.8**	1991:1	1981-2-1983:3
CANDSP	1961:2-2004:4	15.1	1972:4	17.1**	1976:1	12.7**	1969:4	1972:1-1975:2
US TERM AND DEFAULT SPREADS								
USSP1Y	1961:2-2004:4	12.5**	1968:3	11.0**	1974:2	7.9*	1984:3	1967:4-1976:1
USSP5Y	1961:2-2004:4	11.1**	1969:1	11.6**	1969:4	7.7*	1976:2	1968:1-1975:2
USSP10Y	1961:2-2004:4	9.9**	1976:2	12.3**	1969:4	10.5**	1976:2	1972:3-1977:3
USSP20Y	1961:2-2004:4	14.1**	1973:1	13.5**	1974:2	12.2**	1973:1	1971:1-1975:2
USSP3M	1961:2-2004:4	13.9**	1968:3	13.6**	1980:1	11.3**	1968:3	1967:2-1978:1
USDSP	1961:2-2004:4	13.9**	1968:3	13.6**	1980:1	11.5**	1968:3	1957:3-1974:1
GROUP 3: CANADA'S MONETARY AND CREDIT AGGREGATES								
GROWTH IN NOMINAL MONETARY AGGREGATES								
GM0	1961:2-2004:4	6.9*	1972:4	10.4**	1972:4	7.8*	1969.4	1971:3-1974:2
GM1	1961:2-2004:4	22.9**	1981:3	21.2**	1990:1	15.3**	1984:2	1967:2-1969:4 1979:1-1983:3
GM2	1968:2-2004:4	15.1**	1981:2	12.4**	1972:4	12.7**	1969:1	1979:2-1984:1
GM3	1972:2-2004:4	15.1**	1981:2	11.5**	1973:4	8.9*	1969:2	
GBL	1961:2-2004:4	9.9**	1981:3	10.5**	1974:2	9.0*	1969:1	1973:3-1975:2 1979:1-1982:2
GCB	1961:2-2004:4	9.9**	1974:4	5.9*	1973:4	9.1*	1969:1	1972:4-1975:2
GROWTH IN REAL MONETARY AGGREGATES								
GRM0	1961:2-2004:4	11.7**	1972:3	11.6**	1974:2	13.2**	1968:4	1971:1-1974:3

GRM1	1961:2-2004:4	13.7**	1972:4	12.8**	1973:1	13.8**	1991:4	1971:2-1974:1 1990:2-1992:3
GRM2	1968:2-2004:4	9.6**	1981:3	10.6**	1974:2	9.0*	1969:1	
GRM3	1970:2-2004:4	9.7**	1981:2	7.8*	1973:4	9.0*	1969:1	
GRBL	1961:2-2004:4	5.8*	1972:3	5.4*	1998:3	5.9*	1968:4	1973:2-1975:2
GRCB	1961:2-2004:4	7.7**	1987:2	4.9*	1974:3	9.8*	1983:2	1982:2-1989:1
GROUP 4:		**OTHER FINANCIAL AND NON-FINANCIAL VARIABLES**						
DERATE	1961:3-2004:4	10.1**	1972:1	11.1**	1974:2	7.6*	1972:1	1971:1-1975:2
DC6RATE	1970:2-2004:4	10.2**	1981:3	11.4**	1974:2	7.6*	1972:1	
DRERATE	1961:2-2004:4	24.2**	1972:4	11.0**	1974:2	36.9**	1968:2	1972:2-1975:2
GTSE300	1961:2-2004:4	8.2**	1977:4	11.7**	1977:4	6.2*	1976:2	1971:4-1978:3
GRTSE300	1961:2-2004:4	6.9*	1977:4	12.8**	1978:1	5.7*	1969:4	1972:4-1978:2
GROIL	1961:2-2004:4	25.4**	1968:2	9.9**	1974:1	21:8**	1968:2	1967:3-1974:3
GCOMPI	1970:2-2004:4	24.4**	1968:2	9.9**	1974:1	21.7**	1968:2	1967:1-1973:2
GCLISM	1961:2-2004:4	10.6**	1987:4	8.6*	1975:3	10.3**	1980:4	1982:2-1988:3

*significant at the 5% level **significant at the 1% level

Notes: The QLR statistics are heteroskedasticity-robust and were computed for a one-quarter ahead best ARDL(p, q) growth model (equation 1 for h=1), using data for the full-sample. The best lag orders p and q were chosen by SIC. Three versions of the QLR test are reported. The QLR1 statistic tests the null hypothesis that all regression coefficients of the ARDL model are stable in the middle 70% of the full sample. The QLR2 tests the null hypothesis that structural change occurs only in the intercept and the autoregressive lag coefficients, while maintaining that the coefficients of the financial indicator variable remain constant. The QLR3 statistic tests the null hypothesis that structural change occurs only in the coefficients of the financial indicator variable and the intercept, while maintaining that the autoregressive lag coefficients remain constant. For the multiple-breaks Bai-Perron test, the table reports the number of significant breaks and the 90% confidence interval (CI) around each estimated break date. The 90% CI is not provided for a few short series.

