Measuring the Stance of Monetary Policy

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Introduction

In this paper we construct a quantitative measure of the stance of monetary policy in Canada using a vector autoregression (VAR)–based approach. Following Blinder's (1998) recent arguments, we base our policy stance measure on the control of inflation. This is appropriate given that the goal of monetary policy in Canada is to keep inflation within a target range of 1 to 3 per cent. We regard the stance of monetary policy as a quantitative measure of whether policy is too tight, neutral, or too loose relative to the objective of keeping inflation constant.[1] If the stance is too tight (loose), inflation will eventually decrease (increase). In other words, a neutral monetary policy stance is consistent with constant inflation in the medium run (Blinder 1998, 33). A quantitative measure of policy stance is useful and important for at least two reasons. First, knowing how tight or how loose its current stance is helps the Bank of Canada determine the course of monetary policy needed to keep inflation within the target range. Second, a quanti-

1. We choose constant inflation as the benchmark for our stance measure rather than the midpoint (2 per cent) of the current inflation-control target range because the benchmark of constant inflation is more flexible, since the Bank may choose to keep inflation constant at any given rate within the target range. Besides, the target range has changed over history and may change again when the current target range expires at the end of 2001. Finally, many countries, including the United States, do not have explicit inflation targets. Defining the stance with respect to constant inflation would allow cross-country studies.

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tative measure of stance is important for the empirical study of the transmission of monetary policy actions through the economy.

Currently the Bank uses the monetary conditions index (MCI) as an operational guide for policy. The MCI is a weighted sum of the changes in the 90-day commercial paper rate (R90) and the C-6 trade-weighted exchange rate from a given base period. The relative weighting is 3 for the interest rate and 1 for the exchange rate. These weights are based on a number of empirical studies that estimate the effect of changes in real interest rates and in the real exchange rate on real aggregate demand over six to eight quarters.

The MCI can also be interpreted as a measure of the ease or tightness of monetary conditions relative to a base period; however, it should not be interpreted as a measure of monetary policy stance for several reasons.[2] First, the stance of monetary policy should capture only central bank actions, but the MCI also reflects changes—in the interest rate and the exchange rate—that are not related to central bank policy. For example, a currency depreciation due to a decline in commodity prices will cause the MCI to decrease if the depreciation is not accompanied by a proportional rise in the interest rate. However, the easing of monetary conditions may or may not affect inflation. If the central bank considers the depreciation to be consistent with constant inflation because of the negative impact of falling commodity prices on the economy, then the central bank need not change its stance. Conversely, if the central bank concludes that the currency depreciation is inflationary, it will raise the interest rate and rebalance the MCI to offset the inflationary pressure. In this case the central bank's reaction to depreciation constitutes a change in stance, but the fact that its reaction restores the MCI to its previous level means that the MCI has not changed. Second, the MCI does not consider other financial variables that may be important in the monetary transmission mechanism, such as monetary aggregates, and thereby ignores the money channel of the transmission mechanism. As a result, it is useful to construct a stance measure that captures only central bank actions with respect to inflation control and that includes other important financial variables.

Much of the existing work related to measuring policy stance is VAR-based, following Sims's (1980) seminal work. For the United States, Bernanke and Blinder (1992) and Sims (1992) considered the federal funds rate as an indicator of policy stance. Thus the innovations in the federal funds rate are interpreted as innovations to the Fed's policy. Also using the

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2. For a discussion of the role of the MCI in the conduct of policy, see Freedman (1995). For a discussion of the MCI as a measure of monetary conditions, see Bank of Canada (1995).

VAR approach, Christiano and Eichenbaum (1992) suggested that the quantity of non-borrowed reserves is a good measure of policy stance, and Strongin (1995) proposed the portion of non-borrowed reserve growth that is orthogonal to total reserve growth. For Canada, Armour, Engert, and Fung (1996) proposed that innovations in the overnight rate (RON), derived using the Choleski approach, could be a good measure of innovations to the Bank of Canada's policy. By comparing the RON innovations to monetary policy actions as described in the Bank's annual reports, they found the RON innovations to be consistent with the intended policy actions since the early 1960s. However, the RON innovations often show perverse price responses in a monthly VAR when the consumer price index (CPI) is used to measure inflation. Fung and Kasumovich (1998) found that M1 innovations produce impulse responses that are consistent with what one would expect from a monetary policy shock, thus suggesting that M1 innovations could be interpreted as innovations to the Bank's policy. All these studies assumed a priori that a single financial variable is the best policy indicator. Unfortunately, little agreement exists on which single variable most accurately captures the stance of policy.

Recently, Bernanke and Mihov (1998) suggested a VAR methodology that can include all the policy variables previously proposed for the United States as particular specifications of a general model. This approach need not assume that a single variable is the best indicator of monetary policy. Bernanke and Mihov constructed a simple model of the market for bank reserves and relied on the central bank's operating procedure to achieve identification of the VAR model. Then they evaluated the different stance indicators, as implied by different operating procedures, by performing statistical tests in the form of testing overidentifying restrictions. Finally, they constructed an overall measure of the stance of monetary policy—the measure being a linear combination of all the policy variables included in the VAR—by studying a just-identified version of the model. This methodology has been applied to Germany (Bernanke and Mihov 1997) and Italy (De Arcangelis and Di Giorgio 1998).

In this paper we apply the Bernanke and Mihov (1998) methodology to Canada. The stance of monetary policy is assumed to be a single-dimensional unobserved variable that responds to the development of inflation and determines the evolution of inflation. Policy stance, though unobserved, is reflected in the behaviour of a set of observed financial variables, which we call policy variables or indicators. These policy variables are directly influenced by monetary policy within a given period. To obtain a measure of policy stance, the key decision is determining what variables should be included as policy variables.

We consider four financial variables—M1, the term spread, the overnight rate, and the exchange rate—because of the following considerations.[3] First, since the reserve requirement was eliminated in Canada in 1994, Bernanke and Mihov's model of the reserves market is not directly applicable. Reserves can be replaced by excess reserves or Bank of Canada advances to chartered banks, and then the overnight rate would be the instrument of monetary policy. However, the implementation of the Large Value Transfer System (LVTS) in February 1999 complicates the issue, since excess reserves or advances vary closely around zero at the end of each day. Because of these considerations, we replace the market for bank reserves with the market for M1. Previous VAR studies (noted above) have shown that M1 reveals useful information about the stance of policy, and Laidler (1999) suggested using a transactions-money aggregate such as M1 to obtain information about the stance of policy. Second, we consider the term spread, defined as the spread between short-term and long-term interest rates, as a candidate variable in the stance measure. Previous studies have found the term spread to be a good predictor of output growth and a good measure of policy stance. Third, we consider the overnight rate to be the Bank's policy instrument; this is consistent with the monetary policy framework in Canada. Moreover, many recent studies have suggested that a very short-term interest rate captures well the stance of monetary policy. Finally, the exchange rate is added as a potential variable, as in De Arcangelis and Di Giorgio (1998), because Canada is a small open economy where the exchange rate plays an important role in the transmission mechanism. In sum, these four variables have been found to be informative indicators of monetary policy stance in previous studies.

After estimating the model, we construct a stance measure that includes both the endogenous and exogenous components of monetary policy. The measure is constructed as a linear combination of the four policy variables included in the model. We use the measure to examine the Bank's overall policy; for example, whether the Bank accommodates various types of shocks and to what degree. Before doing this, though, we find it instructive to examine the exogenous innovations to our stance measure. By looking at the impulse-response functions of the orthogonalized innovations to the stance measure, we can examine the dynamic responses of other variables in the VAR to monetary policy innovations. We find the results to be consistent with the expected effects of a monetary policy shock; i.e., following an expansionary policy shock, the interest rate and the term spread decline, output and the price level increase, and the Canadian dollar

3. By not focusing on the reserves market, this model can be applied to any country in which there is no reserve requirement or in which reserves do not play an important role in the transmission mechanism.

depreciates relative to the U.S. dollar. We also find that the time series of the policy innovations is consistent with the historical performance of exogenous monetary policy with respect to inflation control. These results suggest that the orthogonalized innovations to our stance measure do behave like a monetary policy shock. Comparing the stance measure with the changes in inflation and output growth, we find that the stance is broadly consistent with the evolution of inflation since the 1970s. The estimated weight for each of the four policy variables included in the stance measure suggests that the overnight rate plays the most important role in capturing the stance of monetary policy.

The rest of our paper is organized as follows. The VAR-based methodology is discussed in the next section. The model of the market for money and the identifying restrictions are described in section 2. The data and the estimation method are described in section 3. The results are reported and discussed in section 4. In the last section we offer our conclusions and some suggestions for future research.

1 Methodology

Our methodology follows that of Bernanke and Mihov (1998). Suppose that the "true" economic structure is the following unrestricted linear dynamic model:[4]

$$Y_t = \sum_{i=0}^{k} B_i Y_{t-i} + \sum_{i=0}^{k} C_i P_{t-i} + A^y V_t^y, \tag{1}$$

$$P_t = \sum_{i=0}^{k} D_i Y_{t-i} + \sum_{i=0}^{k} G_i P_{t-i} + A^p V_t^p, \tag{2}$$

where B_i, C_i, A^y, D_i, G_i, and A^p are square coefficient matrices. Equations (1) and (2) partition the variables under consideration into two groups: a non-policy block (Y) and a policy block (P). The set of policy variables includes variables that are potentially useful as indicators of the stance of monetary policy; e.g., short-term interest rates. The central bank might not have complete control over the policy variables because they are also influenced by other shocks; however, it might have a significant influence on these variables within the current period. Consider the exchange rate, for example: When the central bank implements monetary policy by setting the short-term interest rate, it takes into account the

4. Capital letters indicate vectors or matrices of variables or coefficients; lower-case letters indicate scalars.

contemporaneous reaction of the exchange rate and the subsequent effects on the economy. Non-policy variables (that is, variables not related to central bank policy) include other macroeconomic variables, such as output and prices, whose responses to monetary policy shocks we would like to examine. In this system, each variable is allowed to depend on current or lagged values (up to k lags) of any variable in the system. The vectors V^y and V^p are mutually uncorrelated "structural" or "primitive" disturbances.

Most of the recent VAR work on measuring monetary policy has considered only a single variable, which is assumed a priori to contain the relevant information; i.e., P is a scalar, say p, instead of a vector. In this case, equation (2) can be written as

$$p_t = \sum_{i=0}^{k} D_i Y_{t-i} + \sum_{i=0}^{k} g_i p_{t-i} + v_t^p, \qquad (3)$$

which may be interpreted as the policy reaction function. The central bank sets policy after observing other variables that are represented by the first two terms in equation (3). The term v_t^p is the orthogonalized innovation in p_t and represents the exogenous monetary policy shock. Thus the single indicator of monetary policy, p, consists of an endogenous component, which describes the central bank's response to the state of the economy, and an exogenous component.

For a single measure of policy stance in the United States, for example, Bernanke and Blinder (1992) considered the federal funds rate, Christiano and Eichenbaum (1992) considered non-borrowed reserves, and Kim (1999) considered M1. In Canada, Armour, Engert, and Fung (1996) examined the overnight rate, Fung and Gupta (1997) considered the overnight rate and excess cash reserves, and Fung and Kasumovich (1998) examined M1. One simple approach to identifying the effects of policy shocks on the non-policy variables is by assuming a recursive causal ordering among the variables in the VAR. For example, policy shocks are assumed not to affect non-policy variables within the same period because of, for example, adjustment costs; i.e., the elements of the vector C_0 are all 0. Once the VAR is estimated, a Choleski decomposition of the covariance matrix provides an estimated series for the exogenous monetary policy shock, v_t^p. Impulse-response functions for all variables with respect to the policy shock are then calculated and examined.

In this paper we consider the case that no unique indicator of policy exists, or that even if a single measure of stance does exist, we do not know for certain what it is. In the Bernanke and Mihov (1998) methodology there is no need to assume that a single variable is the best indicator of stance because P can have two or more elements. Their approach used estimates of the central bank's operating procedure to identify policy stance from a set of policy indicators. The approach also allows us to examine cases in which the central bank uses hybrid operating procedures—for example, targeting an interest rate while smoothing exchange rate fluctuations. In this case, both the interest rate and the exchange rate contain information about the stance of monetary policy, but both variables may also be affected by demand or other shocks. Even if there is only a single policy indicator, their approach allows us to choose among the candidate indicators statistically.

