

Unanticipated policy shocks, regime changes and unemployment in Canada, 1967–83

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I. INTRODUCTION

One of the central issues addressed by empirical studies of unemployment is the relative importance of aggregate demand as opposed to natural rate (frictional and structural) factors. On the one hand, it has been argued that the natural rate of unemployment in Canada is a fairly stable 6 to 7% (see Beach and Kaliski, 1985), and that aggregate demand plays a fairly significant role, particularly in determining movements in the rate of unemployment. In contrast, Charette and Kaufman (1984) and Samson (1985) conclude that the natural rate is highly variable and closely tracks the actual unemployment rate. In Samson, for example, demand factors account for a maximum of 1.2 percentage points of the annual unemployment rate during the 1967–83 period.

These contrasting results arise from the use of very different macroeconomic models. Low and stable levels of the natural rate tend to be associated with Keynesian models, in which aggregate demand plays a prominent role. Variable and high estimates of the natural rate generally arise from rational expectations–natural rate (RE–NR) models which possess two key characteristics. Aggregate demand affects unemployment only through the unanticipated component of *domestic* monetary shocks, and the dispersion of employment growth rates across sectors contributes significantly to the determination of the natural rate.

In the analysis which follows, a reduced-form unemployment equation for an open economy is derived and estimated using Canadian data for the 1967–83 period. Though similar to the RE–NR models of Barro (1977), Wogin (1980), Charette and Kaufman (1984), Samson (1985) and Neelin (1985), it extends their analysis by relaxing the restrictions they impose on the demand side of the economy. The purpose of this procedure is to answer the following three questions. Are these restrictions supported by the data? Will the relaxation of the demand side constraints make it possible to reconcile the predictions of RE–NR and Keynesian models with respect to the natural rate? Is the dispersion of employment growth rates variable, which plays such a prominent role in recent empirical natural rate models, acting as a proxy for excluded demand factors and, therefore, is it as important a determinant of the natural rate as found by Lilien (1982), Charette and Kaufman (1984) and Samson (1985).

The unemployment equation estimated below is derived from an explicit macro model which incorporates the potential impact of foreign demand and asset flows on the domestic economy.

In addition to unanticipated domestic monetary shocks, therefore, unanticipated foreign monetary shocks, and both domestic and foreign unanticipated fiscal policy shocks impact on the unemployment rate. The estimated unemployment equation also allows for a change in policy regime from one of targeting the exchange rate to one of targeting the money supply and back again. As a result, the aggregate demand variables can potentially impact on the unemployment rate to differing degrees over the two regimes. Finally, in contrast to previous studies, the policy feedback equations are directly related to the macro model from which the unemployment equation is derived.¹

The results derived below indicate that the natural rate tends to be higher than in existing RE–NR and Keynesian models, but is less variable than found in previous RE–NR studies. Unanticipated demand policies play a more significant role in determining movements in the rate of unemployment than has been found in other RE–NR models and the extent of this role is directly related to the reigning policy regime. However, the dispersion of employment growth rates variable continues to play a significant role in determining the natural rate. Finally, domestic monetary policy shocks are seen to have been much more important than foreign policy shocks as determinants of movements in the unemployment rate.

The analysis proceeds as follows. In Section II the structural model is described and the reduced-form unemployment equation derived. Sections III and IV discuss the specification and estimation of the policy feedback equations. The potential determinants of the natural rate are described in Section V and, in Section VI, the unemployment equation is estimated. Section VII provides a decomposition of the unemployment rate and a discussion of the results. This is followed by a brief summary and conclusion.

II. THE MODEL

The structural equations of the model are given in Table 1. They follow the standard RE–NR model developed in Sargent (1973, 1976) and Sargent and Wallace (1975), but are modified to take account of the open economy in a fashion similar to Burton (1980). (For variable definitions see Appendix A.)²

Equation 1, the aggregate supply function for a composite domestic good, is consistent with the natural rate hypothesis. Output (y) can only deviate from its full employment level (\bar{y}) if expected domestic prices ($E_{t-1} p_t$) differ from actual domestic prices (p_t). This type of supply function was introduced in Friedman (1968) and has many recent, but similar, variants. Nominal wages are set at the end of the previous period, when the current period's demand is not known

¹Kimbrough and Koray (1984) develop a model which includes foreign monetary surprises and, in so doing, are probably most similar to the current analysis. However, they estimate a model of output rather than unemployment, do not allow for unanticipated fiscal policy shocks and do not incorporate the change in policy regime.

²All variables are in logs except the interest rates, the unemployment rate and X_0 . The ε_t and ε_t^* are assumed to be normally distributed with constant variance and mean zero (and, thus, so are μ_t and μ_t^*). All expectations are taken at the end of the previous period and are based only on information available in that period. This means that when the current period endogenous variables are determined, expectations of the following period's price and exchange rate are taken as given.

Table 1. *The model*

$y_t - \bar{y}_t = \alpha_0(p_t - E_{t-1}p_t) + \varepsilon_1$	(1)
$y_t = \alpha_1 + \alpha_2 g_t - \alpha_3(p_t - e_t - p_t^*) - \alpha_4(i_t - (E_{t-1}p_{t+1} - p_t)) + \alpha_5 y^* + \varepsilon_2$	(2)
$i_t = i_t^* + (E_{t-1}e_{t+1} - e_t)$	(3)
$m_t - p_t = \alpha_6 + \alpha_7 y_t - \alpha_8 i_t + \varepsilon_4$	(4)
$y_t^* - \bar{y}_t^* = \beta_0(p_t^* - E_{t-1}p_t^*) + \varepsilon_5^*$	(5)
$y_t^* = \beta_1 + \beta_2 g_t^* - \beta_3(i_t^* - (E_{t-1}p_{t+1}^* - p_t^*)) + \varepsilon_6^*$	(6)
$m_t^* - p_t^* = \beta_4 + \beta_5 y_t^* - \beta_6 i_t^* + \varepsilon_7^*$	(7)
$U_t = U_t^n - \gamma_0(y_t - \bar{y}_t) + \varepsilon_8$	(8)
$U_t^n = \gamma_1 + \gamma_2 X_9 + \varepsilon_9$	(9)
$U_t = \gamma_1 + \gamma_2 X_9 + \theta_3 Rm_t + \theta_4 Rg_t + \theta_5 Rg_t^* + \theta_6 Rm_t^* + \mu_t$	(10)
$U_t = \gamma_1 + \gamma_2 X_9 + \tilde{\theta}_4 Rg_t + \tilde{\theta}_5 Rg_t^* + \tilde{\theta}_6 Rm_t^* + \mu_t'$	(11)