TABLE 3: FORECASTING CANADA'S REAL GDP GROWTH TEST RESULTS

GROUP 1: INTEREST RATES AND BOND YIELDS: FIRST DIFFERENCES OF US REAL INTEREST RATES

Horizon (h):	1 Quarter Ahead		2 Quarters Ahead		4 Quarters Ahead		8 Quarters Ahead	
Out-of-Sample Period	1973:4-1984:4	1985:1-2004:4	1973:4-1984:4	1985:1-2004:4	1973:4-1984:4	1985:1-2004:4	1973:4-1984:4	1985:1-2004:4
DRUSFFO								
Q_1	0	0	0	0	0	0	0	8
Q_2	1	1	1	1	2	5	1	6
Wald	1.553 (0.300)	3.513 (0.124)	0.027 (0.898)	0.967 (0.478)	7.695 (0.092)	7.261 (0.028)	6.071 (0.190)	21.35 (0.012)
U	0.999	0.987	1.011	0.996	0.983	1.077	0.988	0.985
MSE-T	0.068 (0.194)	0.961 (0.068)	-1.055 (0.592)	0.955 (0.066)	0.405 (0.156)	-0.990 (0.634)	0.558 (0.182)	0.140 (0.264)
MSE-F	0.0965 (0.190)	2.050 (0.052)	-0.965 (0.562)	0.541 (0.182)	1.514 (0.066)	-10.69 (0.982)	1.016 (0.092)	2.237 (0.066)
ENC-T	0.246 (0.326)	1.668 (0.054)	-8.844 (0.666)	1.204 (0.122)	1.494 (0.084)	-0.395 (0.564)	1.410 (0.140)	0.965 (0.194)
ENC-NEW	0.182 (0.320)	1.804 (0.064)	-0.385 (0.676)	0.344 (0.284)	3.110 (0.046)	-1.993 (0.980)	1.283 (0.120)	7.755 (0.008)
DRUSTBILL3								
Q_1	0	0	0	0	0	0	0	6
Q_2	1	1	1	1	1	6	1	6
Wald	1.382 (0.334)	3.339 (0.114)	0.007 (0.948)	1.099 (0.380)	0.610 (0.466)	7.097 (0.030)	4.868 (0.150)	24.12 (0.004)
U	0.998	0.987	1.011	0.996	0.999	1.100	0.987	0.984
MSE-T	0.122 (0.150)	0.934 (0.076)	-1.013 (0.644)	1.021 (0.066)	0.054 (0.194)	-0.982 (0.698)	0.777 (0.108)	0.127 (0.292)
MSE-F	0.156 (0.150)	2.081 (0.054)	-1.019 (0.700)	0.535 (0.170)	0.063 (0.194)	-13.39 (0.992)	1.024 (0.034)	2.456 (0.014)
ENC-T	0.268 (0.268)	1.651 (0.052)	-0.514 (0.572)	1.256 (0.114)	0.457 (0.236)	-0.045 (0.478)	1.461 (0.084)	1.179 (0.140)
ENC-NEW	0.173 (0.282)	1.869 (0.054)	-0.244 (0.674)	0.334 (0.270)	0.265 (0.200)	-0.287 (0.848)	0.947 (0.064)	11.49 (0.002)
DRUSCP3M								
Q_1	0	0	0	0	0	0	0	0
Q_2	1	1	1	1	2	5	1	5
Wald	0.666 (0.464)	2.417 (0.212)	0.077 (0.806)	0.645 0.534)	9.322 (0.060)	6.103 (0.044)	6.586 (0156)	7.449 (0.038)
U	1.009	0.987	1.015	0.999	0.982	1.094	0.987	1.058
MSE-T	-0.730 (0.490)	1.261 (0.028)	-1.034 (0.572)	0.435 (0.150)	0.448 (0.160)	-1.108 (0.722)	0.637 (0.172)	-0.765 (0.548)
MSE-F	-0.872 (0.572)	2.136 (0.046)	1.349 (0.672)	0.138 (0.222)	1.616 (0.066)	-12.65 (0.990)	1.081 (0.074)	-7.752 (0.960)
ENC-T	-0.503 (0.556)	1.885 (0.026)	-0.333 (0.442)	0.616 (0.234)	1.740 (0.060)	-0.439 (0.602)	1.516 (0.126)	0.045 (0.418)
ENC-NEW	-0.296 (0.632)	1.626 (0.072)	-0.199 (0.504)	0.099 (0.368)	3.653 (0.028)	-2.342 (0.988)	1.256 (0.112)	0.028 (0.262)
DRUSAAA								
Q_1	0	0	0	0	0	0	1	0
Q_2	1	4	1	4	1	5	1	4
Wald	2.022 (0.226)	4.092 (0.068)	5.031 (0.068)	3.183 (0.090)	4.652 (0.092)	5.090 (0.036)	2.776 (0.218)	5.802 (0.040)
U	0.991	1.166	0.986	1.183	0.977	1.158	0.987	1.083
MSE-T	00.554 (0.076)	-2.818 (0.996)	0.942 (0.070)	-2.051 (0.978)	1.846 (0.016)	-1.746 (0.922)	1.239 (0.066)	-1.598 (0.868)
MSE-F	0.891 (0.094)	-21.13 (1.00)	1.300 (0.038)	-22.52 (1.00)	2.041 (0.014)	-19.56 (0.994)	1.080 (0.032)	-10.83 (0.974)
ENC-T	1.432 (0.062)	-1.829 (0.948)	2.185 (0.014)	-1.465 (0.916)	2.251 (0.022)	-0.639 (0.626)	1.853 (0.074)	-0.054 (0.408)
ENC-NEW	1.182 (0.110)	-5.790 (1.00)	1.798 (0.032)	-5.918 (1.00)	1.278 (0.038)	-2.865 (0.986)	0.726 (0.082)	-0.176 (0.810)
DRUSBAA								
Q_1	0	0	0	0	0	0	1	0
Q_2	2	2	1	4	1	4	1	4
Wald	10.982 (0.012)	2.891 (0.114)	6.080 (0.062)	3.285 (0.098)	5.810 (0.070)	2.510 (0.118)	2.914 (0.210)	4.932 (0.050)
U	0.980)	1.098	0.978	1.149	0.972	1.114	0.987	1.070
MSE-T	0.376 (0.116)	-3.145 (1.00)	0.748 (0.078)	-2.266 (0.982)	1.885 (0.008)	-2.067 (0.978)	1.010 (0.080)	-1.546 (0.848)
MSE-F	1.944 (0.034)	-13.67 (1.00)	2.062 (0.026)	-19.18 (0.998)	2.531 (0.008)	-14.98 (0.994)	1.064 (0.032)	-9.299 (0.960)
ENC-T	2.770 (0.00)	-2.372 (0.996)	2.592 (0.002)	-1.665 (0.928)	2.388 (0.006)	-1.117 (0.834)	1.788 (0.066)	-0.296 (0.504)
ENC-NEW	6.665 (0.002)	-4.637 (1.00)	2.904 (0.016)	-5.600 (1.00)	1.659 (0.034)	-3.652 (0.998)	0.815 (0.086)	-0.872 (0.954)
DRUSGB1Y								
Q_1	0	0	0	0	0	0	0	0
Q_2	1	1	1	5	2	5	1	5
Wald	0.286 (0.620)	2.167 (0.190)	0.998 (0.432)	7.246 (0.030)	9.823 (0.048)	6.033 (0.040)	6.033 (0.146)	10.08 (0.022)
U	1.010	0.985	1.007	1.109	0.967	1.128	0.981	1.074
MSE-T	-1.197 (0.700)	1.544 (0.022)	-0.558 (0.400)	-1.364 (0.770)	0.983 (0.064)	-1.312 (0.802)	1.249 (0.072)	-0.896 (0.586)
MSE-F	-0.892 (0.554)	2.469 (0.034)	-0.618 (0.508)	-14.79 (0.994)	3.048 (0.010)	-16.51 (0.988)	1.578 (0.028)	-9.689 (0.972)
ENC-T	-1.059 (0.760)	2.069 (0.020)	0.185 (0.326)	-0.625 (0.612)	1.805 (0.040)	-0.472 (0.592)	1.820 (0.090)	0.180 (0.352)
ENC-NEW	-0.381 (0.692)	1.696 (0.060)	0.096 (0.324)	-3.124 (0.988)	3.227 (0.014)	-2.677 (0.984)	1.145 (0.070)	0.903 (0.068)
DRUSGB5Y								
Q_1	0	1	0	0	0	0	0	0
Q_2	1	2	1	5	2	6	1	5
Wald	0.353 (0.582)	1.657 (0.274)	04.701 (0.086)	4.451 (0.070)	8.442 (0.058)	10.62 (0.016)	3.876 (0.174)	15.21 (0.004)
U	1.002	1.073	0.993	1.176	0.949	1.173	0.983	1.093
MSE-T	-0.281 (0.264)	-2.647 (0.990)	0.449 (0.078)	-1.697 (0.922)	1.282 (0.026)	-1.413 (0.842)	1.279 (0.060)	-1.339 (0.794)
MSE-F	-0.228 (0.244)	-10.49 (0.996)	0.687 (0.054)	-21.89 (1.00)	4.804 (0.002)	-21.02 (1.00)	1.413 (0.028)	-11.86 (0.978)
ENC-T	-0.018 (0.334)	-1.939 (0.956)	1.532 (0.032)	-0.895 (0.784)	1.973 (0.026)	-0.209 (0.452)	1.826 (0.066)	0.496 (0.248)
ENC-NEW	-0.007 (0.334)	-3.545 (1.00)	1.065 (0.076)	-4.375 (0.994)	3.977 (0.016)	-1.103 (0.968)	0.943 (0.078)	1.973 (0.022)