When P has more than one element, suppose that one element of the set of shocks v_t^p in equation (2) is a shock to monetary policy, denoted as v_t^p. To identify v_t^p and the dynamic responses to that shock, we again make the timing assumption that innovations to variables in the policy block do not affect variables in the non-policy block within the period, or $C_0 = 0$. Now suppose that we write the system equations (1) and (2) in standard reduced-form VAR format by moving the contemporaneous terms Y_t and P_t to the left-hand side. We define U_t^y to be the VAR residuals corresponding to the Y block and U_t^p to be the component of the residuals corresponding to the P block, which is orthogonal to U_t^y. Then equations (1) and (2) can be rewritten as a reduced-form VAR:

$$Y_t = \sum_{i=1}^{k} H_i^y Y_{t-i} + \sum_{i=1}^{k} H_i^p P_{t-i} + U_t^y, \tag{4}$$

$$P_t = \sum_{i=1}^{k} J_i^y Y_{t-i} + \sum_{i=1}^{k} J_i^p P_{t-i} + [(I-G_0)^{-1} D_0 U_t^y + U_t^p]. \tag{5}$$

Suppose that we estimate equations (4) and (5) by standard VAR methods and then extract the component of the residual of equation (5) that is orthogonal to equation (4), denoted by U_t^p. Comparing equations (4) and (5) with equations (1) and (2), it can easily be shown that U_t^p is related to V_t^p by the following:[5]

5. The reduced-form VAR residuals and the structural shocks are related by:

$$\begin{bmatrix} I^y & 0 \\ B_{21} & I^p \end{bmatrix} \begin{bmatrix} U_t^y \\ U_t^p \end{bmatrix} = \begin{bmatrix} A_{11} & 0 \\ A_{21} & A_{22} \end{bmatrix} \begin{bmatrix} V_t^y \\ V_t^p \end{bmatrix},$$

where I^p and I^y are identity matrices, $B_{21} = (I-G_0)^{-1} D_0$, $A_{11} = (I-B_0)^{-1} A^y$, $A_{21} = ((I-G_0)^{-1} D_0 (I-B_0))^{-1} A^y$, and $A_{22} = (I-G_0)^{-1} A^p$. The non-policy block can be identified by restricting A_{11} to be lower triangular when the variables in Y are arranged in a recursive causal order. The policy block is identified by imposing proper restrictions on A_{22} (discussed in the next section). It can easily be shown that $U_t^y = (I-B_0)^{-1} A^y V_t^y$ and $U_t^p = (I-G_0)^{-1} A^p V_t^p$.

$$U_t^p = (I - G_0)^{-1} A^p V_t^p. \quad (6)$$

Equation (6) can be rewritten, dropping subscripts and superscripts, as

$$U = GU + AV. \quad (7)$$

Equation (7) is a standard structural VAR system that relates observable VAR-based residuals U to unobserved structural shocks V. This system can be estimated and identified by conventional methods. Given the parameter estimates, we can recover the structural shocks, V_t^p, including the exogenous monetary policy shock v^s, by inverting equation (6):

$$V_t^p = (A^p)^{-1}(I - G_0)U_t^p. \quad (8)$$

The dynamic responses of all variables to the policy shock can then be examined by the associated impulse-response functions. Since our focus is on identifying the monetary policy stance, this approach allows us to concentrate on the identification restrictions in the policy block by modelling equation (6). To identify the policy block, we rely on a model of the market for money to impose parameter restrictions on the policy variables. To identify the non-policy block of equation (5), we impose a recursive causal ordering of the non-policy variables and restrict A^y to be diagonal. In other words, if output is ordered first in the non-policy block, it will not react contemporaneously to other variables in either the policy or non-policy blocks.

Given the estimated coefficients of the VAR, we can also obtain the following vector of variables:

$$(A^p)^{-1}(I - G_0)P, \quad (9)$$

which are linear combinations of the policy indicators, P. The orthogonalized VAR innovations of the variables described by equation (9) correspond to the structural disturbances V in equation (8), and one of these variables has the property that its VAR innovations correspond to monetary policy shocks. This can be seen most easily by considering the case where P contains only one variable, say the overnight interest rate. In this case the overnight rate is a measure of policy stance, and the orthogonalized innovations to the overnight rate correspond to exogenous monetary policy shocks. When P is a vector of policy variables, the estimated linear combination of policy variables included in P can be used to measure policy stance, including both the endogenous and exogenous portions of policy, and the shock to this measure represents the exogenous monetary policy shock. In subsequent sections we examine the impulse-response functions of a shock to policy stance to see whether it is consistent with what we expect the effects of a monetary policy shock to be. We also compare our stance measure with changes in inflation and with output growth.

2 The Model

To apply the Bernanke-Mihov methodology, the most important decision is which variables should be included in the policy block. Bernanke and Mihov (1998) modelled the reserves market in the United States, including in the policy block only variables in the reserves market, such as total reserves, non-borrowed reserves, and the federal funds rate. Using a similar strategy for Germany, Bernanke and Mihov (1997) included total reserves, Lombard loans, the call rate, and the Lombard rate. In Canada the overnight market for reserves and other short-term funds has evolved continuously since the 1950s (see, for example, Lundrigan and Toll [1998]). One of the most important changes related to our study is the phasing-out of required reserves beginning in 1991 and their eventual elimination in 1994. Moreover, implementation of the LVTS in February 1999 caused further changes in the overnight market, and this makes modelling that market more difficult. For example, Bank of Canada advances to direct clearers vary closely around zero at the end of the day. Thus, the model of the reserves market used in previous studies is not appropriate for Canada.

To apply the Bernanke and Mihov (1988) methodology to Canada, we make the following modifications. First, we add an equation for determining the Can$/US$ exchange rate. Second, instead of using reserves variables, we use other quantity variables. A money aggregate such as M1 seems to be a natural candidate as a replacement for the reserves because M1 has been shown to generate dynamic responses consistent with the expected effects of monetary policy shocks in Canada (see, for example, Fung and Kasumovich 1998). The idea is to model the contemporaneous relationships among variables in the policy block (as discussed in the previous section). The variables considered in the policy block are: the overnight rate (*RON*); the real money supply, defined as M1 divided by the CPI (*M*); the term spread, defined as the spread between R90 and the 10-year-and-above Government of Canada bond yield (*TS*); and the price of foreign exchange (*PFX*). The overnight rate is considered to be the Bank's policy instrument. All these variables have been found to contain useful information about monetary policy and are influenced by monetary policy within the same period. The model, written in innovation form, is described by the following set of equations:[6]

$$\text{Money demand: } u_M = -\beta u_{TS} + v^d \qquad (10)$$

$$\text{Money supply: } u_{TS} = \alpha^d v^d + \alpha^s v^s + \alpha^x v^x + v^b \qquad (11)$$

$$\text{Overnight rate: } u_{RON} = \phi^d v^d + \phi^b v^b + \phi^x v^x + v^s \qquad (12)$$

$$\text{Exchange rate: } u_{PFX} + \gamma_1 u_M + \gamma_2 u_{TS} + \gamma_3 u_{RON} = v^x \qquad (13)$$

Equation (10) relates the innovation in the demand for money (negatively) to the innovation in *TS* and an autonomous shock to money demand; thus, the equation can be interpreted as a short-run money-demand function.[7] Equation (11) determines the amount of money that commercial banks choose to supply by influencing *TS*. The commercial banks are assumed to respond to money-demand shocks (v^d), monetary policy shocks (v^s), and exchange rate shocks (v^x) when determining their money supply. The term v^b is a money-supply shock, which can be interpreted as a credit shock or financial market shock. Here we assume that currency is mainly demand-determined, and thus credit supplied by commercial banks determines the supply of money to the economy.[8]

Equation (12) describes how the Bank sets the overnight rate. This equation assumes that the Bank observes and responds to shocks to the total demand for money, shocks to the supply of money, and shocks to the exchange rate within a given period, with the strength of the response given by the coefficients ϕ^d, ϕ^b, and ϕ^x. Setting $\phi^d = 0$, for example, implies that the Bank completely offsets the money-demand shock to keep the overnight rate from changing. The term v^s represents exogenous monetary policy shocks that we want to identify. Equation (13) is the exchange rate equation, which relates the innovation in the exchange rate to the innovations in all the other policy variables. The equation says that the

6. The vector U^p is the component of the VAR residuals corresponding to the policy block, which is orthogonal to the VAR residuals corresponding to the non-policy block U^y. The total VAR residuals corresponding to the policy block are equal to a linear combination of the orthogonal and the non-orthogonal components [see equation (5)]. Since U^p can be obtained from the estimation of the VAR model, we consider only policy variables when modelling the market for M1; we focus on modelling those policy variables that do not respond to variables in the non-policy block within the same period.

7. Heller and Khan (1979) estimated a money-demand function that includes the whole term structure of interest rates, finding the results to be better than traditional money-demand functions.

8. Laidler (1999) discussed the role of the banking system's supply of nominal monetary liabilities in the monetary transmission mechanism.

innovations in the exchange rate can be decomposed into two components: the responses to innovations in other variables in the policy block, plus an exogenous exchange rate shock.

We can write the relationship between U and V as $(I - G)U = AV$ [see equation (7)]:

$$\begin{bmatrix} 1 & \beta & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ \gamma_1 & \gamma_2 & \gamma_3 & 1 \end{bmatrix} \begin{bmatrix} u_M \\ u_{TS} \\ u_{RON} \\ u_{PFX} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ \alpha^d & 1 & \alpha^s & \alpha^x \\ \phi^d & \phi^b & 1 & \phi^x \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v^d \\ v^b \\ v^s \\ v^x \end{bmatrix} \tag{14}$$

We can then invert relationship equation (14) to determine how the monetary policy shock, v^s, depends on the VAR residuals:

$$v^s = w_M u_M + w_{TS} u_{TS} + w_{RON} u_{RON} + w_{PFX} u_{PFX}, \tag{15}$$

where

$$w_M = \left[\frac{(\phi^b\alpha^d - \phi^d) + (\phi^b\alpha^x - \phi^x)\gamma_1}{(1 - \phi^b\alpha^s)}\right],$$

$$w_{TS} = \left[\frac{(\phi^b\alpha^d - \phi^d)\beta - \phi^b + (\phi^b\alpha^x - \phi^x)\gamma_2}{(1 - \phi^b\alpha^s)}\right],$$

$$w_{RON} = \left[\frac{1 + (\phi^b\alpha^x - \phi^x)\gamma_3}{(1 - \phi^b\alpha^s)}\right],$$

and

$$w_{PFX} = \frac{(\phi^b\alpha^x - \phi^x)}{(1 - \phi^b\alpha^s)}.$$

Equation (15) shows that the monetary policy shock is a linear combination of all the VAR residuals in the policy block, with the weight on each variable equal to some combinations of the model parameters. A measure of the stance can be constructed using the same weights on the corresponding variables as in equation (9).

The model has 14 unknown parameters (including 4 shock variances) to be estimated from 10 residual variances and covariances. To identify the model, further identifying restrictions are needed. Bernanke and Mihov (1998) used two strategies for achieving identification. The first is to model the central bank's operating procedures, such as interest rate targeting, to achieve overidentification of the model. Thus, the model and the proposed operating procedure could be tested in the form of a test of overidentifying restrictions. The second strategy is to impose only enough restrictions to just identify the model, thus allowing the derivation of a measure of monetary policy stance as a linear combination of all the policy variables.

In this paper we focus only on just identifying the model. To achieve just identification we must impose four additional restrictions. We choose these restrictions so that the weight on each variable remains non-zero. We also avoid imposing too many restrictions on the reaction functions of the central bank or commercial banks so that these functions can be determined by the data. As a result, we impose the restrictions $\gamma_1 = 0$, $\gamma_2 = 0$, $\gamma_3 = 0$, and $\phi^d = 0$.[9] This implies that the measure of the monetary policy shock is

$$v^s = w_M u_M + w_{TS} u_{TS} + w_{RON} u_{RON} + w_{PFX} u_{PFX}, \tag{16}$$

where

$$w_M = \frac{\phi^b \alpha^d}{(1 - \phi^b \alpha^s)},$$

$$w_{TS} = \frac{\beta \phi^b \alpha^d - \phi^b}{(1 - \phi^b \alpha^s)},$$

$$w_{RON} = \frac{1}{(1 - \phi^b \alpha^s)},$$

and

$$w_{PFX} = \frac{(\phi^b \alpha^x - \phi^x)}{(1 - \phi^b \alpha^s)}.$$

The first three restrictions imply that the innovation in the exchange rate does not respond to any other variables contemporaneously and thus is purely stochastic. The last restriction implies that the Bank fully offsets shocks to money demand to keep the overnight rate from changing. However, the Bank may accommodate shocks to the credit market and to the exchange rate, depending on the values of ϕ^b and ϕ^x.