where

$$\theta_3 < 0, \theta_4 < 0, \theta_5 < 0, \theta_6 \geq 0, \tilde{\theta}_4 < 0, \tilde{\theta}_5 \geq 0, \tilde{\theta}_6 \geq 0.$$

with certainty, in order to equate labour demand with labour supply, both of which depend on expected real wages. Since the market clearing nominal wage depends upon the expected price, expected real wages differ from actual real wages to the extent that expected prices differ from actual prices. As a consequence, employment is positively related to the unexpected component of domestic prices.³

Aggregate demand for the domestic good is described in Equation 2. It depends positively on foreign income and government spending on goods and services, and negatively on the real rate of interest and the relative price of domestic and foreign goods. Equation 3 is the uncovered interest rate parity condition and Equation 4 represents domestic asset market equilibrium.

Equations 5, 6 and 7 are the supply, demand and asset market equilibrium conditions for the foreign economy. The domestic economy is assumed to be small relative to the foreign economy and, therefore, has no impact on it.

Equation 8 relates the difference between the actual unemployment rate (U) and the natural rate (U^n) to the difference between the actual and the full employment (or natural) level of output. Equation 9 indicates that the natural rate is determined by a variable (or vector) X_9 to be discussed more fully below.

Agents are assumed to have rational expectations and to know that the true model of the economy is described by Equations 1 to 7. Given these assumptions, the model can be solved for

³Specifying output as a function only of unanticipated domestic prices simplifies the supply side, but allows the open economy aspects of the model to enter on the demand side only. This simplification is used by Burton (1980), Kimbrough and Koray (1984) and, implicitly, Wogin (1980), Charette and Kaufman (1984) and Samson (1985). Blejer and Fernandez (1980) relax this assumption in a fixed exchange rate traded-non-traded goods model of Mexico. Leiderman (1979) finds, using Italian data, that augmenting the supply side to account for open economy factors has an insignificant impact.

the reduced-form unemployment Equations 10 and 11.⁴ The first of these applies to the case in which the exchange rate is flexible and the second to that in which it is fixed and the money supply endogenous.

As with other RE-NR models, only non-systematic movements in the policy variables (Rm , Rg , Rm^* and Rg^*) have an impact on the rate of unemployment. However, the two reduced-form unemployment equations differ from those of similar models in two important ways. First, they include the unanticipated components of both domestic and foreign monetary and fiscal policy. This recognizes that foreign shocks alter the demand for a small open economy's goods and, in addition, does not impose the restriction that real government expenditures are predicted with certainty. (See Pesaran, 1982.) Second, Equations 10 and 11 indicate that the reduced-form coefficients on the unanticipated demand variables can potentially differ between the regime of exchange rate targeting and that of monetary targeting. (In fact, the coefficient on the domestic monetary variable is zero in the fixed exchange rate case.)

III. SPECIFICATION OF THE FEEDBACK EQUATIONS

The estimation of the unemployment equation requires the derivation of proxies for the unexpected portion of domestic and foreign monetary and fiscal policy. This is done, following much of the existing literature, by employing a two-step procedure in which a feedback equation for each policy variable is estimated and its residual used as a proxy for the unexpected change in the policy variable.⁵

The monetary feedback equation used in previous studies has included a large variety of variables which could potentially have influenced monetary policy. However, while it has been vaguely assumed that the monetary authorities are trying to stabilize certain target variables, there has been little attempt to relate the feedback equation to the macro model from which the unemployment equation is derived. In contrast, the present analysis derives the policy feedback equations under the assumption that policy makers know the macro model outlined in

⁴The solution method consists of taking expectations of Equations 1-7 on the basis of information available at the end of period $t - 1$. The expected values are then subtracted from the original equations and the model solved for the difference between y_t and expected y_t (Dy_t). This is done under the assumption that the natural rate of output in both economies is known with certainty. Dy_t and the expression for the natural rate, Equation 9, are then substituted into Equation 8 to yield the reduced-form unemployment equation.

⁵This two-step procedure is inefficient because it does not take into account the cross-equation restrictions imposed by the RE-NR hypothesis (Leiderman, 1980), and it yields biased estimates of the standard errors of the coefficients in the unemployment equation (Pagan, 1984). Despite these shortcomings, this procedure is used below because the non-linear estimation of the five-equation system needed to estimate the unemployment equation efficiently is infeasible. This follows from the small number of observations available and the large number of coefficients which would have to be estimated. Since the coefficient estimates are still consistent, the problem is one of efficiency and inference only. As shown in Pagan, the standard errors of the unemployment equation are biased downwards. This implies that specification tests may lead irrelevant variables to be included in the unemployment equation, but will not lead relevant variables to be excluded. Pagan shows that the efficient estimation of the model used in Barro (1977) has an insignificant impact on the results.

Equations 1 to 7 and attempt to set policy optimally in order to stabilize a set of target variables.⁶ Turnovsky (1977) shows that if the government follows an optimal stabilization policy, each policy instrument will depend upon all policy instruments lagged, all targets lagged, and lagged values of those exogenous variables whose current values are not known when the optimal policy is formulated. Thus, the feedback equations should only include, in addition to the policy targets (and several shock dummies), variables which enter the structural model presented in Table 1.