DRUSGB10Y								
Q_1	0	0	0	0	0	0	0	0
Q_2	1	2	1	5	2	5	1	5
Wald	0.809 (0.436)	0.789 (0.398)	4.974 (0.082)	3.545 (0.118)	6.130 (0.068)	6.647 (0.028)	3.274 (0.240)	11.91 (0.020)
U	0.997	1.069	0.990	1.176	0.958	1.164	0.986	1.103
MSE-T	0.258 (0.142)	-3.083 (0.998)	0.548 (0.100)	-1.671 (0.896)	1.318 (0.024)	-1.535 (0.862)	1.199 (0.058)	-1.436 (0.826)
MSE-F	0.259 (0.158)	-10.03 (0.998)	0.911 (0.054)	-21.85 (1.00)	3.970 (0.002)	-20.18 (0.998)	1.096 (0.036)	-13.03 (0.984)
ENC-T	0.715 (0.164)	-2.501 (0.996)	1.830 (0.022)	-0.991 (0.744)	1.951 (0.026)	-0.428 (0.488)	1.793 (0.076)	0.484 (0.278)
ENC-NEW	0.363 (0.232)	-3.721 (1.00)	1.328 (0.048)	-4.573 (0.998)	3.079 (0.020)	-1.978 (0.984)	0.742 (0.092)	1.802 (0.018)
DRUSGB20Y								
q_1	0	0	0	0	0	0	0	0
q_2	1	2	1	5	1	8	1	5
Wald	1.050 (0.388)	0.838 (0.376)	4.650 (0.070)	4.013 (0.048)	3.761 (0.110)	16.81 (0.004)	3.243 (0.176)	10.70 (0.010)
U	0.996	1.069	0.989	1.199	0.985	1.228	0.986	1.132
MSE-T	0.314 (0.140)	-2.911 (0.994)	0.567 (0.104)	-1.642 (0.892)	1.747 (0.018)	-1.443 (0.866)	1.313 (0.068)	-1.508 (0.860)
MSE-F	0.368 (0.148)	-10.06 (0.992)	0.970 (0.060)	-24.13 (1.00)	1.377 (0.018)	-25.96 (0.998)	1.103 (0.030)	-16.03 (0.990)
ENC-T	0.914 (0.142)	-2.434 (0.992)	1.758 (0.034)	-0.945 (0.738)	2.070 (0.026)	0.190 (0.360)	1.855 (0.060)	0.494 (0.242)
ENC-NEW	0.545 (0.196)	-3.767 (1.00)	1.339 (0.048)	-4.462 (1.00)	0.841 (0.066)	0.949 (0.032)	0.716 (0.072)	1.791 (0.010)
FIRST DIFFERENCES OF CANADA'S REAL INTEREST RATES								
DRCANBRATE								
q_1	0	1	0	0	0	0	0	0
q_2	1	1	1	5	2	5	1	6
Wald	0.031 (0.886)	1.157 (0.356)	0.812 (0.460)	9.185 (0.024)	7.390 (0.066)	6.033 (0.074)	6.454 (0.138)	10.53 (0.020)
U	1.033	0.999	1.022	1.078	0.948	1.096	0.977	1.043
MSE-T	-0.961 (0.542)	0.078 (0.236)	-0.512 (0.392)	-0.745 (0.572)	0.694 (0.076)	-0.733 (0.532)	1.155 (0.066)	-0.357 (0.372)
MSE-F	-3.001 (0.864)	0.093 (0.234)	-1.992 (0.810)	-11.00 (0.996)	4.918 (0.004)	-12.89 (0.978)	1.907 (0.058)	-5.856 (0.956)
ENC-T	-0.532 (0.544)	0.717 (0.186)	-0.143 (0.428)	0.345 (0.308)	1.656 (0.050)	0.159 (0.380)	1.511 (0.102)	0.766 (0.206)
ENC-NEW	-0.785 (0.856)	0.433 (0.234)	-0.256 (0.582)	2.154 (0.056)	6.950 (0.006)	1.191 (0.116)	1.442 (0.096)	5.507 (0.016)
DRCANTBILL 3								
q_1	0	1	0	0	0	0	0	0
q_2	1	1	1	5	2	5	1	6
Wald	0.022 (0.902)	1.352 (0.366)	0.686 (0.512)	9.746 (0.024)	7.021 (0.082)	6.614 (0.036)	7.364 (0.140)	12.76 (0.016)
U	1.039	0.998	1.025	1.075	0.952	1.093	0.974	1.043
MSE-T	-1.039 (0.616)	0.268 (0.192)	-0.592 (0.418)	-0.736 (0.564)	0.672 (0.078)	-0.704 (0.484)	1.232 (0.072)	-0.344 (0.400)
MSE-F	-3.441 (0.902)	0.324 (0.196)	-2.202 (0.832)	-10.66 (0.998)	4.495 (0.006)	-12.54 (0.994)	2.162 (0.068)	-5.881 (0.946)
ENC-T	-0.593 (0.576)	0.927 (0.164)	-0.206 (0.466)	0.295 (0.352)	1.666 (0.046)	0.166 (0.374)	1.669 (0.116)	0.780 (0.232)
ENC-NEW	-0.923 (0.892)	0.568 (0.232)	-0.350 (0.686)	1.820 (0.086)	6.206 (0.006)	1.258 (0.098)	1.699 (0.106)	5.915 (0.004)
DRCANTBILL6								
q_1	0	1	0	0	0	0	0	0
q_2	1	1	1	5	2	5	8	7
Wald	0.049 (0.846)	1.387 (0.304)	0.698 (0.478)	8.862 (0.038)	6.951 (0.104)	6.314 (0.062)	182.13 (0.00)	10.63 (0.030)
U	1.040	0.999	1.025	1.081	0.952	1.096	0.748	1.045
MSE-T	-0.935 (0.568)	0.085 (0.208)	-0.645 (0.426)	-0.824 (0.628)	0.744 (0.098)	-0.779 (0.578)	1.720 (0.032)	-0.359 (0.386)
MSE-F	-3.569 (0.912)	0.113 (0.212)	-2.250 (0.834)	-11.40 (0.994)	4.502 (0.012)	-12.91 (0.986)	31.55 (0.00)	-6.151 (0.942)
ENC-T	-0.542 (0.574)	0.743 (0.168)	-0.267 (0.462)	0.159 (0.404)	1.726 (0.060)	0.042 (0.440)	2.083 (0.056)	0.879 (0.184)
ENC-NEW	-0.944 (0.916)	0.496 (0.194)	-0.422 (0.752)	0.916 (0.162)	5.796 (0.010)	0.288 (0.320)	26.97 (0.00)	6.323 (0.012)
DRCANCP1M								
q_1	0	1	0	0	0	4	0	0
q_2	1	1	1	5	2	5	1	8
Wald	0.053 (0.806)	1.790 (0.316)	1.044 (0.424)	12.77 (0.004)	9.039 (0.066)	30.99 (0.002)	8.769 (0.102)	14.40 (0.014)
U	1.047	0.997	1.027	1.069	0.939	1.019	0.971	1.030
MSE-T	-1.254 (0.698)	0.301 (0.172)	-0.619 (0.422)	-0.643 (0.498)	0.793 (0.106)	-0.123 (0.310)	1.258 (0.084)	-0.233 (0.384)
MSE-F	-4.104 (0.930)	0.428 (0.186)	-2.381 (0.842)	-9.852 (0.992)	5.900 (0.014)	-2.787 (0.892)	2.390 (0.016)	-4.259 (0.930)
ENC-T	-0.654 (0.594)	0.987 (0.144)	-0.015 (0.396)	0.457 (0.306)	1.819 (0.056)	0.904 (0.186)	1.798 (0.100)	0.956 (0.212)
ENC-NEW	-0.978 (0.904)	0.697 (0.198)	-0.027 (0.404)	3.012 (0.030)	7.667 (0.016)	10.94 (0.006)	1.968 (0.048)	7.854 (0.004)
DRCANCP3M								
q_1	0	1	0	0	0	4	0	0
q_2	1	1	1	5	2	5	1	8
Wald	0.038 (0.850)	1.793 (0.292)	0.859 (0.434)	11.84 (0.020)	8.776 (0.068)	29.19 (0.00)	8.301 (0.122)	15.83 (0.010)
U	1.045	0.996	1.027	1.071	0.941	1.018	0.973	1.032
MSE-T	-1.236 (0.712)	0.426 (0.148)	-0.691 (0.452)	-0.693 (0.554)	0.829 (0.072)	-0.123 (0.332)	1.288 (0.074)	-0.242 (0.394)
MSE-F	-3.985 (0.926)	0.586 (0.162)	-2.362 (0.850)	-10.12 (0.994)	5.646 (0.008)	-2.715 (0.892)	2.260 (0.050)	-4.474 (0.938)
ENC-T	-0.706 (0.636)	1.125 (0.132)	-0.171 (0.418)	0.371 (0.334)	1.872 (0.044)	0.887 (0.192)	1.798 (0.086)	0.977 (0.216)
ENC-NEW	-1.064 (0.926)	0.783 (0.186)	-0.274 (0.624)	2.300 (0.068)	7.129 (0.008)	10.31 (0.002)	1.790 (0.086)	7.982 (0.012)
DRCANBPR								
q_1	0	0	0	0	0	0	0	0
q_2	1	5	1	5	2	5	1	6
Wald	0.849 (0.438)	18.42 (0.00)	2.305 (0.254)	10.45 (0.016)	10.69 (0.052)	7.081 (0.042)	11.49 (0.076)	9.584 (0.028)
U	1.054	1.092	1.019	1.106	0.919	1.125	0.961	1.057
MSE-T	-0.928 (0.576)	-1.425 (0.808)	-0.322 (0.294)	-0.815 (0.542)	0.904 (0.092)	-0.778 (0.536)	1.332 (0.076)	-0.429 (0.402)