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9. These parameters were found to be very close to 0 when they were unrestricted. The generalized method of moments (GMM) estimation method we use also influences our choice of restrictions, since the variance-covariance matrix derived from the model is also a function of the model parameters. To recover the unrestricted coefficients, all the elements in the covariance matrix have to be non-trivial functions of these unrestricted parameters.

3 Data and Estimation

To estimate the model we need to specify the non-policy variables Y and the policy variables P. In all VARs estimated in this paper we use the following non-policy variables: monthly real GDP at factor cost (*GDP*), the CPI (*P*), and the world commodity-price index (*PCOM*). The commodity-price index is used to capture the non-policy-induced changes in inflation pressure that the Bank may react to when setting policy. Many U.S. studies have found that including *PCOM* helps resolve the price puzzle (after an expansionary policy shock, prices decrease initially rather than increase) usually found in the VAR literature. The three non-policy variables are ordered: *PCOM*, *GDP*, and *P*. It is reasonable to order *PCOM* first, since Canada is a small open economy with a relatively small influence on world commodity prices. Moreover, a commodity-price shock will have an immediate effect on the Canadian economy because of Canada's relatively large resource sector. We also include some U.S. variables—the CPI, GDP, and the federal funds rate—as exogenous variables to capture the close link between the Canadian and U.S. economies.[10] Policy variables include M1, the overnight rate, the Can$/US$ exchange rate, and the term spread.

Since the VAR model is identified by imposing contemporaneous restrictions, monthly data are more appropriate than quarterly data. It is more difficult to defend the identification assumption of no contemporaneous feedback from policy to the economy at the quarterly frequency. All Canadian data are from CANSIM except *PCOM*, which is the world commodity-price index (non-fuel) from the *International Financial Statistics* published by the International Monetary Fund. All variables in the VAR are in log levels except interest rates, which are in levels. Data are available from 1961 through 1999M3. We begin our estimation in 1971M1 to avoid the fixed exchange rate regime in the 1960s. We also consider two subsamples—1971M1 to 1991M12 and 1982M1 to 1999M3—to allow for the structural break around 1982 due to the termination of money-growth targeting and the introduction of inflation-control targets in 1991.[11] Selected series of the data set used are plotted in Figure 1.

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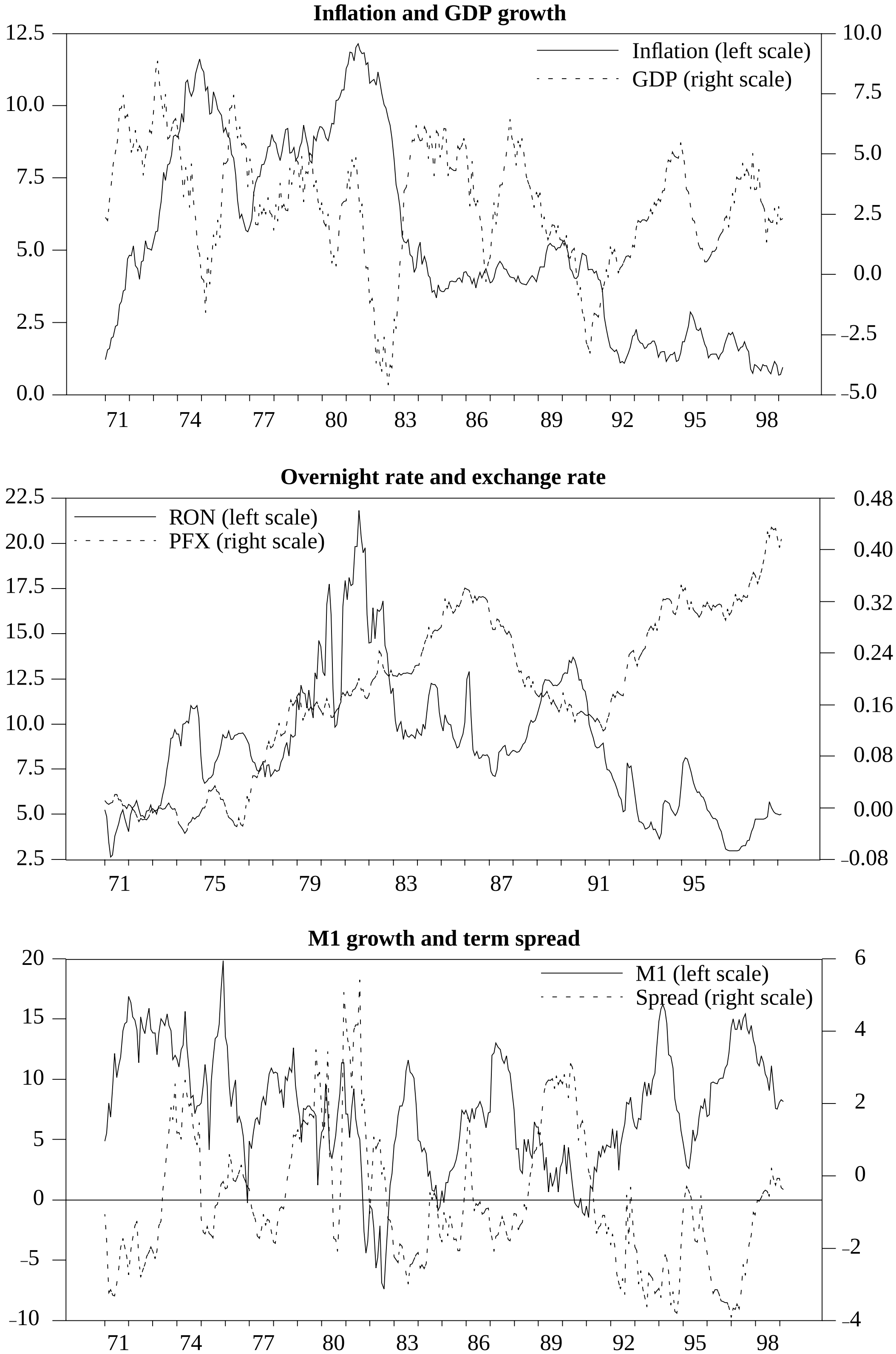
10. The U.S. variables are important because they help to resolve the price puzzle found in previous work on Canadian policy shocks. Including *PCOM* alone does not solve the price puzzle. Recent work on monetary policy shocks in Germany (Bernanke and Mihov 1997) and Italy (De Arcangelis and Di Giorgio 1998) also found the price puzzle, even when *PCOM* was included in the VAR.
11. See section 4 for more discussion.

Figure 1
Selected time series used in the estimation



The models are estimated by a two-step, efficient GMM procedure.[12] In the first step the coefficients of the VAR model are estimated using equation-by-equation ordinary least squares. In the second step the second moments implied by the theoretical model being estimated are matched to the covariance matrix of the policy sector VAR residuals. In the VAR estimation, 12 lags (one year) are included.[13]

4 Results

4.1 Estimation results

The full sample runs from 1971M1 to 1999M3. The estimation results are reported in panel A of Table 1. The short-term interest rate elasticity of money demand, β, is estimated to be 0.0025, but is not significant. The parameters (α^d, α^s, and α^x) in the term-spread equation are all significant. A positive value of the parameter α^d implies that when a positive money-demand shock occurs, the short-term interest rate rises to clear the money market. The parameter estimate $\alpha^s = 0.58$ indicates that the term spread would increase by 58 basis points when the overnight rate rises by 100 basis points. The term spread rises less than one-for-one with the overnight rate because of the two offsetting effects of a monetary policy shock: a liquidity effect and an expected-inflation effect. An unexpected currency depreciation would lead to an increase in the short-term interest rate, an increase that could forestall further currency depreciation $(\alpha^x > 0)$.

The parameters ϕ^b and ϕ^x in the overnight rate equation are not statistically significant. The parameter ϕ^b captures the reaction of the central bank to innovations in the term spread. A negative value of ϕ^b implies that when a positive innovation occurs in the term spread due to, for example, an unexpected tightening of credit conditions in financial markets, the Bank would lower the overnight rate to provide more liquidity to the overnight market. The Bank would also raise the overnight rate in response to an unexpected currency depreciation, resulting in a positive sign of ϕ^x. Neither ϕ^b nor ϕ^x is significant, suggesting that the Bank does not generally respond vigorously to credit or exchange rate shocks within a given period. This may indicate that current information in financial markets is not fed into the policy rule. The Bank tends to maintain a desired overnight rate level according to the expected information at the beginning of any given period.

12. We also estimated the models with maximum-likelihood estimation, and the results were quite similar.
13. The number of lags included in the estimation is determined by a likelihood-ratio test.

Table 1
Estimation results

A. Full sample: 1971M1–1999M3

Parameter estimates of the structural model ($\phi^d = \gamma_1 = \gamma_2 = \gamma_3 = 0$)

β	α^d	α^s	α^x	ϕ^b	ϕ^x
0.0025	9.3397	0.5765	14.8391	–0.0423	2.6769
(0.0016)	(3.7092)	(0.1100)	(4.1197)	(0.1237)	(3.9931)

Weights in the measure of stance

w_M	w_{TS}	w_{RON}	w_{PFX}
–0.2215	0.0392	0.9655	–3.0835
(1.7560)	(0.1144)	(0.0253)	(4.1713)

B. First subsample: 1971M1–1991M12

Parameter estimates of the structural model ($\phi^d = \gamma_1 = \gamma_2 = \gamma_3 = 0$)

β	α^d	α^s	α^x	ϕ^b	ϕ^x
0.0010	5.5888	0.5929	9.4496	–0.0756	–0.0117
(0.0017)	(4.6977)	(0.0446)	(5.1955)	(0.0467)	(5.2851)

Weights in the measure of stance

w_M	w_{TS}	w_{RON}	w_{PFX}
–0.4058	0.0703	0.9574	–0.6794
(0.4560)	(0.0427)	(0.0266)	(5.4864)

C. Second subsample: 1982M1–1999M3

Parameter estimates of the structural model ($\phi^d = \gamma_1 = \gamma_2 = \gamma_3 = 0$)

β	α^d	α^s	α^x	ϕ^b	ϕ^x
0.0036	18.8656	0.5370	19.5508	–0.0779	3.4896
(0.0020)	(6.6653)	(0.0713)	(3.7084)	(0.1065)	(4.1283)

Weights in the measure of stance

w_M	w_{TS}	w_{RON}	w_{PFX}
–1.4015	0.0623	0.9604	–4.7102
(1.9500)	(0.0628)	(0.0538)	(4.3158)

Notes: The parameters of the structural model are estimated by a two-step, efficient GMM procedure. The standard errors are in parentheses.

The estimated weights for the four policy variables (w_M, w_{TS}, w_{RON}, and w_{PFX}) in the stance measure are also reported in panel A of Table 1. The parameter estimates have the anticipated signs. An expansion in money supply or a currency depreciation represents an easing (a negative weight), and a rise in the short-term interest rate relative to the long-term rate, or an increase in the overnight rate, represents a tightening (a positive weight). According to the estimate of the weight on M (–0.22), a one-percentage-point increase in M1 implies a reduction in the stance measure of 0.22 basis points; however, the standard error of the weight suggests that it is not significant. The weight on the exchange rate is estimated to be –3.08, which means that a depreciation of one Canadian cent reduces the stance measure by 3.08 basis points. The weight on the term spread is 0.039 and is not significant. Only the weight on the overnight rate, 0.97, is statistically significant. These results suggest that the overnight rate contains the most significant amount of information about policy stance.