The domestic policy feedback equations are specified under the assumption that Canada used monetary and fiscal policies to stabilize output during the sample period (see Selody and Lynch, 1983), and, depending upon the regime, either to stabilize the exchange rate or target the money supply. For simplicity the break between these two regimes is assumed to be distinct (i.e. non-overlapping) and unanticipated by the public. The period of monetary targeting is assumed to have extended from the last quarter of 1975 through the second quarter of 1981.⁷ The beginning of this period corresponds to the policy's announcement by the Governor of the Bank of Canada. Controversy exists as to when the policy was abandoned, though there is little doubt that it was considerably before the official announcement at the end of 1982. The mid-point of 1981 is used here because it corresponds to a precipitous movement in the money supply below the target bound at a time when the exchange rate was under considerable pressure.⁸

The money supply and real government expenditure on goods and services are assumed to have been the instruments of policy in Canada during the sample period. The targets for output and the exchange rate are taken to be distributed lags of their past values. Following Gregory and Raynauld (1985), the monetary target is calculated as the mid-point of the target bounds announced by the Bank of Canada.⁹

Similarly, it is assumed that policy makers in the USA attempted to stabilize output and interest rates. For the purposes of estimation, their policy targets were approximated by a distributed lag of the targeted variables, while the money supply and government expenditure were taken to be their policy instruments.¹⁰

IV. ESTIMATION OF THE FEEDBACK EQUATIONS

The feedback equations describing Canadian and US monetary and fiscal policy were estimated using quarterly data for the 1966i to 1983i period. (See Appendix A for data sources.) The use of

⁶Following the existing literature, this assumes policy makers try to stabilize output to some extent, even though a systematic policy of this type in a RE-NR model is ineffective. As a result, policy makers must believe they have more information than the public or that the public's expectations are less than fully rational.

⁷For part of the sample period, up to 1 June, 1970, the exchange rate was fixed. In the early 1970s, after it was allowed to float, it remained a prime target of stabilization policy according to Courchene (1976).

⁸See Courchene (1982) for a discussion of the end of monetary targeting. He maintains that the exchange rate became the principal target in 1981. Also, financial innovations at this time made the relationship between M1 and GNP more uncertain and thus monetary control less practicable. (Bank of Canada, 1983).

⁹Thus, for part of the sample period, the money supply is both an instrument and a target. This implies that the monetary authority could have set the money supply equal to its target value during this period if it had not targeted output as well.

¹⁰On the choice of the targets and instruments of fiscal and monetary policy in the USA see Goldfeld and Blinder (1972), Friedlaender (1973), Froyen (1974) and Hamburger and Zwick (1981).

$M1$ and real federal government expenditures on goods and services as the monetary and fiscal policy instruments for both countries is consistent with the existing RE-NR literature.

In the initial estimates of the Canadian feedback equations, the two policy instruments were regressed on lagged values of themselves, and lagged m^* , g^* , y , the exchange rate target, the monetary target, and slope dummies with respect to g , m and y for the period of monetary targeting. These slope dummies were included to allow the coefficients of the feedback equations to differ over the two regimes. Since the regime of monetary targeting did not extend for a sufficiently long period to allow the estimation of slope dummies for all the explanatory variables, those on the two foreign policy variables were arbitrarily excluded. A constant term, an intercept dummy for the monetary targeting period, and a postal strike dummy (see Gregory and Mackinnon, 1980) were also included in both regressions.

Estimation of the US feedback equations involved regressing m^* and g^* on lags of themselves and on lags of y^* , the US interest rate, and a slope dummy on the interest rate for the period of monetary targeting in the US (1979iv to 1982iii). Both US equations also included a constant and trend dummy variable for the monetary targeting period, a dummy variable for the abandonment of the gold standard by the USA, and a dummy variable for the period of price controls during the early 1970s.

Following Hendry and Mizon (1978), the methodology used to estimate the four feedback equations consisted of estimating an unrestricted version of each equation and then gradually restricting its dynamic structure. To start, each dependent variable was regressed on four lags of the explanatory variables. Four lags were chosen because the data used were quarterly and because, given the number of observations available, it seemed infeasible to estimate realistically more parameters than implied by this number of lags.

Common factor restrictions were tested and rejected in all four cases. The lag length of each equation was reduced in a step-wise fashion until the last lag on each explanatory variable was significant at the 95% level. The restrictions imposed on the dynamic structure of each equation by this procedure were tested using F -tests and could not be rejected. Each equation was also tested for heteroscedasticity using the test outlined in Breusch and Pagan (1979), and for structural change using a Chow test which split the sample in half at 1974iii. Both tests were unable to reject their respective null hypotheses. A modified Q -statistic, as described in Harvey (1981), could not reject the hypothesis that the residuals of the feedback equations were white noise.

The estimates of the four feedback equations are given in Table 2. For ease of exposition, only the sum of the lagged coefficients on each explanatory variable are reported. For variables which include more than one lagged coefficient, an F -statistic for the test that all the lagged coefficients of this variable are zero is provided. In other cases, a t -statistic is reported.¹¹

¹¹The reaction functions estimated here might possibly be interpreted as inverted aggregate demand functions. However, the latter relates current output to the current policy variables while the estimated reaction functions relate current policy variables to lagged values of the explanatory variables, including lagged output. It is this difference in timing which distinguishes the two types of equation. Further, note that for the results of the paper to hold, it is not necessary that the estimated reaction functions be the actual reaction functions which determine government policy. Rather, it is only necessary that agents in the economy form their expectations of the values of the policy variables on the basis of these equations, and that their expectations not be systematically wrong (which is the case here since the estimated residuals of the four reaction functions are not significantly different from white noise).