MSE-F	-4.671 (0.930)	-12.94 (1.00)	-1.729 (0.752)	-14.38 (0.998)	8.005 (0.008)	-16.17 (0.986)	3.288 (0.036)	-7.698 (0.958)
ENC-T	0.008 (0.370)	0.565 (0.212)	0.432 (0.238)	0.362 (0.306)	2.085 (0.040)	0.184 (0.366)	1.827 (0.098)	0.734 (0.232)
ENC-NEW	0.020 (0.364)	2.185 (0.056)	1.086 (0.120)	2.555 (0.044)	11.48 (0.008)	1.550 (0.070)	2.718 (0.054)	5.584 (0.016)
DRCANGB1T3								
q_1	0	1	0	0	0	0	0	1
q_2	1	1	1	5	2	4	1	8
Wald	1.076 (0.380)	3.416 (0.114)	2.452 (0.222)	8.337 (0.014)	9.711 (0.068)	6.778 (0.044)	7.946 (0.128)	18.86 (0.008)
U	1.023	1.006	1.010	1.092	0.937	1.074	0.981	1.067
MSE-T	-0.452 (0.402)	-0.359 (0.364)	-0.311 (0.276)	-1.003 (0.646)	1.222 (0.026)	-0.921 (0.628)	1.503 (0.078)	-0.784 (0.570)
MSE-F	-2.086 (0.834)	-0.926 (0.694)	-0.914 (0.524)	-12.74 (1.00)	6.102 (0.004)	-10.24 (0.976)	1.519 (0.080)	-8.930 (0.962)
ENC-T	0.038 (0.382)	0.540 (0.226)	0.266 (0.280)	0.054 (0.388)	1.870 (0.030)	-0.006 (0.430)	1.768 (0.112)	1.359 (0.096)
ENC-NEW	0.083 (0.358)	0.693 (0.170)	0.372 (0.238)	0.287 (0.274)	5.634 (0.010)	-0.028 (0.452)	1.021 (0.152)	5.309 (0.008)
DRCANGB3T5								
q_1	0	1	0	0	0	0	3	1
q_2	1	1	1	5	2	4	8	8
Wald	1.812 (0.248)	4.720 (0.072)	3.766 (0.138)	8.452 (0.014)	9.759 (0.058)	6.739 (0.028)	58.50 (0.002)	25.40 (0.002)
U	1.016	1.011	1.006	1.090	0.934	1.071	0.730	1.051
MSE-T	-0.320 (0.314)	-0.529 (0.450)	-0.181 (0.292)	-1.081 (0.736)	1.258 (0.030)	-1.018 (0.732)	1.437 (0.060)	-0.875 (0.642)
MSE-F	-1.511 (0.758)	-1.697 (0.822)	-0.549 (0.404)	-12.53 (0.998)	6.398 (0.002)	-9.879 (0.982)	34.95 (0.00)	-6.941 (0.970)
ENC-T	0.252 (0.296)	0.486 (0.266)	0.557 (0.250)	-0.005 (0.412)	1.815 (0.038)	-0.009 (0.458)	1.635 (0.118)	1.935 (0.042)
ENC-NEW	0.577 (0.198)	0.769 (0.166)	0.838 (0.154)	-0.026 (0.432)	5.565 (0.016)	-0.037 (0.508)	27.22 (0.00)	5.277 (0.004)
DRCANGB5T10								
q_1	0	1	0	0	0	0	0	0
q_2	1	1	1	5	2	4	1	6
Wald	2.977 (0.132)	7.037 (0.022)	5.252 (0.100)	9.207 (0.014)	10.29 (0.058)	7.139 (0.032)	6.656 (0.118)	25.43 (0.004)
U	1.010	1.014	0.998	1.086	0.932	1.067	0.983	1.012
MSE-T	-0.202 (0.284)	-0.530 (0.436)	0.058 (0.184)	-1.110 (0.694)	1.217 (0.036)	-1.056 (0.712)	1.316 (0.050)	-0.293 (0.378)
MSE-F	-0.976 (0.624)	-2.175 (0.858)	0.173 (0.152)	-12.02 (0.994)	6.606 (0.006)	-9.325 (0.982)	1.386 (0.064)	-1.689 (0.922)
ENC-T	0.531 (0.228)	0.720 (0.212)	0.842 (0.126)	0.019 (0.388)	1.789 (0.044)	0.029 (0.360)	1.606 (0.092)	2.367 (0.016)
ENC-NEW	1.320 (0.104)	1.463 (0.068)	1.299 (0.070)	0.088 (0.332)	5.186 (0.016)	0.110 (0.270)	0.901 (0.158)	4.579 (0.008)
DRCANGB10+								
q_1	0	1	0	0	0	0	0	0
q_2	3	1	1	4	3	4	1	5
Wald	17.67 (0.004)	9.670 (0.006)	7.353 (0.062)	10.94 (0.008)	15.97 (0.024)	7.512 (0.024)	6.616 (0.122)	15.74 (0.002)
U	0.996	1.017	0.990	1.087	0.910	1.079	0.983	1.022
MSE-T	0.039 (0.176)	-0.572 (0.432)	0.260 (0.138)	-1.453 (0.838)	1.021 (0.078)	-1.221 (0.756)	1.316 (0.068)	-0.558 (0.444)
MSE-F	0.357 (0.136)	-2.717 (0.920)	0.911 (0.080)	-12.10 (0.992)	9.142 (0.004)	-10.82 (0.976)	1.415 (0.050)	-3.128 (0.948)
ENC-T	1.811 (0.026)	0.984 (0.138)	1.117 (0.092)	0.056 (0.390)	1.752 (0.056)	-0.071 (0.422)	1.631 (0.094)	2.023 (0.026)
ENC-NEW	12.054 (0.00)	2.343 (0.038)	2.059 (0.032)	0.212 (0.284)	9.587 (0.006)	-0.241 (0.740)	0.920 (0.102)	3.394 (0.012)
GROUP 2: TERM AND DEFAULT SPREADS:			**CANADA'S TERM AND DEFAULT SPREADS**					
Period	**1973:4-1984:4**	**1985:1-2004:4**	**1973:4-1984:4**	**1985:1-2004:4**	**1973:4-1984:4**	**1985:1-2004:4**	**1973:4-1984:4**	**1985:1-2004:4**
CANSPGB1T3								
q_1	0	0	0	0	0	0	0	0
q_2	1	2	1	2	1	2	3	1
Wald	7.446 (0.036)	31.03 (0.00)	31.00 (0.016)	38.11 (0.00)	30.95 (0.016)	34.94 (0.004)	21.93 (0.086)	13.73 (0.030)
U	0.948	0.931	0.866	0.905	0.784	0.919	1.066	0.921
MSE-T	1.219 (0.024)	0.979 (0.044)	2.072 (0.012)	0.655 (0.098)	1.787 (0.018)	0.409 (0.170)	-0.286 (0.320)	0.403 (0.170)
MSE-F	5.313 (0.006)	12.33 (0.002)	15.36 (0.00)	17.47 (0.00)	27.57 (0.00)	14.23 (0.010)	-4.789 (0.608)	13.01 (0.014)
ENC-T	2.307 (0.004)	2.664 (0.006)	2.34 (0.016)	1.625 (0.40)	2.008 (0.036)	1.179 (0.144)	0.385 (0.350)	1.062 (0.162)
ENC-NEW	5.138 (0.002)	18.71 (0.00)	12.41 (0.00)	26.63 (0.00)	20.81 (0.002)	25.03 (0.002)	2.436 (0.198)	18.56 (0.012)
CANSPGB3T5								
q_1	0	0	0	0	0	0	0	0
q_2	1	2	3	2	1	2	3	1
Wald	9.635 (0.020)	32.17 (0.00)	33.14 (0.004)	34.98 (0.00)	26.73 (0.024)	34.89 (0.004)	24.25 (0.060)	14.00 (0.026)
U	0.919	0.953	0.874	0.932	0.746	0.936	1.008	0.921
MSE-T	1.850 (0.004)	0.594 (0.094)	1.033 (0.050)	0.423 (0.134)	1.854 (0.014)	0.289 (0.158)	-0.004 (0.244)	0.335 (0.180)
MSE-F	8.542 (0.00)	7.997 (0.002)	14.18 (0.002)	11.95 (0.00)	35.00 (0.002)	10.84 (0.016)	-0.677 (0.292)	13.04 (0.026)
ENC-T	2.853 (0.002)	2.522 (0.004)	1.881 (0.044)	1.533 (0.070)	2.198 (0.028)	1.162 (0.132)	0.672 (0.268)	1.062 (0.170)
ENC-NEW	6.928 (0.00)	19.71 (0.00)	14.82 (0.00)	28.21 (0.00)	26.92 (0.002)	28.14 (0.00)	4.829 (0.124)	23.10 (0.008)
CANSPGB5T10								
q_1	0	0	0	0	0	0	0	0
q_2	1	2	1	2	1	2	3	1
Wald	10.39 (0.010)	32.72 (0.002)	28.36 (0.004)	31.73 (0.00)	29.46 (0.120)	32.30 (0.004)	34.66 (0.034)	15.25 (0.028)
U	0.907	0.978	0.8115	0.955	0.708	0.953	0.969	0.923
MSE-T	2.139 (0.002)	0.263 (0.178)	2.199 (0.006)	0.267 (0.178)	1.898 (0.024)	0.201 (0.204)	0.145 (0.248)	0.293 (0.192)
MSE-F	10.08 (0.00)	3.623 (0.030)	23.84 (0.00)	7.581 (0.018)	43.85 (0.00)	7.683 (0.046)	2.631 (0.158)	12.59 (0.034)
ENC-T	3.042 (0.00)	2.365 (0.020)	2.520 (0.008)	1.459 (0.080)	2.196 (0.042)	1.155 (0.160)	0.866 (0.280)	1.085 (0.180)
ENC-NEW	7.689 (0.00)	19.38 (0.00)	17.88 (0.002)	27.91 (0.00)	33.63 (0.00)	29.66 (0.002)	7.392 (0.118)	26.58 (0.010)