Parameter instability is always a concern for time-series analysis because of changes in monetary regimes and financial structures. In the mid-1970s, Canada experienced significant inflation problems. In response, the Bank of Canada introduced a program of "monetary gradualism," under which M1 growth was controlled within a gradually falling target range. In the meantime the government imposed wage and price controls. Monetary gradualism was abandoned in November 1982.[14] In February 1991, inflation-control targets were adopted jointly by the Bank of Canada and the Government of Canada.[15] Thus, it is desirable to split the full sample period into two subsamples: 1971M1 to 1982M10 and 1982M11 to 1999M3. However, the large number of variables (10) and lags (12) in the VAR model cause a degrees-of-freedom problem in the estimation if these subsamples are used. To eliminate this problem, we revise the first subsample to 1971M1 to 1991M12, which excludes data for the years after inflation targets were introduced. We revise the second subsample to 1982M1 to 1999M3, which excludes the period of money targeting.

The estimation results of the two subsamples are reported in panels B and C of Table 1. Most of the estimates of parameters and weights for the two subsamples are similar to those for the full sample, suggesting that these estimates are quite robust to the use of different sample periods.[16]

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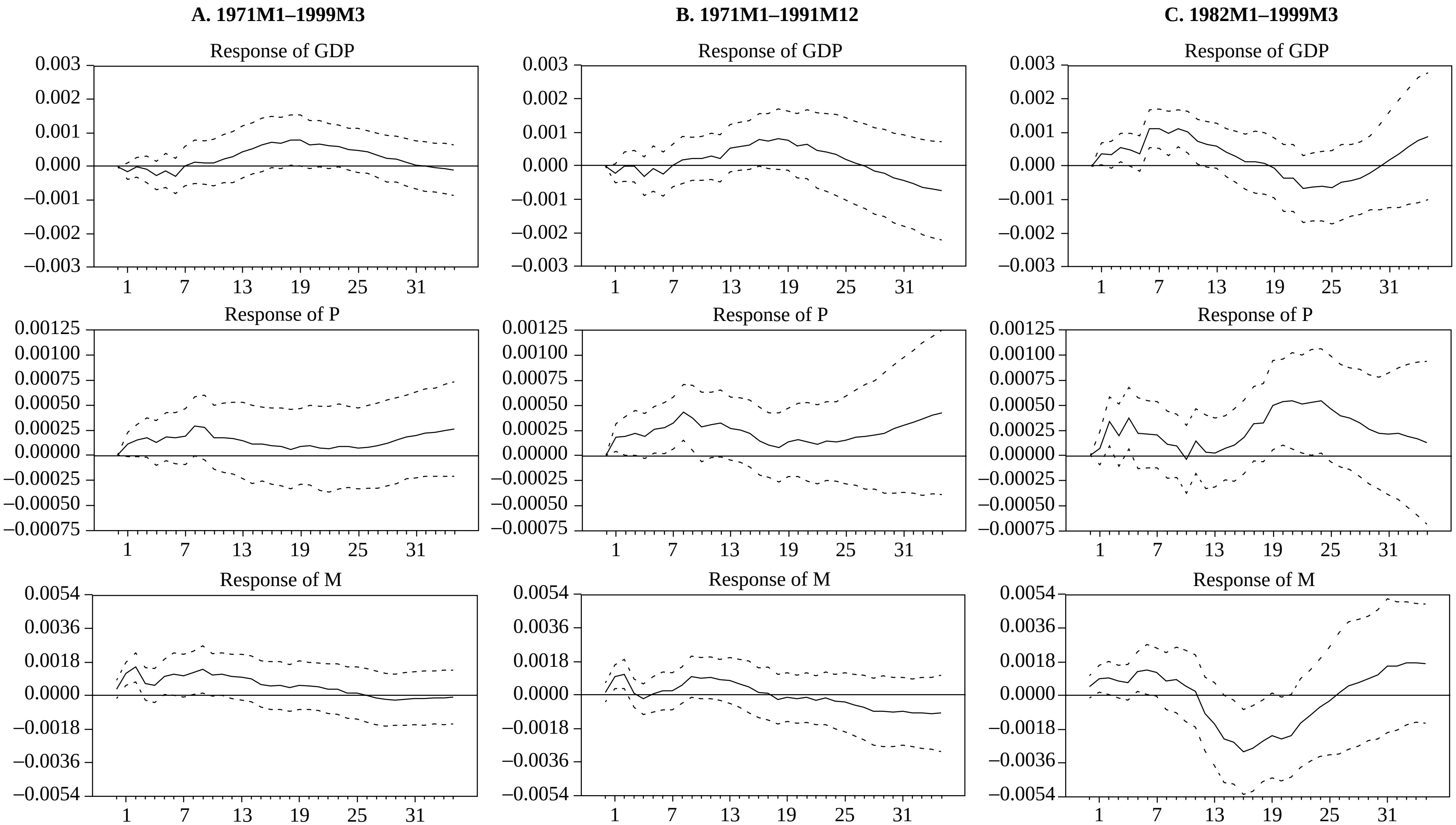
14. Following the adoption of monetary gradualism in 1975, the Canadian dollar depreciated sharply. The Bank of Canada responded by tightening policy more than was needed to meet the M1 targets. Because of financial innovations, M1 targets were abandoned in November 1982.

15. The inflation rate in 1991 was 5.9 per cent as measured by the CPI. The goal was to reduce inflation to progressively lower levels to ensure a favourable climate for long-lasting economic growth. By December 1993, inflation had been reduced to 2 per cent. At that time the government and the Bank agreed to extend the target range (1 to 3 per cent inflation) for three more years, to the end of 1998. In February 1998, with inflation well contained, the existing targets were extended to the end of 2001. The government and the Bank agreed that before that time they would jointly determine an appropriate long-run target consistent with price stability.

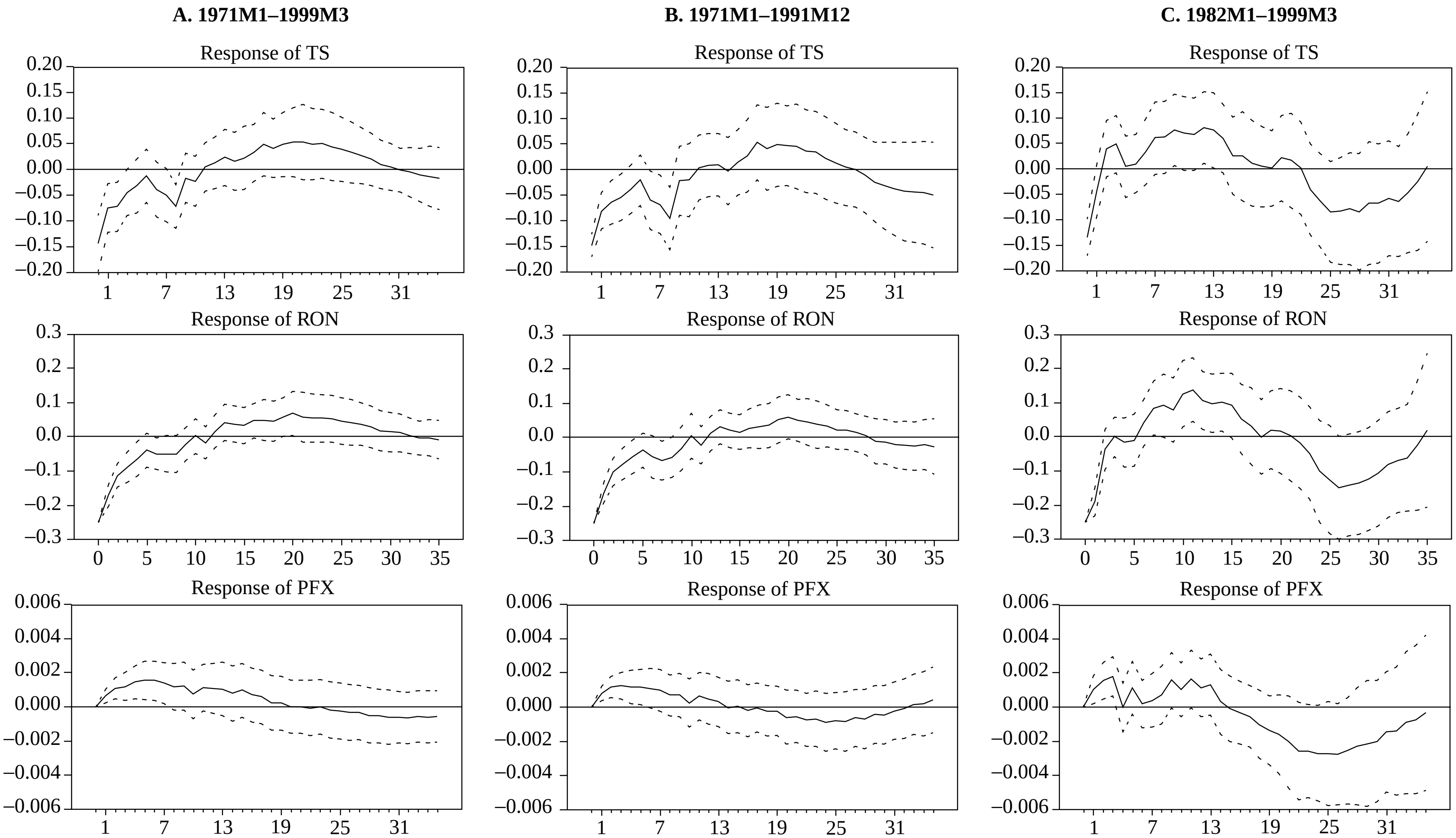
16. There is evidence that some parameter estimates are unstable across the subsamples. We will address this problem in future research by considering non-linear models.

Figure 2
Impulse-response functions to a shock in v^s



(continued)

Figure 2 (continued)
Impulse-response functions to a shock in v^s



4.2 Impulse responses to monetary policy shocks

Our purpose is to derive a good measure of monetary policy stance. The orthogonalized innovation to policy stance corresponds to an exogenous monetary policy shock (see section 2) and thus in evaluating the stance derived from the model, it is instructive to examine the impulse-response functions of such monetary policy shocks.

Figure 2 shows the estimated dynamic responses of real output, real money, the price level, the term spread, the overnight rate, and the exchange rate to a monetary policy shock (v^s). The responses of the commodity-price index are not reported, since Canadian monetary policy has only a small influence on the commodity-price index. The experiment we consider is an expansionary policy shock that results in a decline in the overnight rate by 25 basis points $(u_{RON} = -0.25)$. The two dashed lines represent the 95 per cent confidence bands.

Column A in Figure 2 shows the results for the full sample. Following an expansionary policy shock, the overnight rate decreases by 25 basis points, and the term spread decreases by 15 basis points. The overnight rate responses show a liquidity effect that lasts for almost 10 months and is significant for the first 8 months. After 10 months the anticipated inflation effect dominates, resulting in a rise in the overnight rate. The overnight rate finally returns to its pre-shock level 3 years after the shock. The responses of the term spread are very similar to those of the overnight rate, but are smaller in magnitude. This similarity may be due to the fact that R90 and the overnight rate are highly correlated and that monetary policy shocks have relatively small effects on the long-term rate. Output starts to increase 6 months after the shock and peaks around 18 months after the shock. The responses become significant 1 year after the shock and are significant for 9 months. Compared with output, the price level responds more quickly and the responses are more persistent: It starts to increase 1 month after the shock and is significant for about 9 months. After the expansionary policy shock the exchange rate increases (the Canadian dollar depreciates) significantly for 9 months, but after that the responses are not significant. Money demand increases because of the lower opportunity cost of holding money (the lower short-term interest rate) and an increase in aggregate economic activity. The money responses are significant for about 9 months after the shock.

Columns B and C in Figure 2 show the responses for the two subsamples. The responses of the overnight rate and the term spread are quite similar across the sample and subsamples. However, the liquidity effect is more short-lived in the second subsample—the term spread decreases for only about 3 months and the overnight rate decreases for

6 months. The second subsample includes the 1990s, when the Bank has brought inflation down and has been keeping it well within the target range. Thus, it is somewhat puzzling that the expected inflation effect becomes dominant so much sooner than in the sample and the other subsample. Also, the responses of the overnight rate and the term spread are more volatile in the second subsample. The responses of output and the price level in the first and second subsamples are qualitatively similar, but are different in terms of their speed and significance. In the first subsample, output responds to the shock slowly, and the responses are not significant throughout the horizon considered. However, in the second subsample, output responds more quickly, and the responses are significant for the first year after the shock. For both subsamples the responses of the price level are similar to that of the full sample. The price level responds quickly and the responses are persistent. The responses are significant for the first year in the first subsample, but more volatile in the second subsample—the responses are significant for the first 9 months and also for another 6 months about 18 months after the shock. The Canadian dollar depreciates after the expansionary policy shock, but the depreciation is significant only in the first subsample. In the second subsample, the Canadian dollar appreciates significantly 18 months after the shock, possibly because of the significant increase in the overnight rate 9 months after the shock.