V. DETERMINANTS OF THE NATURAL RATE

For the model described in Table 1, the natural rate of unemployment is that level of unemployment which exists when there are no expectational errors. In order to estimate the unemployment equation, it is necessary to specify the possible determinants of the natural rate. Likely candidates are the rate of growth and changing composition of the labour force, the

Table 2. Estimates of the feedback equations

(a) g Equation

Lagged explanatory variable	Sum of coefficients	Test statistic for zero restriction ^a
Constant	-6.503	-3.96
g^*	0.201	3.27
y	0.901	6.62
$MTAR$	0.010	4.44(4,53)
m	-0.247	5.49(3,53)
m^*	0.377	3.72(4,53)
Mg	0.646	10.09
Mm	-0.575	-10.12

$R^2 = 0.984$; $\bar{R}^2 = 0.980$
 $Q^*(12) = 19.22$
 Breusch-Pagan LM(15) = 15.53
 Chow test $F(35, 19) = 2.29$

(b) m Equation

Lagged explanatory variable	Sum of coefficients	Test statistic for zero restriction ^a
Constant	-0.325	-0.475
y	-0.200	7.70(4,50)
$ETAR$	-0.334	4.65(3,50)
m	0.837	57.20(4,50)
m^*	0.337	3.42
Mg	0.171	3.75
Mm	-0.146	8.31(4,50)
PSD	0.028	4.19

$R^2 = 0.999$; $\bar{R}^2 = 0.999$
 $Q^*(12) = 11.82$
 Breusch-Pagan LM (18) = 17.05
 Chow test $F(34, 16) = 1.79$

(c) g^* Equation

Lagged explanatory variable	Sum of coefficients	Test statistic for zero restriction ^a
Constant	5.90	3.49
g^*	0.920	197.5(4,55)
y^*	-0.607	3.86(4,55)
i^*	-0.002	3.82(4,55)
m^*	0.284	3.02

$R^2 = 0.962$; $\bar{R}^2 = 0.952$
 $Q^*(12) = 6.79$
 Breusch-Pagan LM(13) = 14.53
 Chow test $F(34, 21) = 1.08$

(d) m^* Equation

Lagged explanatory variable	Sum of coefficients	Test statistic for zero restriction ^a
Constant	-0.470	-5.94
m^*	1.04	158.37
i^*	-0.002	13.59(3,57)
<i>USMTRD</i>	0.002	8.67(3,57)
<i>USMTTRD</i>	-0.002	-3.17
<i>USMTD</i>	0.189	3.10
<i>USGSD</i>	-0.014	-3.93
<i>USPCD</i>	0.008	2.99

$R^2 = 0.9998$; $\bar{R}^2 = 0.9997$
 $Q^*(12) = 8.92$
 Breusch-Pagan LM(11) = 9.45
 Chow test $F(34, 25) = 1.03$

Sample period 1966i-1983i.

Number of observations = 69.

Chow test split sample just before 1974iii.

^a*F*-statistics are followed by their degrees of freedom in brackets.

Statistics not followed by brackets are *t*-statistics.

unemployment insurance system, and changes in the distribution of labour demand.¹²

The large increase in young and female entrants to the labour market during the 1970s is likely to have increased the natural rate (see Kaliski, 1984). Women and youth are frequently newcomers to the labour force and, as a consequence, tend to spend a longer time searching and

¹²According to Riddell and Smith (1982), the effect of minimum wages on aggregate unemployment is inconclusive. Charette and Kaufman (1984) found minimum wages to have an insignificant impact on aggregate unemployment.

are often unemployed while so doing. They also tend to form loose job attachments, relative to adult males, leading to increased frequency of search. The potential impact of these factors on the natural rate of unemployment is represented in the unemployment equation estimated below by *DEM*, the ratio of males under the age of 25 and women in the labour force to the total labour force.

An increase in the relative attractiveness of unemployment insurance benefits reduces the cost of unemployment to workers and could increase their reservation wage and, thereby, the frequency and duration of unemployment. In addition, the non-experience rating of unemployment insurance premiums lowers the cost of lay-offs to firms and is likely to increase the number of lay-offs (Feldstein, 1975). To account for the possible impact of the unemployment insurance programme on the natural rate of unemployment, the estimated unemployment equation includes *UIC*, the ratio of average weekly unemployment insurance benefits to the average weekly wage weighted by the proportion of the labour force covered by the programme.

Lilien (1982) contends that a greater dispersion of demand across industrial sectors may lead to a higher level of unemployment by increasing the necessary time spent in search and re-training as workers move from declining to growing sectors. The studies of Samson (1985) and Charette and Kaufman (1984) find that for Canada this factor provides the principal explanation of movements in the natural rate and explains a large portion of movements in the total unemployment rate. As Neelin (1985) points out, in a highly regionalized economy such as Canada, changes in demand across regions could have the same effect. The potential impact of sectoral and regional demand shocks on the natural unemployment rate is accounted for by *SIGP* and *SIGPI*, the variance in employment growth rates across the 10 provinces of Canada, and across both provinces and industries, respectively.¹³

VI. ESTIMATION OF THE UNEMPLOYMENT EQUATION

The unemployment equation to be estimated was formed by splicing together Equations 10 and 11, with the former holding for the monetary targeting period – 1975iv through 1981ii – and the latter for the balance of the sample. Since the exchange rate was not perfectly fixed during the exchange rate targeting period, the unanticipated component of the money supply was included in Equation 11. The lack of an adequate number of observations during the period of monetary targeting implied that slope dummies on all four unanticipated policy variables could not be estimated. As a consequence, the slope dummies on the two foreign demand variables were excluded.