CANSPGB10+								
q_1	0	0	0	0	0	0	2	0
q_2	1	2	1	2	1	2	5	1
Wald	10.15 (0.016)	32.79 (0.00)	25.08 (0.008)	26.33 (0.004)	26.97 (0.026)	25.75 (0.002)	76.04 (0.016)	14.99 (0.022)
U	0.909	0.982	0.815	0.962	0.715	0.964	1.126	0.931
MSE-T	2.341 (0.00)	0.212 (0.170)	2.147 (0.002)	0.226 (0.178)	1.841 (0.006)	0.159 (0.170)	-0.446 (0.334)	0.279 (0.224)
MSE-F	9.808 (0.00)	2.859 (0.012)	23.23 (0.00)	6.335 (0.014)	42.14 (0.00)	5.888 (0.052)	-8.442 (0.712)	11.19 (0.044)
ENC-T	3.013 (0.00)	2.317 (0.010)	2.412 (0.008)	1.428 (0.092)	2.095 (0.036)	1.151 (0.122)	0.399 (0.358)	1.096 (0.196)
ENC-NEW	6.842 (0.002)	18.76 (0.00)	16.42 (0.00)	26.58 (0.00)	31.15 (0.00)	27.98 (0.00)	2.515 (0.244)	24.74 (0.004)
CANDSP								
q_1	0	0	0	0	0	0	1	0
q_2	1	1	1	1	1	1	1	1
Wald	1.311 (0.348)	0.023 (0.906)	2.108 (0.326)	0.030 (0.906)	0.981 (0.590)	0.216 (0.722)	0.002 (0.976)	1.635 (0.410)
U	1.021	1.018	1.014	1.023	1.022	1.018	1.053	0.990
MSE-T	-0.633 (0.450)	-2.333 (0.972)	-0.353 (0.288)	-2.046 (0.928)	-0.449 (0.302)	-1.528 (0.790)	-0.735 (0.392)	1.001 (0.092)
MSE-F	-1.932 (0.788)	-2.783 (0.888)	-1.319 (0.464)	-3.550 (0.802)	-1.931 (0.386)	-2.787 (0.534)	-3.904 (0.470)	1.466 (0.202)
ENC-T	0.557 (0.192)	-2.121 (0.978)	0.521 (0.256)	-1.906 (0.946)	0.068 (0.386)	-1.425 (0.854)	0.054 (0.432)	1.291 (0.142)
ENC-NEW	0.876 (0.114)	1.252 (0.958)	1.242 (0.192)	-1.615 (0.904)	0.154 (0.384)	-1.276 (0.694)	0.198 (0.414)	0.975 (0.326)
US TERM AND DEFAULT SPREADS								
USSP1Y								
q_1	0	0	0	0	0	0	1	0
q_2	1	1	1	1	1	1	1	1
Wald	6.921 (0.038)	0.689 (0.464)	2.456 (0.306)	0.066 (0.852)	0.603 (0.624)	0.001 (0.980)	0.186 (0.826)	0.029 (0.888)
U	0.941	1.073	1.004	1.049	1.031	1.018	1.023	1.013
MSE-T	1.123 (0.034)	-4.089 (1.00)	-0.118 (0.268)	-2.471 (0.978)	-2.015 (0.900)	-1.314 (0.712)	-1.802 (0.806)	-0.921 (0.550)
MSE-F	6.087 (0.00)	-10.57 (1.00)	-0.375 (0.296)	-7.163 (0.950)	-2.587 (0.544)	-2.735 (0.622)	-1.794 (0.418)	-1.818 (0.488)
ENC-T	1.474 (0.064)	-3.451 (1.00)	0.579 (0.244)	-2.130 (0.966)	-1.678 (0.890)	-1.206 (0.768)	-0.742 (0.610)	-0.849 (0.648)
ENC-NEW	5.205 (0.006)	-4.300 (1.00)	1.131 (0.172)	-3.009 (0.978)	-0.997 (0.690)	-1.245 (0.740)	-0.389 (0.514)	-0.830 (0.632)
USSP5Y								
q_1	0	0	0	0	0	0	0	0
q_2	1	2	1	2	1	2	3	1
Wald	0.030 (0.902)	8.579 (0.024)	1.537 (0.380)	4.587 (0.126)	6.372 (0.180)	1.807 (0.352)	5.843 (0.290)	1.134 (0.428)
U	1.030	1.069	1.025	1.077	1.008	1.095	1.089	1.066
MSE-T	-1.178 (0.682)	-2.025 (0.954)	-0.518 (0.338)	-1.842 (0.908)	-0.093 (0.230)	-1.841 (0.906)	-1.067 (0.486)	-1.897 (0.890)
MSE-F	-2.729 (0.842)	-10.06 (0.998)	-2.191 (0.606)	-10.90 (0.982)	-0.735 (0.282)	-12.76 (0.946)	-6.328 (0.608)	-8.721 (0.800)
ENC-T	-0.555 (0.582)	-0.829 (0.724)	0.263 (0.282)	-0.971 (0.706)	1.288 (0.136)	-1.243 (0.792)	0.237 (0.370)	-1.362 (0.818)
ENC-NEW	-0.616 (0.790)	-1.908 (0.984)	0.539 (0.244)	-2.551 (0.958)	4.362 (0.090)	-3.510 (0.942)	0.583 (0.348)	-2.279 (0.778)
USSP10Y								
q_1	0	0	0	0	0	0	0	0
q_2	1	2	1	2	1	2	3	1
Wald	0.565 (0.516)	10.71 (0.014)	4.282 (0.176)	5.098 (0.096)	9.962 (0.120)	1.696 (0.358)	6.650 (0.300)	1.025 (0.522)
U	1.033	1.067	1.018	1.094	1.002	1.124	1.1004	1.086
MSE-T	-0.947 (0.560)	-1.843 (0.914)	-0.321 (0.300)	-1.846 (0.894)	-0.015 (0.202)	-1.995 (0.894)	-1.001 (0.498)	-2.211 (0.924)
MSE-F	-2.941 (0.850)	-9.713 (0.998)	-1.635 (0.510)	-12.98 (0.984)	-0.152 (0.214)	-16.12 (0.966)	-7.176 (0.648)	-11.12 (0.832)
ENC-T	-0.078 (0.388)	-0.546 (0.624)	0.866 (0.176)	-0.925 (0.680)	1.498 (0.110)	-1.316 (0.796)	0.308 (0.362)	-1.719 (0.880)
ENC-NEW	-0.116 (0.438)	-1.345 (0.974)	2.107 (0.106)	-2.782 (0.968)	6.283 (0.066)	-4.091 (0.954)	0.869 (0.336)	-2.763 (0.804)
USSP20Y								
q_1	0	0	0	0	0	0	1	0
q_2	1	2	1	2	1	2	3	1
Wald	0.648 (0.502)	11.26 (0.012)	4.947 (0.158)	4.377 (0.154)	9.025 (0.092)	1.127 (0.472)	6.146 (0.336)	0.658 (0.628)
U	1.038	1.060	1.033	1.096	1.036	1.131	1.157	1.091
MSE-T	-1.248 (0.758)	-1.680 (0.910)	-0.628 (0.350)	-1.799 (0.902)	-0.313 (0.264)	-2.002 (0.914)	-1.266 (0.606)	-2.218 (0.936)
MSE-F	-3.419 (0.920)	-8.818 (0.994)	-2.883 (0.674)	-13.27 (0.990)	-3.047 (0.552)	-16.85 (0.970)	-10.11 (0.734)	-11.68 (0.828)
ENC-T	-0.408 (0.552)	-0.394 (0.524)	0.657 (0.202)	-0.932 (0.730)	1.242 (0.124)	-1.335 (0.812)	-0.405 (0.544)	-1.761 (0.910)
ENC-NEW	-0.534 (0.820)	-0.962 (0.954)	1.345 (0.168)	-2.868 (0.978)	4.253 (0.066)	-4.208 (0.964)	-1.028 (0.618)	-2.758 (0.796)
USSP3M								
q_1	0	0	0	0	0	0	1	0
q_2	1	1	1	1	1	1	1	1
Wald	16.66 (0.006)	9.031 (0.016)	12.54 (0.034)	7.695 (0.022)	8.378 (0.122)	5.985 (0.080)	3.434 (0.382)	2.999 (0.224)
U	0.929	1.090	0.873	1.089	0.856	1.065	0.9116	1.023
MSE-T	0.778 (0.056)	-3.613 (1.00)	1.501 (0.016)	-2.832 (0.992)	1.918 (0.008)	-2.097 (0.924)	1.703 (0.046)	-0.661 (0.386)
MSE-F	7.349 (0.002)	-12 73 (0.998)	14.37 (0.00)	-12.49 (0.994)	15.98 (0.002)	-9.143 (0.916)	8.136 (0.038)	-3.321 (0.576)
ENC-T	2.689 (0.002)	-2.643 (0.996)	2.337 (0.014)	-1.863 (0.930)	2.227 (0.030)	-1.136 (0.716)	2.089 (0.062)	-0.089 (0.374)
ENC-NEW	11.73 (0.00)	-4.194 (1.00)	15.19 (0.00)	-3.854 (1.00)	15.35 (0.006)	-2.450 (0.906)	5.428 (0.080)	-0.222 (0.400)
USDSP								
q_1	0	0	0	0	0	0	1	0
q_2	1	1	1	1	1	1	1	1
Wald	16.66 (0.006)	9.031 (0.024)	12.54 (0.036)	7.695 (0.058)	8.378 (0.132)	5.985 (0.112)	3.434 (0.382)	2.999 (0.246)
U	0.929	1.090	0.873	1.089	0.856	1.065	0.911	1.023