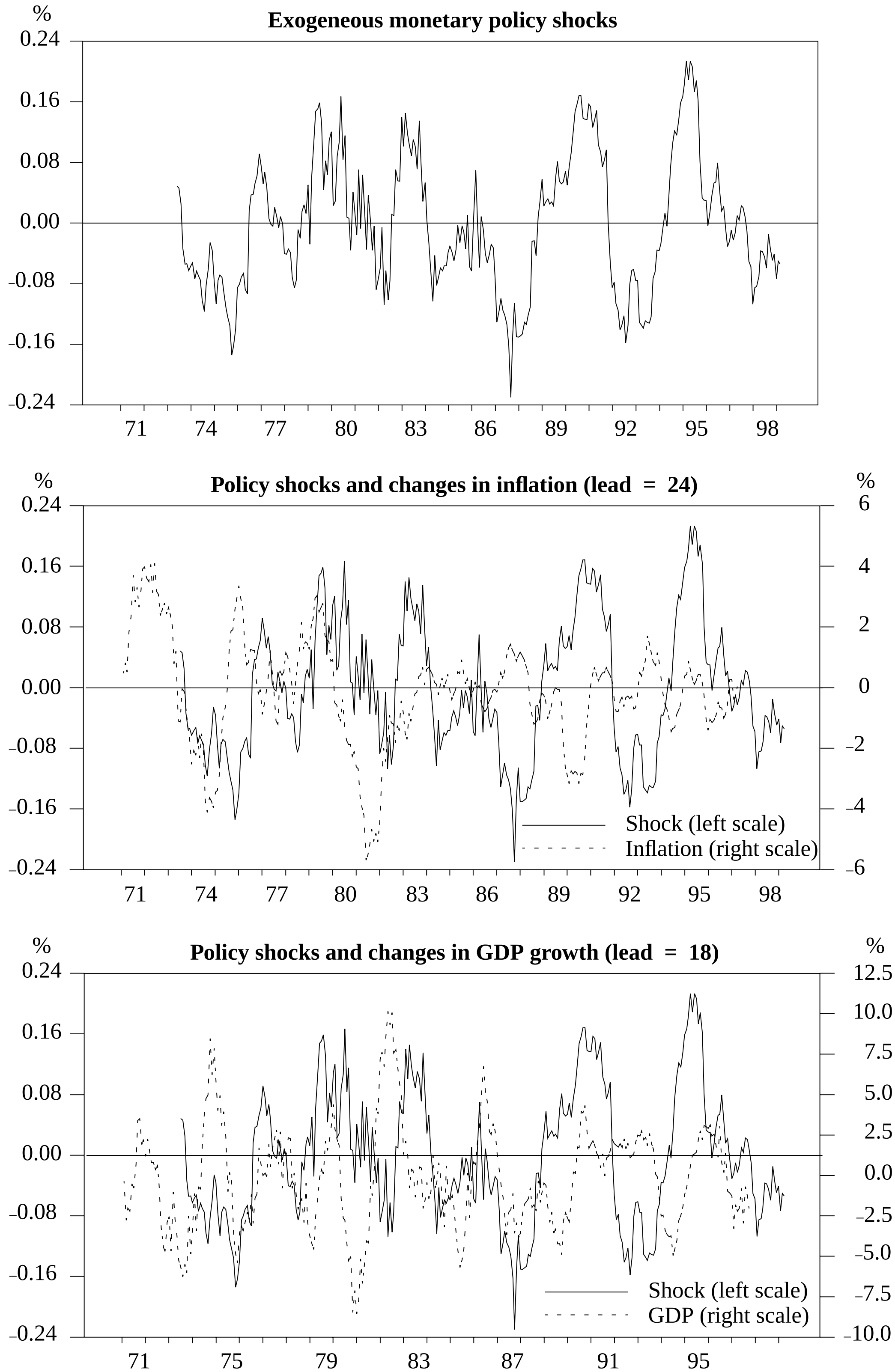
4.3 Exogenous monetary policy shocks

Once the model is estimated, the exogenous monetary policy shock v^s can be identified. Since v^s is very volatile, we plot the 18-month moving averages of v^s in the top panel of Figure 3.[17] The zero line defines the benchmark at which all policy actions are fully anticipated. If no further monetary policy shocks occur, inflation and output growth will stay on the long-run trend. If v^s is above (below) the zero line, then policy is tighter than expected (easier than expected).

Next we compare the major monetary policy episodes with the derived policy shocks. The description of the episodes is adapted from Table 1 in Armour, Engert, and Fung (1996), which provides a chronology of major episodes from 1961 to 1994 based mainly on Bank of Canada annual reports. To illustrate the impact of policy shocks on future inflation and output growth, we plot, in the middle and bottom panels of Figure 3, the derived monetary policy shocks, the 2-years-ahead change in inflation, and the 18-months-ahead change in output growth. To facilitate our discussion we divide the sample into four periods: 1973–78, 1979–83, 1984–88, and

17. We consider an 18-month moving average because it takes, on average, about 18 to 24 months for monetary policy to affect the economy.

Figure 3
Monetary policy shocks, inflation, and GDP growth



1989–99. The top panel of Figure 3 shows that policy shocks were mostly easier than expected in the first and third periods, but mainly tighter than expected in the second period. Comparing these shocks with inflation depicted in the top panel of Figure 1, we can also see that the derived policy shocks are consistent with the trend of inflation in each of the four periods.

From 1973 to 1978 the derived policy shocks in Figure 3 suggest that policy stance was easier than expected in general except from mid-1976 to early 1977. Thus, except from 1975 to 1976, inflation was on an upward trend for most of the period until mid-1981, so the change in inflation was mostly positive in the middle panel of Figure 3. According to Armour, Engert, and Fung (1996), during 1973–75 the Bank generally pursued an expansionary policy. In 1974, inflation increased to a double-digit level, and output growth surged in 1976 to around 6 per cent (see Figure 1). In the summer of 1975, the Bank of Canada came to the view that underlying inflationary pressure was rapidly building up to a critical level, and in September 1975, the Bank raised the Bank Rate substantially and continued to push up short-term interest rates in the first part of 1976. However, in the second quarter of 1976, M1 growth slowed abruptly, and in the third quarter, M1 growth was below the lower limit of the target range. To move M1 growth back into the target range, the Bank lowered interest rates through the last two months of 1976 and into 1977.

The policy shocks shown in Figure 3 suggest that policy was mostly tighter than expected from 1979 to 1983 and also rather volatile. Policy was tighter than expected in 1979, but gradually conformed to what financial markets expected in 1980. Inflation declined sharply from its peak of about 12 per cent in 1981 to around 5 per cent in 1982. Output growth also dropped from 5 per cent in 1981 to negative values in 1982 and 1983 as a result of the recession. Policy was easier than expected for a short period from mid-1980 to mid-1981, then tighter than expected again until 1983. Thus, the change in inflation was mostly negative in this period. In 1979, the Bank raised the Bank Rate in January, July, September, and twice in October (Armour, Engert, and Fung 1996). Tight policy continued until the summer of 1980. From the second half of 1980 to 1981, policy eased substantially and output growth started to rebound about 18 months later. Inflation, however, remained on a slight downward trend. In the second half of 1982, there was strong downward pressure on interest rates. Concerned about the dollar's weakness, the Bank acted to moderate the decline in short-term interest rates. Thus, policy remained relatively tight, resulting in further declines in inflation and output growth in 1984.

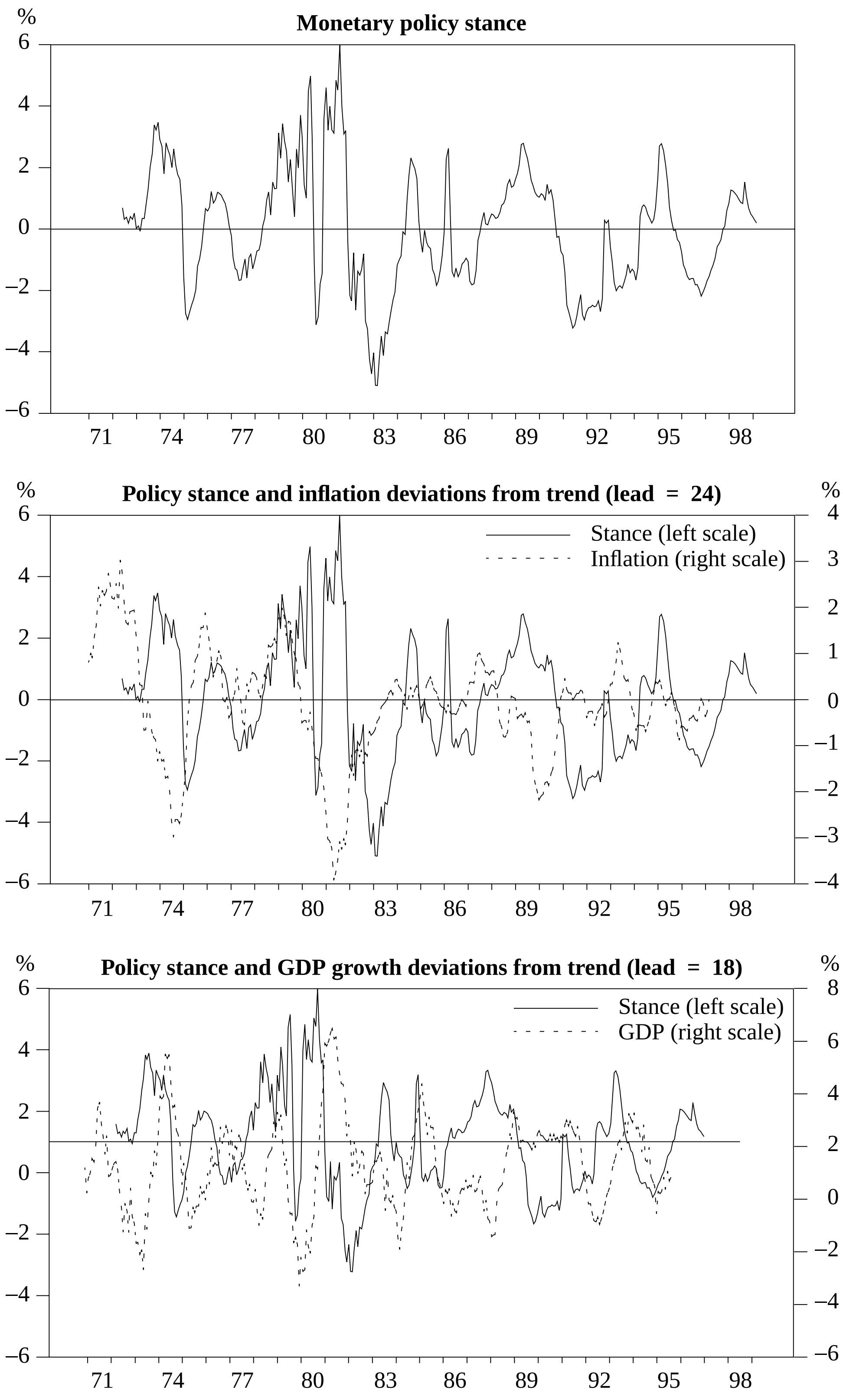
From 1984 to mid-1988, our policy-shock measure suggests that policy was relatively easier than expected—with one brief exception. In late 1985 and early 1986, the Canadian dollar was under downward pressure and the Bank reacted strongly to support it (Armour, Engert, and Fung 1996). Our policy-shock measure indicates that policy was as expected or slightly tighter than expected during this period, suggesting that policy did not deviate too much from an expansionary stance. Because of the expansionary stance, inflation was mainly on a slight upward trend, rising from 3 per cent in 1984 to around 5 per cent in 1989. Output growth remained rather stable in the period.