The unemployment equation was estimated using quarterly data for 1967i to 1983i. The end of the sample period coincides with a break in the method used by Statistics Canada to measure employment. The starting date, allowing for four lags, was necessitated by the change in the method of conducting the Labour Force Survey which came into full effect in January 1966. Since this change may have altered the distribution of the unemployment series, it does not seem

¹³These industries are: forestry; mining (including milling); manufacturing; construction; transportation, communication and other utilities; trade (retail and wholesale); finance, insurance and real estate; commercial services; non-commercial services; public administration and defence.

legitimate to splice together pre- and post-1966 data as has been done in existing studies of Canadian unemployment.

The methodology used to estimate the unemployment equation was identical to that used to estimate the feedback equations. As with the feedback equations, common factor restrictions were rejected, but the hypotheses of homoscedasticity, parameter stability and white noise errors could not be rejected. A joint test of the RE-NR hypothesis was carried out by testing for the significance in the final unemployment equation of the anticipated values of the four policy variables (as given by the estimated feedback equations). For the unemployment equation which included *SIGP*, the zero restriction on the anticipated policy variables could not be rejected at the 95% confidence level either individually or jointly. For the unemployment equation incorporating *SIGPI*, the zero restrictions on the coefficients of \hat{m} and \hat{m}^* could not be rejected at 95% and those on \hat{g}^* and \hat{g} could not be rejected at 99%. However, jointly, these restrictions were rejected at 99% and, as a consequence, only the equation using *SIGP* was used below to calculate the natural rate.

The two estimates of the unemployment equation, one including *SIGP* and the other *SIGPI*, are given in Table 3. For convenience, only the sum of the coefficients on each explanatory variable is reported. *F*-statistics (*t*-statistics where appropriate) for the test that the current and lagged coefficients of each explanatory variable are jointly zero are also presented.

Table 3. *Estimates of the unemployment equations*

Equation including <i>SIGP</i>			Equation including <i>SIGPI</i>	
Explanatory variable (current and lagged)	Sum of current and lagged coefficients	Test statistic for zero restriction ^a	Sum of coefficients	Test statistic for zero restriction ^a
Constant	-0.026	-2.25	-0.045	-3.78
<i>U</i> lagged	0.817	322.6(2,45)	0.824	260.8(2,45)
<i>DEM</i>	0.057	2.01	0.089	3.28
<i>SIGP</i>	1.349	6.15(4,45)		
<i>SIGPI</i>			0.536	7.61(4,45)
<i>Rg</i> *	0.021	1.52(5,45)	0.009	1.18(5,45)
<i>Rm</i>	-0.023	5.09(2,45)	-0.052	3.00(2,45)
<i>MRm</i>	-0.465	3.54(5,45)	-0.293	2.17(5,45)
$R^2 = 0.9845$; $\bar{R}^2 = 0.9779$			$R^2 = 0.9857$; $\bar{R}^2 = 0.9796$	
$Q^*(12) = 14.32$			$Q^*(12) = 10.26$	
Breusch-Pagan LM(19) = 27.83			Breusch-Pagan LM (19) = 25.55	
Chow test $F(32, 13) = 0.593$			Chow test $F(32, 13) = 0.596$	

Sample period 1967i-1983i.

Number of observations = 65.

Chow test split sample just before 1975i.

^a*F*-statistics are followed by their degrees of freedom in brackets. Statistics not followed by brackets are *t*-statistics.

The estimates of the two equations are similar and the variables excluded by restricting their dynamic structure are identical. These restrictions indicate that the unemployment insurance programme, US monetary shocks and domestic fiscal policy contribute insignificantly to the explanation of aggregate unemployment. On the other hand, the results given in Table 3 show that demographic factors, regional/sectoral employment shocks, unanticipated domestic monetary shocks and unanticipated US fiscal policy had some role in determining the aggregate level of Canadian unemployment during the sample period (though the coefficients of the latter are jointly insignificant, the coefficient on its longest lag is individually significant).

As expected, the demographic variable and the regional/sectoral shift variable were found to have a positive impact on unemployment. The positive coefficient on the US fiscal policy variable and the negative coefficient on the unanticipated domestic monetary shock variable are both consistent with the theoretical model. Further, as the model predicts, during the fixed, or closely managed, exchange rate period, the effect of monetary shocks is extremely small relative to their effect during the monetary targeting period.

VII. DECOMPOSITION OF UNEMPLOYMENT

The relative significance of the determinants of the rate of unemployment can be compared by using the estimated unemployment equation to decompose the unemployment rate into its component parts. The presence of lagged values of the dependent variable in the unemployment equation implies that the exact decomposition of the unemployment rate would require the calculation of an infinite sum. As an approximation to this sum, the average of two decompositions, one using zero in place of the initial lagged values of unemployment and the other the actual unemployment rate, was used.¹⁴ This procedure yielded predictions of the components of the unemployment rate which were small relative to the actual unemployment rate. To correct for this, the difference between the sum of the simulated values of the individual components of unemployment and the predicted rate of unemployment (from the estimated unemployment equation) was allocated among the determinants of unemployment on the basis of their relative simulated size.

Using this method of approximation and the coefficient estimates from the unemployment equation containing *SIGP*, it was possible to derive estimates of the natural rate (that level of unemployment attributable to the constant, *DEM*, and the regional shock variable) and its components. In a similar fashion, it was possible to calculate the level of unemployment due to aggregate demand factors (unexpected Canadian monetary policy and US fiscal policy) along with its two components.

Estimates of the natural rate and aggregate demand unemployment are given in Table 4, along with the actual unemployment rate and the predicted unemployment rate from the estimated unemployment equation. As with earlier studies of the RE-NR type, the bulk of unemployment is accounted for by the natural rate. However, the natural rate given in Table 4 is larger and less variable than found in previous studies and the role attributed to aggregate demand shocks from 1976 onwards is considerably more significant (see Samson, 1985, for example).

¹⁴The simulations using the two different starting values all converged to within 0.5 percentage points by 1969ii and to within 0.25 percentage points by 1971i.