MSE-T	0.778 (0.060)	-3.613 (1.00)	1.501 (0.014)	-2.832 (0.996)	1.918 (0.022)	-2.097 (0.942)	1.703 (0.054)	-0.661 (0.428)
MSE-F	7.349 (0.002)	-12.73 (0.998)	14.37 (0.00)	-12.49 (0.994)	15.98 (0.004)	-9.143 (0.912)	8.136 (0.040)	-3.321 (0.602)
ENC-T	2.689 (0.002)	-2.643 (0.994)	2.337 (0.008)	-1.863 (0.948)	2.227 (0.040)	-1.136 (0.752)	2.089 (0.076)	-0.089 (0.412)
ENC-NEW	11.736 (0.00)	-4.194 (1.00)	15.19 (0.00)	-3.854 (0.998)	15.35 (0.008)	-2.450 (0.896)	5.428 (0.116)	-0.222 (0.454)

GROUP 3: CANADA'S MONETARY AND CREDIT AGGREGATES

GROWTH IN NOMINAL MONETARY AND CREDIT AGGREGATES

Period	1973:4-1984:4	1985:1-2004:4	1973:4-1984:4	1985:1-2004:4	1973:4-1984:4	1985:1-2004:4	1973:4-1984:4	1985:1-2004:4
GM0								
q_1	0	0	0	0	0	0	0	0
q_2	1	1	1	1	1	1	1	1
Wald	1.109 (0.352)	5.377 (0.060)	0.659 (0.554)	4.862 (0.092)	0.071 (0.878)	2.385 (0.278)	0.495 0(.740)	0.564 (0.534)
U	1.003	0.967	1.007	0.949	1.029	0.981	1.010	1.017
MSE-T	-0.177 (0.232)	1.720 (0.016)	-0.410 (0.314)	2.024 (0.006)	-1.263 (0.636)	2.001 (0.014)	-0.274 (0.330)	-1.243 (0.674)
MSE-F	-0.290 (0.254)	5.512 (0.002)	-0.634 (0.322)	8.489 (0.00)	-2.467 (0.522)	2.982 (0.052)	-0.819 (0.348)	-2.334 (0.582)
ENC-T	0.154 (0.306)	2.694 (0.006)	-0.079 (0.404)	2.872 (0.002)	-1.159 (0.742)	2.313 (0.014)	0.059 (0.456)	-1.048 (0.712)
ENC-NEW	0.127 (0.304)	4.277 (0.004)	-0.061 (0.396)	6.091 (0.008)	-1.103 (0.696)	1.944 (0.122)	0.079 (0.450)	-0.991 (0.714)
GM1								
q_1	0	0	0	0	0	0	0	0
q_2	1	1	1	1	1	1	1	1
Wald	31.92 (0.00)	28.88 (0.00)	21.57 (0.014)	14.66 (0.008)	18.41 (0.038)	9.092 (0.032)	11.97 (0.118)	5.630 (0.106)
U	0.702	1.062	0.727	1.041	0.754	1.070	0.888	1.029
MSE-T	3.088 (0.00)	-0.921 (0.608)	1.727 (0.016)	-0.361 (0.326)	1.639 (0.026)	-0.568 (0.426)	1.669 (0.048)	-0.290 (0.334)
MSE-F	48.45 (0.00)	-9.039 (0.990)	41.07 (0.00)	-6.148 (0.936)	33.33 (0.00)	-9.749 (0.956)	10.69 (0.022)	-4.182 (0.724)
ENC-T	3.510 (0.00)	2.530 (0.008)	2.029 (0.034)	1.827 (0.026)	2.006 (0.046)	1.257 (0.108)	1.817 (0.102)	0.993 (0.178)
ENC-NEW	36.59 (0.00)	13.55 (0.00)	31.19 (0.00)	16.53 (0.00)	25.88 (0.00)	10.41 (0.006)	7.256 (0.050)	6.280 (0.046)
GM2								
q_1		1		0		0		0
q_2		2		2		2		2
Wald		2.273 (0.244)		5.016 (0.104)		3.844 (0.242)		3.888 (0.252)
U		1.059		1.050		1.039		1.057
MSE-T		-1.889 (0.922)		-1.572 (0.812)		-1.077 (0.562)		-0.920 (0.436)
MSE-F		-7.523 (0.988)		-6.334 (0.898)		-4.894 (0.696)		-6.512 (0.610)
ENC-T		-1.218 (0.830)		-0.929 (0.730)		-0.413 (0.530)		0.202 (0.338)
ENC-NEW		-2.086 (0.990)		-1.551 (0.876)		-0.899 (0.600)		0.626 (0.322)
GM3								
q_1		1		1		0		0
q_2		1		1		1		1
Wald		0.014 (0.928)		0.157 (0.756)		0.453 (0.676)		1.709 (0.494)
U		1.008		1.015		1.022		1.021
MSE-T		-1.544 (0.836)		-2.038 (0.946)		-1.965 (0.898)		-0.855 (0.480)
MSE-F		-1.127 (0.560)		-2.044 (0.566)		-2.846 (0.466)		-2.577 (0.412)
ENC-T		-1.147 (0.902)		-1.897 (0.962)		-1.791 (0.926)		-0.518 (0.576)
ENC-NEW		-0.513 (0.752)		-0.929 (0.758)		-1.269 (0.670)		-0.753 (0.542)
GBL								
q_1	0	0	0	0	0	0	0	0
q_2	1	1	1	1	1	2	7	7
Wald	2.107 (0.204)	0.009 (0.928)	2.172 (0.236)	0.043 (0.844)	3.798 (0.248)	2.782 (0.198)	28.76 (0.026)	3.201 (0.206)
U	0.988	1.030	1.008	1.037	0.968	1.078	0.780	1.205
MSE-T	0.627 (0.086)	-2.122 (0.974)	-0.423 (0.312)	-2.026 (0.928)	1.246 (0.056)	-1.737 (0.872)	2.151 (0.016)	-2.235 (0.946)
MSE-F	1.183 (0.080)	-4.607 (0.976)	-0.717 (0.374)	-5.610 (0.942)	2.977 (0.070)	-10.77 (0.960)	25.74 (0.00)	-22.72 (0.964)
ENC-T	1.046 (0.128)	-2.017 (0.988)	0.106 (0.340)	-1.916 (0.948)	1.461 (0.120)	-1.023 (0.680)	2.825 (0.016)	-2.088 (0.958)
ENC-NEW	1.018 (0.120)	-2.055 (0.998)	0.099 (0.338)	-2.439 (0.982)	2.612 (0.110)	-3.251 (0.970)	23.64 (0.002)	-5.630 (0.970)
GCB								
q_1		1		0		0		0
q_2		1		1		2		5
Wald		0.749 (0.464)		1.855 (0.276)		5.397 (0.124)		3.132 (0.324)
U		1.062		1.065		1.055		1.140
MSE-T		-2.084 (0.964)		-1.741 (0.874)		-1.039 (0.562)		-2.369 (0.960)
MSE-F		-9.141 (0.986)		-9.334 (0.956)		-7.924 (0.872)		-16.86 (0.896)
ENC-T		-1.746 (0.946)		-1.004 (0.758)		0.461 (0.252)		-0.601 (0.560)
ENC-NEW		-3.448 (0.996)		-2.367 (0.964)		2.112 (0.164)		-1.674 (0.710)