Our measure in Figure 3 shows that policy was tighter than expected from late 1988 to 1991, then became easier than expected for about two years until early 1994. Policy was again tighter than expected from early 1994 until 1996. Since 1996, policy shocks have been slightly easier than expected or close to expectations. Again, this description of policy is consistent with the monetary policy episodes mentioned in Armour, Engert, and Fung (1996) and with the evolution of inflation since 1988. In the second half of 1988, the Bank began to implement a contractionary policy that was consistent with the objective of price stability. The Bank strongly and consistently resisted an upsurge in inflation until the first half of 1991. Thus, inflation was reduced between 1990 and 1992. Output growth also slowed down between 1989 and 1991 and became negative in 1990 and 1991 (a recession, see Figure 1). From 1992 to 1993, policy was expansionary. As a result, both inflation and output growth followed a slight upward trend about 18 to 24 months later. From 1994 to 1996, policy was tightened to ensure that inflation would fall into the inflation-target range, which depressed real activity and brought inflation down. Since 1996, policy has been neutral or slightly easy, but output growth has remained depressed. Output growth decreased in 1997 and 1998, a decrease that may be due to reduced government spending and other structural changes. Inflation has remained fairly constant at a very low level since 1996, though on a slight downward trend.

4.4 Measure of policy stance

As we discussed in section 1, we can also construct, using the same weights reported in Table 1, a stance measure that includes both the endogenous and exogenous components of policy. Following Bernanke and Mihov (1998), we normalized the stance at each date by subtracting from it an 18-month moving average of its own past values. This procedure has the effect of defining zero as the benchmark of neutral monetary policy, indicating that policy has not deviated from the average stance in the past 18 months. This normalized stance measure captures the pressure on recent inflation. Thus, when the stance is neutral, inflation will not move away from its 18-month moving average. A positive (negative) stance implies that future inflation will fall below (rise above) the average inflation rate of the past 18 months in

Figure 4
Monetary policy stance, inflation, and GDP growth



the absence of the other shocks. The derived stance is plotted in the top panel of Figure 4.

In the middle and bottom panels of Figure 4 we also compare the stance with actual inflation and GDP growth with a 24-month lead and an 18-month lead. Inflation and GDP growth are also calculated as the deviations from their 18-month moving averages. A tight (easy) policy stance should be followed by a decrease (increase) in inflation if no other demand or supply shocks occur, or if monetary policy shocks dominate other shocks. The middle panel of Figure 4 shows that this relationship between the stance and inflation generally holds, most notably for the period 1986–94. When policy was expansionary in 1986 and the first half of 1987, inflation rose above its past trend. When the Bank started its anti-inflationary policy in 1988 and the policy stance became tighter than its past average, inflation decreased to a level consistent with the Bank's inflation-control targets. During the 1990–91 recession the stance was below its past trend to stimulate aggregate demand, and inflation stayed around its own trend or slightly higher in 1994 and 1995.

Similarly, a tight (easy) policy stance should be followed by a decrease (increase) in output growth. The bottom panel of Figure 4 shows that this relationship between stance and output growth also generally holds, notably during the following tight-policy periods: 1973, 1976–77, 1979–82, 1984, 1986, 1988–89, and 1994–95. This implies that monetary policy plays an important role in affecting short-run aggregate demand in these periods.

These graphs should be interpreted with caution, since price level and output are determined by the interaction of aggregate demand and aggregate supply. So far, we have considered only the influence of monetary policy on inflation. Other demand shocks, such as government-spending shocks, may also influence aggregate demand and hence inflation. Supply shocks, such as commodity-price shocks and technological innovations, can also affect inflation.

4.5 Demand-shock dominance or supply-shock dominance

To better understand the effects of monetary policy on inflation and output growth, we examine the historical co-movements of inflation and output growth. In each year the economy is subject to a variety of shocks—broadly speaking, demand shocks and supply shocks. By looking at the co-movements of inflation and output growth, we may be able to identify whether the economy in a particular year is dominated by demand shocks (positive co-movement) or supply shocks (negative co-movement). For those years that are dominated by demand shocks, we examine whether monetary policy stance can account for the co-movements of inflation and output growth.

In Table 2 we report the stance indices from 1974 to 1998 and 1-year changes in inflation and output growth for each year from 1975 to 1998. The integers in column 2 are the stance normalized to a scale of –2 to 2: –2 to –1 denotes "very loose" to "mildly loose," 0 denotes "neutral," 1 to 2 denotes "mildly tight" to "very tight."[18] The 1-year changes in inflation and GDP growth are reported in columns 3 and 4. In column 5, each year is labelled as demand-shock (D)- or supply-shock (S)-dominated according to the co-movements of inflation and output growth. The + and – signs denote positive and negative shocks. In any given year, if inflation and output growth move in the same direction, the year is considered to be demand-shock-dominated; otherwise it is considered to be supply-shock-dominated. A positive (negative) demand or supply shock corresponds to an increase (decrease) in output growth.

In the 24-year period from 1974 to 1998, we find that demand shocks have dominated for about 13 years. Monetary policy can explain 9 of them (assuming monetary policy affects the economy with a 1-year lag): 1975, 1978, 1982, 1985, 1990–91, 1993, and 1996–97. For example, when policy was very tight in 1989 (an index of 2), both inflation and output growth fell in 1990. To account for the remaining 4 years, we consider another major demand shock—government-spending shocks (GS). A simple quarterly AR(4) model is estimated for government spending on goods and services over the period. Of these 4 years, 2 can be explained by government-spending shocks—1981 and 1987—leaving only 2 years unexplained—1979 and 1998. This analysis suggests that monetary policy plays an important role in determining inflation and output growth when the economy is not dominated by supply shocks.

Conclusion

In this paper we derive a measure of the stance of monetary policy based on a model that considers three channels of monetary transmission: the interest rate channel, the exchange rate channel, and the money channel. From the impulse-response functions we find that the model can generate dynamic responses that are consistent with the standard views of the monetary

18. We normalize the stance by assuming that the stance is normally distributed and dividing the distribution into five regions of equal probability. The regions from left to right are labelled by the integers from –2 to 2. Then we classify the stances according to the region labels. For example, if a stance falls into region 0, then the stance is classified as 0, which implies a neutral policy. The government-spending shocks are also classified according to the same procedure.

Table 2
Numerical presentation of policy stance, 1974 to 1998

	MS	π_t–π_{t-12}	dy_t–dy_{t-12}	D or S	GS
1974	2	3.12	–3.45	–S	–2
1975	–2	–0.18	–2.42	–D	–2
1976	1	–2.88	4.63	+S	1
1977	–1	0.33	–2.76	–S	–2
1978	1	0.95	0.29	+D	1
1979	2	0.13	0.74	+D	0
1980	1	0.93	–2.15	–S	–2
1981	2	2.07	1.13	+D	–1
1982	–2	–1.43	–5.99	–D	0
1983	–2	–4.57	5.52	+S	0
1984	1	–1.51	2.97	+S	0
1985	–1	–0.33	–0.42	–D	–2
1986	0	0.22	–2.44	–S	2
1987	–1	0.16	1.16	+D	–1
1988	1	–0.28	0.60	+S	–2
1989	2	0.89	–2.25	–S	–1
1990	1	–0.20	–1.84	–D	–2
1991	–2	–0.91	–1.80	–D	1
1992	–2	–2.28	2.24	+S	1
1993	–2	0.38	1.60	+D	2
1994	0	–0.48	2.04	+S	1
1995	1	0.89	–1.86	–S	2
1996	–2	–0.70	–1.09	–D	2
1997	–1	0.07	2.53	+D	1
1998	1	–0.65	–1.17	–D	0

Notes: Column 2 reports the normalized policy stance (MS) we calculated. The scale –2 to –1 denotes “very loose” to “mildly loose,” 0 denotes “neutral,” and 1 to 2 denotes “mildly tight” to “very tight.” The 1-year changes in inflation are in column 3, and the 1-year changes in GDP growth are in column 4. In column 5 the year is labelled as demand-shock (D)- or supply-shock (S)-dominated according to the co-movements of inflation and output growth. The + and – signs denote positive shocks and negative shocks. Government-spending shocks (GS) reported in column 6 are estimated based on an AR(4) process. The normalized scale –2 to 2 denotes a range from a large positive shock (expansionary fiscal policy) to a large negative shock (contractionary fiscal policy).

transmission mechanism; i.e., following an expansionary policy shock, the interest rate and the term spread decline, output and the price level increase, and the Canadian dollar depreciates relative to the U.S. dollar.

The stance measure derived from the model is broadly consistent with the historical performance of monetary policy with respect to the developments of inflation and output growth. Among the four variables considered in the stance, only the overnight rate plays a significant role. This result is robust across the two subsamples considered. Our results also suggest that, in general, the Bank does not respond vigorously to contemporaneous surprises in the credit market and the exchange rate. This is consistent with the fact that the Bank does not target the exchange rate, but acts only to smooth the change in the exchange rate to avoid disruption to financial markets. We also find that the policy shocks and policy stance are quite consistent with the historical record of inflation and output growth. Finally, the empirical evidence suggests that monetary policy plays an important role in affecting short-term aggregate demand and inflation dynamics.

Parameter instability is always a concern in time-series analysis because of policy regime switches, financial innovations, and other structural changes. In the subsample estimations we observe different parameter estimates and dynamic responses of output and the price level. In the future we will re-examine this issue by considering several non-linear regression models, such as time-varying parameter models (Boivin 1999), smooth transitional regression models (Weiss 1999), and threshold models (Choi 1999). Non-linear analysis is more suited to dealing with parameter instability because, for example, regime shifts can be determined by the data rather than by subjective judgment.

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Discussion

Frank Smets

Introduction

It is a real pleasure to take part in this conference and discuss the paper by Ben Fung and Mingwei Yuan. I have followed the Bank of Canada's conferences for several years now and always very much appreciated the high-calibre, focused, and policy-relevant papers that are presented here (and their paper is no exception to this rule). Moreover, this year's conference has a special focus on money and the role of money in monetary policy, and as you may know, money plays a special role in the monetary policy strategy of the European Central Bank (ECB). In its attempt to maintain price stability, the ECB uses a two-pillar strategy consisting of a prominent role for money in the form of a reference value for growth in M3 and a so-called broadly based assessment of the outlook for price developments and the risks to price stability. We are thus very interested in hearing about the role of money in a somewhat different monetary policy framework such as that of the Bank of Canada.

But back to the Fung and Yuan paper. Let me start by saying that I very much enjoyed reading this paper. It is well written, addresses a very interesting policy issue, and produces some interesting results. I will divide my comments into two parts. In the first part I will focus on the authors' implementation of the Bernanke-Mihov methodology, in particular their choice of policy variables and identification scheme. In the second part I will discuss more generally how to measure the stance of monetary policy (following Blinder's suggestion) and will suggest an alternative VAR methodology for this purpose.

1 Identifying Monetary Policy Shocks

As Fung and Yuan discuss, Bernanke and Mihov (1998) distinguished between policy variables and non-policy variables. Fung and Yuan choose non-policy variables (variables not contemporaneously affected by policy) that are similar to those used in the literature. However, they depart from the literature in, first, their choice of policy variables and, second, their short-run identification scheme to identify the policy shock using the policy variables they have chosen. I will discuss both in turn.

1.1 Choice of policy variables

In addition to using the most commonly used indicator of monetary policy, a policy-controlled interest rate, Fung and Yuan include three other variables: the exchange rate, the term spread between the 3-month rate and the 10-year government bond yield, and the monetary aggregate M1. The importance of the short-term interest rate and the exchange rate for measuring the stance of monetary policy in an open economy is well understood. These two variables are included in the MCI because they reflect the two most important transmission channels of monetary policy in the Canadian economy. This is discussed in Freedman (1994) and Longworth and Poloz (1995), and has also been reflected in the VAR literature, which tries to identify monetary policy shocks in open economies—see, for example, Cushman and Zha (1997) for Canada and Smets and Wouters (1999) for Germany.

A natural question is, Why do Fung and Yuan include the term spread and M1 in the VAR? They give some indication in their introduction, but I think a more extensive discussion is appropriate. In particular, there are two reasons why such financial variables may enter a policy reaction function and thus become important in identifying monetary policy shocks. One reason is that these variables play a role in the transmission mechanism. A second reason is that they contain information about future output and inflation, information that is not captured by the other variables.