Table 4. *The unemployment rate decomposed*^a

Year	Actual unemployment	Predicted unemployment	Natural unemployment rate	Demand unemployment
1967	3.8	3.7	3.0	0.7
1968	4.5	4.6	5.1	-0.6
1969	4.4	4.4	4.6	-0.1
1970	5.7	5.7	6.0	-0.3
1971	6.2	6.1	5.8	0.3
1972	6.2	6.1	5.8	0.3
1973	5.6	5.5	6.1	-0.6
1974	5.3	5.4	5.4	0
1975	6.9	7.0	6.9	0.1
1976	7.1	7.1	9.6	-2.5
1977	8.1	8.1	9.8	-1.7
1978	8.3	8.5	6.3	2.2
1979	7.4	7.4	6.5	0.8
1980	7.5	7.6	8.6	-0.9
1981	7.5	7.5	7.5	0
1982	11.1	10.8	9.8	1.0
1983i	12.5	12.5	11.8	0.7

^aAnnual averages in percentages.

The relative contribution of the different explanatory variables to movements in the unemployment rate can be examined by comparing the first difference of the unemployment rate with that of its components. These are presented in Table 5 where the predicted, rather than actual, unemployment rate has been used in order to avoid assigning the residual of the unemployment equation to either natural rate or demand factors.

While the natural rate accounted for a large part of the movements in the unemployment rate during the sample period, demand shocks played an equivalent role after 1975. In the latter part of the sample period, movements in demand unemployment tended to cancel out movements in the natural rate so that movements in the actual unemployment rate were less extreme than those of either of its two components. The demographic variable, though contributing significantly to the absolute level of unemployment, contributed little to its movement. As with the studies of Lilien (1982) and Samson (1985), movements in the natural rate were principally the result of changes in the variance of regional employment growth rates.¹⁵ On the demand side, unanticipated movements in US fiscal policy played a relatively small role in relation to that of unanticipated changes in the domestic money supply.

¹⁵Abraham and Katz (1984) and Neelin (1985) maintain that part of the variance in industry (regional) employment growth rates is due to the different impact of aggregate demand shocks on different industries (regions). This would imply that the decomposition of unemployment given here overestimates the contribution of regional shocks and underestimates the contribution of demand factors. It would still be the case, however, that the unemployment attributed to *SIGP* is the result of the failure of the labour market to adjust to structural changes in demand and, therefore, is part of structural unemployment.

Table 5. Changes in the rate of unemployment^a

Year	Predicted unemployment	Natural unemployment rate ^b	Demand unemployment ^c	Unemployment due to DEM	Unemployment due to SIGP	Unemployment due to g*	Unemployment due to m
1968	0.8	2.1	-1.3	3.6	-0.1	-1.8	-0.8
1969	-0.1	-0.5	0.4	-1.2	0.3	0.1	0.7
1970	1.3	1.4	-0.1	-0.9	2.1	0.3	-0.2
1971	0.4	-0.2	0.6	1.3	-1.2	0.1	0.3
1972	-0.1	-0.1	0	0.8	-0.8	0.1	-0.3
1973	-0.5	0.4	-0.8	-0.1	0.3	-0.7	-0.1
1974	-0.1	-0.7	0.6	-0.4	-0.3	0.6	0
1975	1.5	1.4	0.1	0.6	0.9	0	0.1
1976	0.1	2.7	-2.6	0	2.9	-0.4	-2.3
1977	1.0	0.2	0.8	0.5	-0.5	0.4	0.5
1978	0.4	-3.5	3.9	-0.2	-3.3	0	3.9
1979	-1.1	0.3	-1.4	0.1	0.1	-0.1	-1.3
1980	0.3	2.1	-1.8	0.6	1.5	0	-1.8
1981	-0.2	-1.1	0.9	-0.9	-0.2	-0.5	1.4
1982	3.4	2.3	1.0	1.5	0.9	0.5	0.4
1983i ^c	1.7	2.0	-0.3	0.7	1.3	0.3	-0.6

^aDifferences of annual averages (in percentage points).

^bThe natural rate and demand unemployment are not just the sum of the four other components, but rather were simulated separately.

^cThis is the change from the average for 1982 to 1983i.

VIII. CONCLUSION

The analysis presented above differs from previous studies of unemployment in a number of ways. The reduced form unemployment equation was derived from a structural model of an open economy in which unanticipated foreign demand shocks, both monetary and fiscal, play a role. Allowance was made for the potential effect of domestic and foreign fiscal policies and explicit account was taken of the two policy regimes followed during the sample period. In addition, the policy feedback equations were derived from the same macro model as the unemployment equation.

The principal conclusions reached are that the effects on Canadian unemployment of US fiscal and monetary policy, and Canadian fiscal policy, are minimal or insignificant. As a consequence, the practice in previous studies of arbitrarily restricting the coefficients on these variables to zero is unlikely to bias estimates of the unemployment equation seriously. In contrast, the change in monetary regimes does seem to have had a significant impact. This is clearly seen by the large role played by unexpected monetary shocks during the period of monetary targeting relative to their insignificant impact under exchange rate targeting. By not accounting for the change in regime, previous studies are likely to have significantly underestimated the effect of monetary policy on unemployment from 1976 through 1980, and overestimated its effect for the balance of the sample.

The estimate of the natural rate calculated above is both less variable and larger than that found by Samson, but more variable and larger than Keynesian models would predict. The dispersion of employment growth rates variable continues to play a significant role and, as a result, is not likely to have been a proxy for excluded demand factors in previous studies.

APPENDIX A

Variable definitions and data sources

All data are from Statistics Canada's Cansim Database. Cansim identifiers are given in brackets. Unless indicated all data are seasonally adjusted. The labour force and monetary data are by month and were converted by averaging.