GROWTH IN REAL MONETARY AND CREDIT AGGREGATES

GRM0								
q_1	0	0	0	0	0	0	0	0
q_2	1	2	1	1	1	1	1	1
Wald	3.697 (0.096)	13.26 (0.010)	3.308 (0.194)	5.420 (0.084)	3.680 (0.228)	5.289 (0.082)	3.125 (0.318)	3.976 (0.154)
U	0.975	0.988	0.944	0.996	0.954	0.998	0.975	0.997
MSE-T	0.823 (0.046)	0.430 (0.132)	0.898 (0.072)	0.110 (0.242)	0.826 (0.106)	0.038 (0.260)	1.299 (0.084)	0.143 (0.216)
MSE-F	2.418 (0.020)	1.967 (0.050)	5.655 (0.012)	0.546 (0.194)	4.356 (0.038)	0.195 (0.236)	2.100 (0.094)	0.449 (0.188)
ENC-T	1.082 (0.098)	2.346 (0.012)	1.097 (0.140)	1.754 (0.048)	1.165 (0.158)	1.273 (0.112)	1.453 (0.156)	1.581 (0.106)

ENC-NEW	1.759 (0.052)	5.383 (0.004)	4.018 (0.038)	4.179 (0.028)	3.374 (0.080)	3.236 (0.044)	1.331 (0.192)	2.204 (0.094)
GRM1								
q_1	0	0	0	0	0	2	0	1
q_2	1	1	1	1	1	2	1	1
Wald	23.56 (0.00)	15.69 (0.004)	20.19 (0.008)	11.33 (0.012)	23.11 (0.028)	10.09 (0.038)	18.19 (0.076)	5.391 (0.140)
U	0.770	1.095	0.729	1.107	0.661	1.279	0.738	1.172
MSE-T	3.128 (0.00)	-1.947 (0.944)	1.918 (0.010)	-1.406 (0.778)	1.971 (0.016)	-3.706 (1.00)	2.204 (0.022)	-2.559 (0.974)
MSE-F	32.26 (0.00)	-13.30 (1.00)	40.39 (0.00)	-14.58 (0.988)	56.59 (0.00)	-29.91 (0.998)	33.33 (0.00)	-19.86 (0.954)
ENC-T	3.593 (0.00)	1.060 (0.128)	2.349 (0.016)	1.013 (0.116)	2.637 (0.014)	-0.346 (0.514)	2.688 (0.038)	-0.275 (0.452)
ENC-NEW	22.25 (0.00)	3.800 (0.026)	30.09 (0.00)	5.606 (0.010)	47.19 (0.00)	-1.561 (0.798)	25.28 (0.006)	-0.956 (0.548)
GRM2								
q_1		0		0		0		0
q_2		1		1		1		1
Wald		0.020 (0.884)		0.008 (0.934)		0.360 (0.648)		1.675 (0.410)
U		1.019		1.021		1.011		0.986
MSE-T		-1.844 (0.926)		-2.025 (0.946)		-1.296 (0.682)		0.988 (0.096)
MSE-F		-2.507 (0.858)		-2.760 (0.800)		-1.483 (0.526)		1.783 (0.116)
ENC-T		-1.585 (0.924)		-1.754 (0.942)		-1.174 (0.750)		1.196 (0.158)
ENC-NEW		-1.045 (0.930)		-1.133 (0.890)		-0.659 (0.672)		1.179 (0.216)
GRM3								
q_1		1		0		0		0
q_2		1		1		1		1
Wald		1.102 (0.430)		0.000 (0.998)		0.019 (0.926)		0.536 (0.658)
U		1.002		1.003		1.006		0.998
MSE-T		-0.148 (0.280)		-3.246 (1.00)		-1.444 (0.748)		0.863 (0.100)
MSE-F		-0.254 (0.296)		-0.429 (0.304)		-0.770 (0.320)		0.254 (0.222)
ENC-T		0.269 (0.358)		-3.219 (1.00)		-1.396 (0.846)		1.068 (0.158)
ENC-NEW		0.226 (0.352)		-0.210 (0.468)		-0.367 (0.518)		0.165 (0.378)
GRBL								
q_1	0	1	0	0	0	0	0	0
q_2	2	1	2	1	1	1	1	1
Wald	1.228 (0.374)	0.661 (0.462)	0.573 (0.568)	0.0002 (0.99)	1.096 (0.470)	0.275 (0.642)	0.847 (0.592)	0.165 (0.718)
U	1.046	1.028	1.063	1.012	1.012	1.019	1.008	1.015
MSE-T	-1.473 (0.806)	-1.832 (0.926)	-1.485 (0.770)	-1.655 (0.868)	-0.554 (0.374)	-1.438 (0.774)	-1.155 (0.590)	-1.692 (0.852)
MSE-F	-4.026 (0.924)	-4.310 (0.958)	-5.328 (0.904)	-1.883 (0.730)	-1.042 (0.430)	-2.788 (0.778)	-0.666 (0.372)	-2.211 (0.744)
ENC-T	-0.911 (0.724)	-1.505 (0.910)	-1.276 (0.802)	-1.561 (0.906)	-0.302 (0.460)	-1.053 (0.738)	-1.131 (0.718)	-1.211 (0.778)
ENC-NEW	-1.189 (0.940)	-1.674 (0.990)	-2.171 (0.966)	-0.851 (0.854)	-0.298 (0.506)	-1.038 (0.844)	-0.309 (0.524)	-0.803 (0.778)
GRCB								
q_1		1		0		1		0
q_2		1		1		1		1
Wald		1.809 (0.246)		2.745 (0.182)		4.051 (0.134)		2.610 (0.270)
U		1.071		1.050		1.029		1.036
MSE-T		-2.161 (0.956)		-1.788 (0.886)		-0.921 (0.502)		-2.279 (0.958)
MSE-F		-10.29 (0.988)		-7.375 (0.954)		-4.251 (0.800)		-4.933 (0.798)
ENC-T		-1.557 (0.916)		-0.567 (0.558)		0.858 (0.140)		0.554 (0.270)
ENC-NEW		-3.288 (1.00)		-1.061 (0.858)		2.384 (0.068)		0.891 (0.208)
GROUP 4:			**OTHER FINANCIAL AND NON-FINANCIAL VARIABLES**					
Period	**1973:4-1984:4**	**1985:1-2004:4**	**1973:4-1984:4**	**1985:1-2004:4**	**1973:4-1984:4**	**1985:1-2004:4**	**1973:4-1984:4**	**1985:1-2004:4**
DERATE								
q_1	0	0	0	0	0	0	0	0
q_2	1	1	1	1	1	1	1	1
Wald	0.001 (0.976)	0.707 (0.416)	0.059 (0.870)	0.886 (0.436)	0.216 (0.774)	0.990 (0.404)	1.662 (0.420)	0.547 (0.568)
U	1.0344	0.999	1.040	1.003	1.008	1.005	1.002	1.029
MSE-T	-1.691 (0.884)	0.078 (0.216)	-1.765 (0.860)	-0.488 (0.386)	-0.917 (0.556)	-0.681 (0.480)	-0.232 (0.324)	-1.228 (0.720)
MSE-F	-3.079 (0.880)	0.060 (0.226)	-3.482 (0.870)	-0.505 (0.364)	-0.713 (0.394)	-0.756 (0.432)	-0.195 (0.328)	-4.041 (0.816)
ENC-T	-1.136 (0.804)	0.506 (0.226)	1.111 (0.764)	-0.044 (0.396)	-0.506 (0.546)	-0.319 (0.484)	-0.019 (0.422)	-1.016 (0.754)
ENC-NEW	-0.986 (0.918)	0.209 (0.270)	-0.988 (0.882)	-0.023 (0.390)	-0.169 (0.490)	-0.174 (0.478)	-0.008 (0.422)	-1.569 (0.846)
DC6RATE								
q_1		1		1		0		8
q_2		1		1		1		5
Wald		1.441 (0.352)		1.529 (0.384)		0.874 (0.596)		21.66 (0.044)
U		1.008		1.009		1.001		0.934
MSE-T		-0.680 (0.376)		-0.904 (0.422)		-0.278 (0.218)		0.616 (0.070)
MSE-F		-1.295 (0.474)		-1.509 (0.436)		-0.158 (0.182)		10.57 (0.014)
ENC-T		-0.231 (0.472)		-0.307 (0.450)		0.017 (0.394)		1.631 (0.072)
ENC-NEW		-0.216 (0.504)		-0.252 (0.468)		0.005 (0.394)		16.95 (0.026)
DRERATE								
q_1	0	0	0	0	0	0	0	0
q_2	1	1	1	1	1	1	1	1
Wald	0.175 (0.690)	0.034 (0.874)	0.128 (0.782)	0.161 (0.704)	0.009 (0.962)	0.719 (0.520)	0.326 (0.714)	0.454 (0.626)