It is quite important to distinguish between those two reasons in the context of Fung and Yuan’s paper because one may argue that if the main reason for responding to a policy variable is its information content, a reason that seems to be implied by some of their introductory discussion, then it is not clear that the policy variable should necessarily be incorporated in a measure of the stance of policy. Such a measure should include only financial variables that play a structural role in the transmission mechanism. For example, if developments in M1 have leading-indicator properties for real growth because agents hold more money in anticipation of stronger growth, then it may be appropriate for the central bank to respond to strong M1 growth by raising short-term interest rates. However, in the absence of a structural role in the transmission mechanism, such a rise in M1 growth should not be treated as an easing of the policy stance. This example shows that identifying the short-term reaction function of monetary policy does not necessarily imply that one has identified the appropriate weights on the various variables to measure the stance of policy.

More discussion of the transmission channels through M1 and the term spread would be useful because it would give an indication of the appropriate weight on these indicators in the stance measure. For example, what is the evidence of a direct-money channel that Fung and Yuan (page 234) discuss, and what form does that channel take? Does it have a real balance effect? Interestingly, McCallum (1999) calibrated the real balance effect in an otherwise-standard real business cycle model and found that for conventional parameters this effect should be quite small. Or do the authors have a bank-credit channel in mind? If so, what is the evidence for such a channel in Canada? Research presented at a previous Bank of Canada conference suggests that there is little evidence of such a narrow bank-lending channel in Canada.

Similarly, concerning the term spread, what channel (in addition to that working through the short-term rate) do Fung and Yuan have in mind? For example, do they think that changes in the risk premium on Canadian government bonds will spill over into risk premiums for the corporate sector and therefore affect spending? If this is the transmission channel envisaged, then one would expect that a fall in the term spread driven by a rise in the long-term rate would have a negative impact on economic activity and that the central bank would respond by lowering rates in response to an unexpected steepening of the term structure.

1.2 Identifying the policy shock

Identifying a monetary policy shock from a system of four highly interdependent financial variables is not easy. In equations (10) through (13), Fung and Yuan show the short-run model. Apart from the restriction that money-demand shocks have no impact on the interest rate set by the Bank of Canada, no obvious restrictions come to mind.[1] Nevertheless, they need three additional restrictions to identify the various money market shocks. They therefore assume that changes to the exchange rate are purely

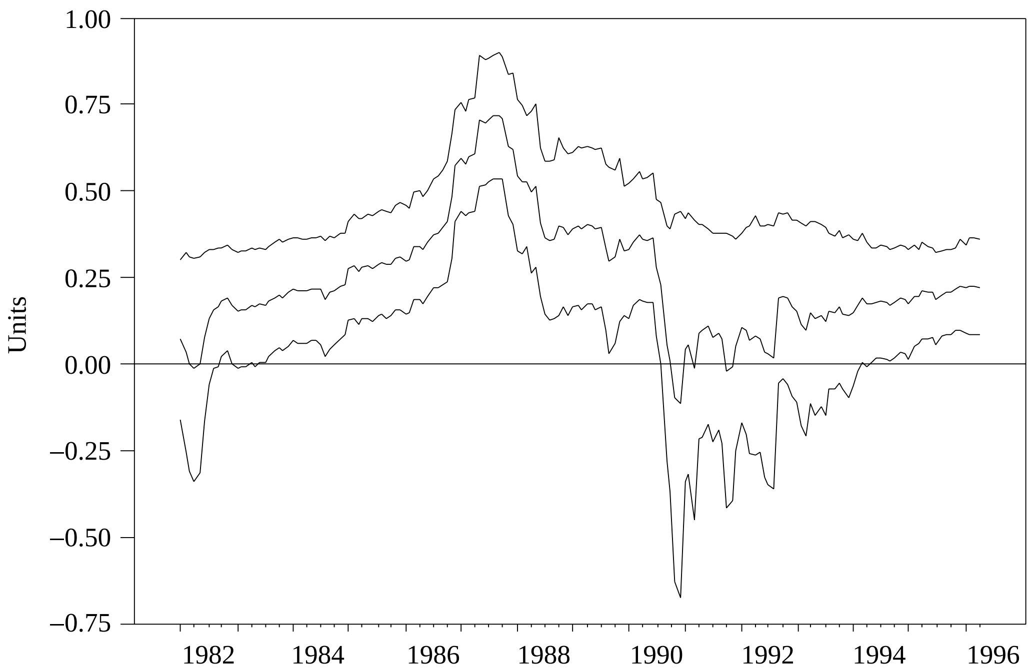
1. This restriction seems to suggest that there is no structural role for money in the transmission mechanism. Otherwise the central bank would find it optimal to offset such shocks.

random and are not contemporaneously determined by money-demand, policy, or term-structure shocks.

Because of the interest rate parity condition, assuming that the term-structure shocks have no direct effect on the exchange rate is clearly unattractive. For example, assume that for some reason the financial markets expect the Bank of Canada to raise rates in the future. This would lead to a contemporaneous steepening of the term structure and an appreciation of the exchange rate. With this shock the correlation between the term spread and the altered exchange rate would be the opposite of the one following an exchange rate shock. Even more importantly, current policy decisions would likely affect the current exchange rate through the interest rate parity condition. If such shocks occur, then imposing zero restrictions would result in a misspecification of the model and implicitly affect the weights on the various components of the policy shock. This misspecification may explain why the estimated weight on the exchange rate is insignificant and economically small. One advantage of having overidentified restrictions (as in Bernanke and Mihov 1998) is that the specification can be tested. However, without additional instruments it is difficult to see what alternative restrictions would be reasonable.

Most of the VAR literature has focused on trying to find such suitable instrument variables. Under the assumption that the monetary authority does not directly respond to the foreign interest rate, one commonly used instrument is the foreign interest rate innovation (Bernanke and Mihov 1997 and Clarida and Gertler 1997). Cushman and Zha (1997) applied the Sims and Zha (1998) identification scheme to an open-economy VAR for Canada. They assumed that the central bank only responds to current financial variables (such as the exchange rate) that are directly observed; the central bank does not react to current output and prices, which are only observed with a lag. However, the exchange rate is affected by all variables in the VAR, including current output and prices. Under these assumptions, changes in current output and prices can be used as instruments to estimate the policy reaction to the exchange rate. Finally, a number of authors, including Smets and Wouters (1999), have argued that foreign exchange rates can be used to identify exchange rate shocks. In some unpublished work for Canada I have used the DM/US$ and ¥/US$ bilateral exchange rates as instruments and found a quite significant reaction of monetary policy to exchange rate variables. This is, of course, consistent with the use of an MCI as an operational target at the Bank of Canada. At the same time, given the change in policy regime and the fact that the MCI was only used since the end of the 1980s, one would expect the estimated weight varies over time, and this is indeed the case. Figure 1 depicts the estimated MCI weight with a 95 per cent confidence interval (using a moving window of

Figure 1
Estimated MCI weight, Canada, 10-year moving window, 1982 to 1996, 95 per cent confidence interval



10 years) in an otherwise conventional VAR that includes real growth, inflation, a nominal trade-weighted exchange rate, and a short-term nominal interest rate.

2 The Stance of Monetary Policy

Fung and Yuan refer to Blinder (1998) when defining the stance of monetary policy as a quantitative measure of whether policy is too tight (restrictive), neutral, or too loose (accommodative) relative to the objective of keeping inflation constant. As they discuss, having a good stance measure is important because it allows the central bank to assess its policy's impact on the objective of price stability. Everything else being equal, a restrictive policy stance, when maintained, will eventually lead to deflation, whereas an accommodative policy stance will eventually lead to inflation.

The big question is, What is a neutral stance? Fung and Yuan provide two different policy stance measures that correspond to two different notions of the neutral stance and show their relationship with future price developments. The first measure, discussed in their section 4.3, is an 18-month moving average of the monetary policy shock. This measure basically compares actual policy with the central bank's average reaction function over the estimation period. Although such information is useful and gives an indication of the (limited, it is to be hoped) contribution of unexpected monetary policy changes to the economy's volatility, this measure is not the one Blinder (1998) proposed, as I will discuss below. Moreover, given the inflation performance over the estimation period, it is clear that whatever the central bank's average reaction function was over this period, it was not appropriate with respect to the goal of price stability as currently defined by the Bank of Canada.

I have three further remarks on this particular measure. First, it surprises me that the admittedly smoothed measures of monetary policy deviations are so persistent. If these shocks are independent and identically distributed as they should be, then taking a moving average should quickly bring them to zero. Second, this analysis depends very much on the stability of the reaction function over the estimation period. As Fung and Yuan at various stages emphasize that the monetary policy regime has changed over this period, it would be interesting to see whether the analysis, now based on the whole sample, holds true for the shorter samples. In fact, the shifts in policy regime may well explain why the shocks are relatively persistent. Third, in their Figure 3 the authors should use a historical decomposition of inflation using the estimated VAR. Such a historical decomposition gives a direct measure of the estimated contribution of the policy shocks to the developments in inflation—see, for example, Gerlach and Smets (1995).

The second measure of the policy stance is discussed in Fung and Yuan's sections 4.4 and 4.5. In these sections they follow Bernanke and Mihov (1998), applying the estimated weights in the identification procedure of the policy shock to the endogenous policy variables and normalizing the stance at each date by subtracting from it an 18-month moving average of its own past values. This procedure defines the average stance in the last 18 months as the benchmark of neutral policy. I have two remarks about this. First, this choice is obviously arbitrary, and it would be useful to discuss a bit further why an 18-month average was chosen and to see whether different windows produce different results. Second, it is not clear why this measure should be related to future output and inflation. The association between this measure and future output and inflation depends on the source of the shock that drives the changes in the financial variables. In interpreting this measure, Fung and Yuan therefore face the same problem as the one they identify in their introduction with using the MCI as a measure of the policy stance.

In sum, both measures are problematic because they do not use a satisfactory definition of the neutral stance. To solve this problem one needs to define the long-run equilibrium values of the various components in the measure of policy stance. Here it is useful to review what Blinder had in mind with his definition of the neutral stance.

In the context of a relatively closed economy, Blinder (1998, 32) noted that

> at any point in time, given all the standard determinants of aggregate demand—including fiscal policy, the exchange rate, and the spending propensities of consumers and investors—the economy has some *steady-state IS curve* [author's italics]. By this I mean the IS curve that will prevail once all the lags have worked themselves out, and provided all random shocks are set to zero.

He then defined "the neutral real interest rate . . . . as the interest rate that equates GDP along this steady-state IS curve to potential GDP . . . ." As a result, "the neutral real interest rate is not a fixed number. It depends, among other things, on fiscal policy and the exchange rate; and it is sensitive to other *permanent* [my italics] (though not temporary) IS shocks." The big problem when empirically implementing the Blinder definition is that one needs to distinguish between permanent and temporary shocks to the IS curve. In a way, Blinder used the steady-state IS curve to filter out transitory fluctuations in demand and focus on longer run factors. Durable IS shocks do change the neutral real interest rate, but temporary shocks do not.

This emphasis on the need to distinguish between temporary and permanent shocks to the real interest rate suggests that an alternative VAR methodology, based on long-run identification restrictions, may be more fruitful for uncovering a measure of the policy stance. Using the common-trends methodology of King et al. (1991), we could define the neutral real interest rate as that part of the interest rate that is driven by the stochastic trends in the model. Obviously, for an open economy such as Canada the model would need to be extended in order to also uncover the long-run trends that govern the equilibrium real exchange rate, as is done, for example, in Clarida and Galí (1994). The measure of monetary policy stance could then be defined as the deviation of the weighted average of actual policy variables from their long-run value.

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Discussion

Sharon Kozicki

What is the current stance of monetary policy? The answer is an important piece of information for those who craft monetary policy. When assessing whether current policy should be adjusted, policy-makers like to have reliable benchmarks. A stance measure that indicates whether current policy is tight, neutral, or loose would be very useful. Fung and Yuan set out to provide such a benchmark for Canada in the form of a single-dimensioned variable that measures the stance of monetary policy relative to an objective of keeping inflation constant.[1]

Fung and Yuan construct their stance measure as a linear combination of observable variables and normalize it so that a stance measure of 0 means a neutral policy. In my comments I will divide their procedure into two steps. In the first step, Fung and Yuan decide what variables to include in the policy block and estimate the weights to be applied to those variables. In the second step, they assess what level of the stance measure, before normalization, corresponds to neutral policy.