<i>DEM</i>	= the ratio of both sexes in the labour force between 15 and 24 years (D767618) plus women aged 25 and over in the labour force (D767726) to the total labour force over age 15 (D767606).
<i>e</i>	= the exchange rate.
<i>ETAR</i>	= the exchange rate target for 1966i through 1975iii and from 1981iii through 1983i. It is given by the lagged value of the Canadian dollar price of a US dollar not seasonally adjusted (B3400).
<i>g</i>	= federal expenditure on goods and services in current dollars (D40350) deflated by the GNE price index (D40625).
<i>g*</i>	= US federal government purchases of goods and services in 1972 constant dollars (B50321).
<i>i</i>	= the domestic interest rate.
<i>i*</i>	= US federal funds rate not seasonally adjusted (B54408).
<i>m</i>	= currency plus demand deposits (B1627).
<i>m*</i>	= US <i>M1</i> (B54358).
<i>MRg</i>	= a slope dummy on unanticipated government spending on goods and services for the period of monetary targeting, 1975iv to 1981ii.
<i>MRm</i>	= a slope dummy on the unanticipated component of the money supply for the period of monetary targeting, 1975iv to 1981ii.
<i>Mg</i>	= a slope dummy on government spending on goods and services for the period of monetary targeting, 1975iv to 1981ii.
<i>Mm</i>	= a slope dummy on the money supply for the period of monetary targeting, 1975iv to 1981ii.
<i>MTAR</i>	= monetary targets for the period 1975iv through 1981ii calculated as the midpoint of the target bounds given in Gregory and Raynauld (1985) using currency plus demand deposits (B1627) as base.
<i>p</i>	= the domestic price level.
<i>p*</i>	= the foreign price level.
<i>PSD</i>	= a dummy variable for postal strikes in Canada equal to one in 1965iii, 1968iii, 1970ii, 1970iii, 1974ii, 1975iv, 1978iv and zero otherwise.
<i>Rg</i>	= unanticipated government spending on goods and services.

- Rg** = unanticipated US government spending on goods and services.
Rm = the unanticipated component of the money supply.
*Rm** = the unanticipated component of the US money supply.
SIGP = the variance of employment growth rates in the ten Canadian provinces. This is calculated using data from Cansim matrix 1715 following the method given in Lilien (1982). The employment series were converted from monthly to quarterly before *SIGP* was calculated.
SIGPI = the variance of employment growth rates by industry and by province. This is calculated using data from Cansim matrix 1715 following the method given in Lilien (1982). The employment series were converted from monthly to quarterly before *SIGPI* was calculated.
TARD = a dummy variable for the period of monetary gradualism equal to one in 1975iv through 1981ii and zero otherwise.
U = the unemployment rate for workers 15 years and over (D767611).
Uⁿ = the natural rate of unemployment.
UIC = the ratio of persons covered by the unemployment insurance programme (D1248) to the total labour force (D767606) all multiplied by the ratio of average weekly unemployment insurance benefit payments (D730465) to average weekly earnings for an industrial composite (D700169).
USGSD = a dummy variable for the US leaving the gold standard. It equals one in 1971iv and thereafter.
USMTD = a dummy variable for the period of US monetary targeting equal to one in 1979iv through 1982iii and zero otherwise.
USMTRD = a slope dummy on the US interest rate for the period of monetary targeting equal to the US federal funds rate (B54408) in 1979iv through 1982iii and zero otherwise.
USMTTRD = a trend dummy for the period of US monetary targeting equal to a trend in 1979iv through 1982iii and zero otherwise.
USPCD = a dummy variable for the period of US price controls equal to one in 1971iv through 1974i and zero otherwise.
y = gross national expenditure in constant 1971 dollars (D40593).
 \bar{y} = the natural level of output.
*y** = US gross domestic product in 1972 constant dollars (B51401).
 \bar{y}^* = the US natural level of output.

APPENDIX B

Data*

Year	<i>U</i>	<i>DEM</i>	<i>UIC</i>	<i>SIGP</i>	<i>SIGPI</i>	<i>Rg*</i>	<i>Rm*</i>	<i>Rg</i>	<i>Rm</i>
1967	3.8	0.460	0.151	0.0048	0.0236	0.0073	0.0037	-0.0193	-0.0031
1968	4.5	0.467	0.157	0.0046	0.0201	0.0045	0.0048	0.0156	-0.0024
1969	4.4	0.473	0.183	0.0083	0.0277	-0.0002	-0.0026	-0.0070	0.0001
1970	5.7	0.478	0.184	0.0057	0.0231	-0.0124	-0.0020	-0.0017	-0.0114
1971	6.2	0.487	0.184	0.0064	0.0199	0.0030	-0.0019	0.0089	0.0032
1972	6.2	0.493	0.365	0.0055	0.0189	-0.0107	0.0024	0.0077	0.0002
1973	5.6	0.503	0.381	0.0058	0.0179	-0.0009	-0.0003	-0.0114	0.0011
1974	5.3	0.511	0.376	0.0052	0.0195	0.0002	0.0030	0.0020	-0.0022
1975	6.9	0.518	0.374	0.0115	0.0305	-0.0047	-0.0015	0.0063	0.0177
1976	7.1	0.523	0.369	0.0086	0.0245	-0.0039	-0.0035	-0.0032	0.0032
1977	8.1	0.527	0.366	0.0065	0.0208	0.0078	-0.0008	-0.0026	-0.0072
1978	8.3	0.534	0.373	0.0058	0.0220	0.0009	-0.0008	0.0113	0.0019
1979	7.4	0.538	0.335	0.0073	0.0207	0.0034	0.0006	-0.0111	0.0002
1980	7.5	0.543	0.340	0.0073	0.0207	-0.0035	0.0001	-0.0008	0.0031
1981	7.5	0.546	0.327	0.0084	0.0255	-0.0022	0	-0.0015	-0.0102
1982	11.1	0.543	0.328	0.0076	0.0273	0.0143	0.0006	0.0065	0.0014
1983i	12.5	0.544	0.334	0.0074	0.0197	-0.0344	0.0049	-0.0171	0.0094

*1967 through 1982 are annual averages of quarterly figures.