U	1.007	1.007	1.011	1.005	1.018	1.002	1.012	1.012
MSE-T	-1.641 (0.854)	-0.945 (0.568)	-0.108 (0.636)	-1.946 (0.904)	-1.881 (0.884)	-0.669 (0.484)	-0.894 (0.496)	-1.135 (0.682)
MSE-F	-0.679 (0.448)	-1.135 (0.728)	-1.048 (0.536)	-0.871 (0.514)	-1.595 (0.560)	-0.304 (0.326)	-0.918 (0.486)	-1.738 (0.654)
ENC-T	-1.432 (0.874)	-0.534 (0.538)	-0.687 (0.626)	-1.804 (0.928)	-1.354 (0.832)	-0.483 (0.564)	-0.639 (0.586)	-1.005 (0.746)
ENC-NEW	-0.296 (0.610)	-0.315 (0.674)	-0.306 (0.592)	-0.395 (0.636)	-0.543 (0.672)	-0.113 (0.452)	-0.288 (0.558)	-0.757 (0.756)
GTSE300								
q_1	0	0	0	0	0	0	0	7
q_2	1	1	1	1	1	1	1	7
Wald	9.596 (0.016)	14.07 (0.006)	6.688 (0.102)	10.34 (0.020)	7.140 (0.106)	8.724 (0.020)	0.000 (0.994)	4.525 (0.082)
U	0.919	0.987	0.925	0.976	0.968	0.992	1.030	1.149
MSE-T	1.803 (0.010)	0.321 (0.158)	0.956 (0.060)	0.415 (0.102)	0.523 (0.134)	0.182 (0.210)	-1.194 (0.652)	-1.954 (0.936)
MSE-F	8.620 (0.00)	2.183 (0.046)	7.792 (0.012)	3.926 (0.022)	2.977 (0.068)	1.249 (0.126)	-2.366 (0.654)	-17.70 (0.990)
ENC-T	2.419 (0.008)	1.910 (0.028)	1.503 (0.080)	1.871 (0.024)	1.127 (0.166)	1.477 (0.068)	-1.031 (0.752)	-0.838 (0.708)
ENC-NEW	6.582 (0.00)	6.381 (0.004)	7.008 (0.014)	8.838 (0.004)	3.431 (0.064)	4.520 (0.020)	-1.009 (0.806)	-3.173 (0.982)
GRTSE300								
q_1	0	0	0	0	0	0	0	0
q_2	1	1	1	1	1	1	1	1
Wald	10.35 (0.026)	13.40 (0.014)	8.591 (0.084)	11.03 (0.018)	11.07 (0.066)	10.62 (0.032)	0.515 (0.638)	2.859 (0.178)
U	0.906	1.000	0.895	0.993	0.929	1.006	1.017	0.993
MSE-T	2.052 (0.004)	-0.003 (0.284)	1.183 (0.054)	0.135 (0.220)	0.969 (0.088)	-0.141 (0.264)	-0.536 (0.366)	0.704 (0.136)
MSE-F	10.30 (0.00)	-0.018 (0.286)	11.40 (0.006)	1.152 (0.138)	6.893 (0.022)	-0.881 (0.426)	-1.359 (0.474)	1.076 (0.142)
ENC-T	2.596 (0.008)	1.597 (0.068)	1.683 (0.080)	1.642 (0.056)	1.542 (0.118)	1.346 (0.088)	-0.315 (0.514)	1.395 (0.112)
ENC-NEW	7.496 (0.002)	4.737 (0.014)	9.527 (0.012)	7.170 (0.006)	6.351 (0.026)	3.884 (0.042)	-0.399 (0.568)	0.999 (0.176)
GRPOIL								
q_1	0	0	0	0	0	0	0	0
q_2	2	1	1	1	1	4	1	5
Wald	0.502 (0.496)	0.089 (0.780)	0.256 (0.708)	0.078 (0.830)	5.713 (0.174)	9.728 (0.030)	6.332 (0.202)	8.018 (0.038)
U	1.490	1.019	1.274	1.044	1.016	1.211	1.118	1.229
MSE-T	-1.365 (0.794)	-1.214 (0.692)	-1.113 (0.646)	-1.830 (0.918)	-0.361 (0.332)	-1.449 (0.824)	-0.906 (0.522)	-1.458 (0.804)
MSE-F	-25.83 (1.00)	-2.518 (0.904)	-17.66 (0.984)	-5.421 (0.958)	-1.413 (0.652)	-20.36 (1.00)	-8.033 (0.894)	-20.26 (0.992)
ENC-T	1.032 (0.756)	-0.956 (0.676)	-0.958 (0.714)	-1.645 (0.932)	0.288 (0.346)	1.391 (0.082)	-0.487 (0.558)	1.323 (0.156)
ENC-NEW	-3.265 (0.996)	-0.946 (0.932)	-2.685 (0.964)	-2.219 (0.982)	0.663 (0.196)	4.475 (0.012)	-1.178 (0.894)	2.853 (0.020)
GCOMPI								
q_1	0	1	0	1	2	0	1	0
q_2	1	1	1	1	1	1	1	1
Wald	24.43 (0.002)	0.488 (0.618)	19.08 (0.018)	1.095 (0.488)	18.67 (0.038)	0.017 (0.938)	5.857 (0.222)	2.129 (0.390)
U	0.779	1.006	0.802	1.001	0.902	1.009	0.970	1.018
MSE-T	2.858 (0.002)	-0.861 (0.540)	1.624 (0.020)	-0.074 (0.242)	1.398 (0.032)	-0.929 (0.556)	1.442 (0.054)	-0.739 (0.454)
MSE-F	30.33 (0.00)	-0.918 (0.448)	25.54 (0.00)	-0.112 (0.240)	10.06 (0.008)	-1.421 (0.448)	2.512 (0.078)	-2.558 (0.570)
ENC-T	3.426 (0.002)	-0.639 (0.632)	2.126 (0.022)	0.140 (0.408)	2.141 (0.032)	-0.642 (0.612)	1.727 (0.088)	-0.051 (0.440)
ENC-NEW	22.56 (0.00)	-0.329 (0.608)	20.50 (0.00)	0.106 (0.422)	9.435 (0.018)	-0.486 (0.612)	1.657 (0.186)	-0.084 (0.448)
GCLISM								
q_1	0	0	0	0	2	0	1	0
q_2	1	1	1	1	1	1	1	1
Wald	24.43 (0.00)	43.84 (0.00)	19.08 (0.018)	30.42 (0.002)	18.67 (0.04)	19.07 (0.004)	5.86 (0.212)	7.458 (0.044)
U	0.78	0.901	0.802	0.895	0.902	0.940	0.970	0.963
MSE-T	2.858 (0.00)	1.518 (0.032)	1.624 (0.012)	1.109 (0.054)	1.398 (0.026)	0.767 (0.116)	1.442 (0.068)	0.860 (0.100)
MSE-F	30.34 (0.00)	18.21 (0.00)	25.54 (0.00)	19.28 (0.00)	10.06 (0.008)	9.916 (0.010)	2.512 (0.088)	5.586 (0.016)
ENC-T	3.426 (0.00)	2.863 (0.004)	2.126 (0.016)	2.025 (0.038)	2.142 (0.024)	1.499 (0.094)	1.727 (0.088)	1.356 (0.100)
ENC-NEW	22.56 (0.00)	19.98 (0.00)	20.51 (0.00)	20.76 (0.00)	9.43 (0.012)	10.78 (0.004)	1.66 (0.178)	4.489 (0.032)

Notes: q_1 and q_2 are lag orders of the ARDL equation chosen by SIC. Wald is the Chi-square statistic used to test the null hypothesis that the financial variable does not Granger-cause Canada's real GDP growth rate over the full sample; U = $RMSFE_1$ /$RMSFE_2$ where $RMSFE_1$ and $MSEFE_2$ are the unrestricted and restricted model out-of-sample root mean square forecast errors respectively; the MSE-T and MSE-F statistics test the null hypothesis that $RMSFE_1$ = $RMSFE_2$ .For the short series GM2, GM3, GCB, GRM2, GRM3, GRCB and DC6RATE results are reported only for the second out-of-sample period.

Table 4: Simulated Power of the Out-of-Sample Test Statistics over the1985:1-2004:4 Regime. Results are Based on the Financial Spread CANSPGB5T10.

Horizon (h):	1 Quarter Ahead	2 Quarters Ahead	4 Quarters Ahead	8 Quarters Ahead
MSE-T	0.025	0.253	0.276	0.193
MSE-F	0.052	0.425	0.426	0.285
ENC-T	0.518	0.641	0.431	0.231
ENC-NEW	0.830	0.862	0.637	0.351

Notes: The data generating process for Canada's real GDP growth is the ARDL growth equation with the financial spread CANSPGB3T5 as the explanatory variable and a structural break at 1982:1; based on 199 simulated series for real GDP growth and the financial spread and 1000 bootstrap replications for each simulation; power is the proportion of the bootstrap p-values that are less than or equal to 0.10.