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REFERENCES

- Abraham, K. G. and Katz, L. F. (1984) Cyclical unemployment: sectoral shifts or aggregate disturbances? NBER Working Paper No. 1410.
- Bank of Canada (1983) Monetary aggregates: some recent developments, *Bank of Canada Review*, December, 3-17.
- Barro, R. J. (1977) Unanticipated money growth and unemployment in the United States, *American Economic Review*, 67, 101-15.
- Beach, C. M. and Kaliski, S. F. (1985) Structural unemployment: demographic change or industrial structure, and, the impact of sectoral shifts, demographic changes and deficient demand on unemployment in Canada, Queen's University Discussion Paper No. 624, Kingston.
- Blejer, M. I. and Fernandez, R. B. (1980) The effects of unanticipated money growth on prices and on output and its composition in a fixed-exchange-rate open economy, *Canadian Journal of Economics*, 13, 82-95.
- Breusch, T. S. and Pagan, A. R. (1979) A simple test for heteroskedasticity and random coefficient variation, *Econometrica*, 47, 1287-94.
- Burton, D. (1980) Expectations and a small open economy with a flexible exchange rate, *Canadian Journal of Economics*, 13, 1-15.
- Charette, M. F. and Kaufman, B. (1984) Short-run variation in the natural rate of unemployment, University of Windsor, mimeo.

- Courchene, T. J. (1976) *Money, Inflation, and the Bank of Canada: An Analysis of Canadian Monetary Policy from 1970 to Early 1975*, C. D. Howe Research Institute, Montreal.
- Courchene, T. J. (1982) Recent Canadian monetary policy; 1975-81: reflections of a monetary gradualist, Queen's University Discussion Paper No. 505, Kingston.
- Feldstein, M. S. (1975) The importance of temporary layoffs: an empirical analysis, *Brookings Papers on Economic Activity*, 725-44.
- Friedlaender, A. F. (1973) Macro policy goals in the postwar period: a study in revealed preference, *Quarterly Journal of Economics*, 88, 25-43.
- Friedman, M. (1968) The role of monetary policy, *American Economic Review*, 58, 1-17.
- Froyen, R. T. (1974) A test of the endogeneity of monetary policy, *Journal of Econometrics*, 6, 175-88.
- Goldfeld, S. M. and Blinder, A. S. (1972) Some implications of endogenous stabilization policy, *Brookings Papers on Economic Activity*, 585-644.
- Gregory, A. W. and Mackinnon, J. G. (1980) Where's my cheque? A note on postal strikes and the demand for money in Canada, *Canadian Journal of Economics*, 13, 683-7.
- Gregory, A. W. and Raynauld, J. (1985) An econometric model of Canadian monetary policy over the 1970s, *Journal of Money, Credit and Banking*, 17, 43-58.
- Hamburger, M. J. and Zwick, B. (1981) Deficits, money and inflation, *Journal of Monetary Economics*, 7, 141-50.
- Harvey, A. C. (1981) *The Econometric Analysis of Time Series*, Philip Allan, Oxford.
- Hendry, D. F. and Mizon, G. E. (1978) Serial correlation as a convenient simplification, not a nuisance: A comment on a study of the demand for money by the Bank of England, *The Economic Journal*, 88, 549-63.
- Kaliski, S. F. (1984) Why must unemployment remain so high? *Canadian Public Policy*, 10, 127-41.
- Kimbrough, K. P. and Koray, F. (1984) Money, output and the trade balance: theory and evidence, *Canadian Journal of Economics*, 17, 508-22.
- Leiderman, L. (1979) Expectations and output-inflation trade-offs in a fixed-exchange-rate economy, *Journal of Political Economy*, 87, 1285-306.
- Leiderman, L. (1980) Macroeconometric testing of the rational expectations and structural neutrality hypothesis for the United States, *Journal of Monetary Economics*, 6, 69-82.
- Lilien, D. M. (1982) Sectoral shifts and cyclical unemployment, *Journal of Political Economy*, 90, 777-93.
- Neelin, J. (1985) Sectoral shifts and Canadian unemployment, Princeton University, mimeo.
- Pagan, A. (1984) Econometric issues in the analysis of regressions with generated regressors, *International Economic Review*, 25, 221-47.
- Pesaran, M. H. (1982) A critique of the proposed tests of the natural rate-rational expectations hypothesis, *Economic Journal*, 92, 529-54.
- Riddell, W. C. and Smith, P. M. (1982) Expected inflation and wage changes in Canada, 1967-81, *Canadian Journal of Economics*, 15, 377-94.
- Samson, L. (1985) A study of the impact of sectoral shifts on aggregate unemployment in Canada, *Canadian Journal of Economics*, 18, 518-30.
- Sargent, T. J. (1973) Rational expectations, the real rate of interest and the natural rate of unemployment, *Brookings Papers on Economic Activity*, 429-72.
- Sargent, T. J. (1976) A classical macroeconomic model of the United States, *Journal of Political Economy*, 84, 207-37.
- Sargent, T. J. and Wallace, N. (1975) 'Rational' expectations, the optimal monetary instrument and the optimal money supply rule, *Journal of Political Economy*, 83, 215-28.
- Selody, J. G. and Lynch, K. G. (1983) Modelling government fiscal behavior in Canada, Bank of Canada Technical Report 34.
- Turnovsky, S. J. (1977) Optimal control of linear systems with stochastic coefficients and additive disturbances, in *Applications of Control Theory to Economic Analysis*, (Ed) J. D. Pitchford and S. J. Turnovsky, North-Holland, Amsterdam.
- Wogin, G. (1980) Unemployment and monetary policy under rational expectations: some Canadian evidence, *Journal of Monetary Economics*, 6, 59-68.