I will comment on Fung and Yuan's procedures and offer my interpretations of their results. I have two main observations. Interestingly, the empirical results suggest that the overnight rate summarizes *all* relevant information about the stance of monetary policy in Canada from a candidate

1. Fung and Yuan define their measure of the stance of monetary policy relative to an objective of keeping inflation constant. According to their definition the stance is considered neutral if it is consistent with constant inflation in the medium run. Alternative definitions are possible. For instance, if a central bank is targeting inflation, then an alternative definition of the stance could be made relative to the central bank's target for inflation or to the midpoint of the central bank's target band for inflation. One advantage of the definition Fung and Yuan choose is that it can be applied in situations where inflation targets are not announced.

list of variables including M1, the term spread, the overnight rate, and the exchange rate. However, I don't think that Fung and Yuan's empirical representation of neutral monetary policy corresponds to their conceptual definition of it. Consequently, although the Fung-Yuan stance measure may provide information about relative ease or tightness of policy in Canada, I don't think it quantifies policy in an absolute sense as tight, neutral, or easy.

1 Variables and Weights

My first set of comments addresses issues related to policy-block variables and weights. Fung and Yuan follow the VAR-based approach of Bernanke and Mihov (1998) to estimate weights to be used in their quantitative measure of the stance of monetary policy in Canada. In the Bernanke-Mihov approach the stance is defined as an unobserved variable that is constructed as a linear combination of policy-block variables. The weights used in the linear combination depend on the identifying assumptions and structural VAR techniques that are used to recover structural shocks in the policy block—different assumptions could lead to different weights. I will comment briefly on the policy-block variables, the identification of structural shocks, and the interpretation of the policy stance measure (before normalization).

1.1 The policy block

The policy block contains a set of variables that are potentially useful as indicators of the stance of monetary policy. Fung and Yuan note that the central bank might not have complete control over the policy-block variables, because such variables are also influenced by other shocks, but the bank might have significant influence on these variables in the current period. The literature provides a long list of candidate variables that may provide information on the stance of monetary policy. The MCI, measures of the exchange rate, and short-maturity interest rates are obvious candidates for Canada. In the United States the federal funds rate is frequently used in empirical studies as an indicator of policy stance. Variations on these themes include real short-maturity interest rates and spreads between long- and short-maturity rates. Measures of money and reserves are other obvious candidates. The four variables that Fung and Yuan include in their policy block are real M1, the term spread, the overnight rate, and the exchange rate.

Fung and Yuan define the stance of monetary policy as a linear combination of these four variables, normalized by a quantitative measure of neutral. Is this reasonable? Perhaps not, according to Fung and Yuan themselves. In their introduction they note that the MCI can be interpreted as a measure of the ease or tightness in monetary conditions relative to a base period, but they criticize interpreting the MCI as a stance measure because the MCI reflects non-policy-related changes in the interest rate and exchange rate. In their words, “the stance of monetary policy should capture only central bank actions” (page 234). But does the newly proposed definition of the stance satisfy this condition? Because the proposed definition also may reflect non-policy-related changes in money, interest rates, and the exchange rate, it may not satisfy this condition. However, this concern may not be problematic, given the specific weight estimates in the paper and my discussion below (section 1.3).

1.2 Identifying structural shocks

Are the identifying assumptions reasonable? This is a standard issue when structural VAR techniques are used. The proposed stance measure is a weighted combination of policy-block variables. Weights depend on identifying assumptions used to recover structural shocks in the policy block; different assumptions could result in different weights. Consequently, the results in their paper and my comments are contingent on the identifying assumptions that Fung and Yuan have made.

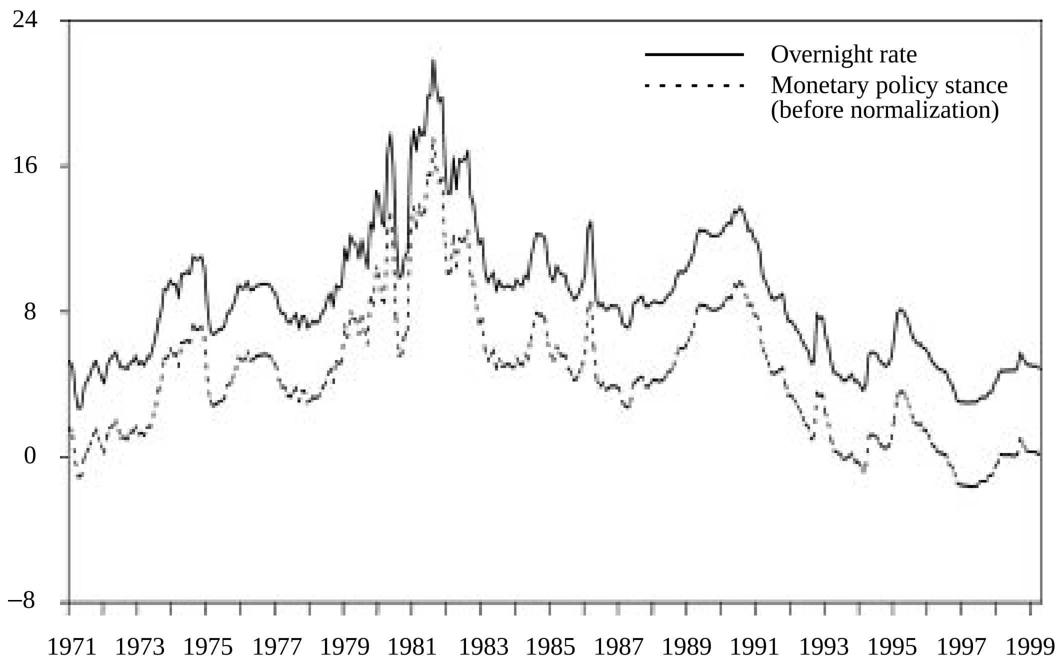
1.3 Policy stance versus the overnight rate

Do estimated weights provide any insight into the policy stance measure? Standard errors of estimated weights suggest that only the weight on the overnight rate is significantly different from 0. Furthermore, the estimated weight on the overnight rate is not significantly different from 1. Although Fung and Yuan did not examine it, I would be interested in knowing whether the joint null hypothesis H_0: $w_M = w_{TS} = w_{PFX} = 0, w_{RON} = 1$ would be rejected. If it were not rejected, then the empirical results would suggest that the overnight rate summarizes *all* the statistically significant information about the stance of Canada’s monetary policy from a candidate list of variables including M1, the term spread, the overnight rate, and the exchange rate.

To graphically examine the extent to which the overnight rate summarizes the relevant information about the stance of Canada’s monetary policy, I have prepared two figures. Figure 1 shows the overnight rate and the monetary policy stance measure before normalization. The not-normalized stance measure was constructed as

$$w_M\ M + w_{TS}\ TS + w_{RON}\ RON + w_{PFX}\ PFX\ ,$$

Figure 1
Monetary policy stance (before normalization) and the overnight rate



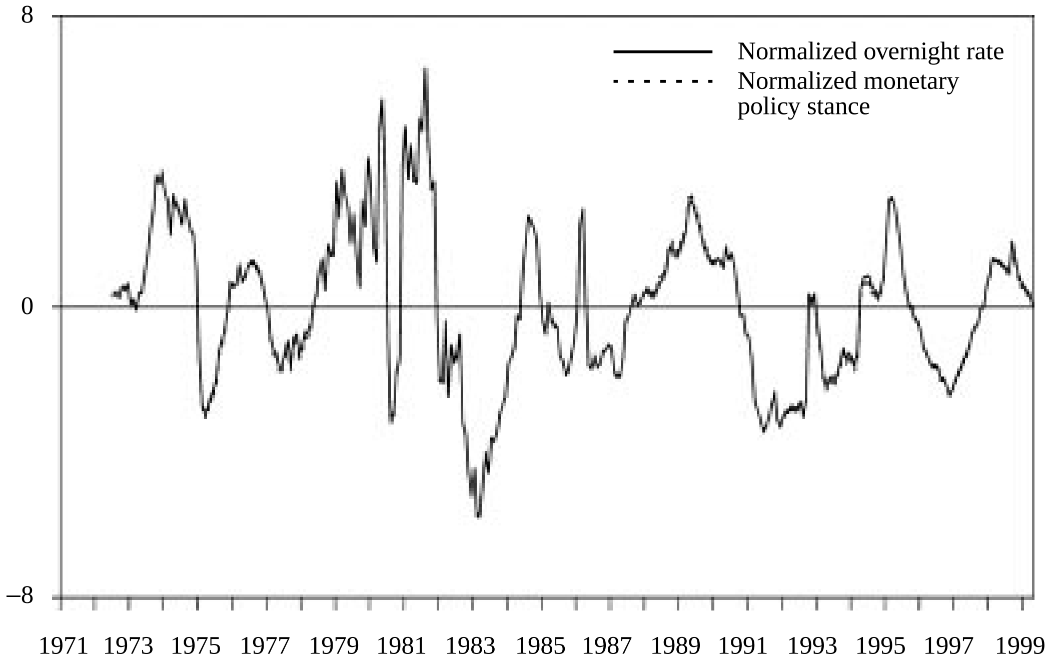
using Fung and Yuan's full-sample estimated weights and data for the natural logarithm of real M1 (*M*), the term spread (*TS*), the overnight rate (*RON*), and the natural logarithm of the Can$/US$ exchange rate (*PFX*). The not-normalized stance measure differs from the overnight rate primarily by a level shift. Variation in the two series is remarkably similar.

Figure 2 shows the normalized monetary policy stance measure and a normalized version of the overnight rate. Each series is normalized by subtracting from the not-normalized version of the series an 18-month moving average of its own past values. The two series are almost identical. These results suggest that Fung and Yuan (page 249) understate their conclusions when they find that "the overnight rate contains the most significant amount of information about policy stance." In fact, it appears that the overnight rate contains *all* the policy block's information about policy stance.

2 Quantifying Neutral Policy

My second set of comments addresses the procedure Fung and Yuan use to quantify neutral policy (i.e., to normalize the stance measure). Without normalization the stance measure provides some information on the *relative*

Figure 2
Normalized monetary policy stance and overnight rate



stance of policy, but does a poor job of describing its *absolute* stance. For instance, a specific value of the overnight rate might represent “easy” policy when expected inflation is high, but “tight” policy when expected inflation is low (Bernanke and Blinder 1992). The not-normalized stance measure may help establish whether policy is tighter or easier than in a not-distant period when inflation expectations were similar, but it isn’t very helpful in establishing whether policy in any given period is tight or easy.

My main criticism lies with Fung and Yuan’s empirical definition of neutral monetary policy. I don’t think that their empirical representation corresponds to their conceptual definition. Empirically, neutral monetary policy is defined as an 18-month moving average of the not-normalized stance measure.[2] Conceptually a neutral monetary policy stance is defined as consistent with constant inflation in the medium run.[3]

Fung and Yuan’s stance measure is normalized so that 0 is the benchmark of neutral monetary policy. Since their normalization procedure subtracts an 18-month moving average of the not-normalized stance

2. Bernanke and Mihov normalized their policy stance measure by subtracting from it a 36-month moving average of its own past values. Consequently, similar concerns to those raised in this section may apply to Bernanke and Mihov’s normalization.

3. I prefer the conceptual definition of neutral to the empirical definition. In general, I don’t support using moving averages as representative of a neutral benchmark for normalization.

measure from itself, they are defining a neutral stance as the 18-month moving average. For this to be consistent with their conceptual definition of neutral, they are assuming that average policy over every 18-month period is neutral and consistent with constant inflation in the medium run.

I believe that this assumption is unreasonable. Presumably, if average policy were consistent with constant inflation over a moderate horizon, then roughly stable inflation rates should be observed. However, inflation rates moved considerably in 1971–82 and 1991–92. Average policy over the 18-month periods before and during most of these intervals was likely not consistent with constant inflation. In contrast, inflation rates were relatively stable from 1983 to 1990 and from 1992 to 1999. It might be reasonable to assume that policy was, on average, consistent with constant inflation over a portion of these two subsamples. This might explain why, as the middle panel of Fung and Yuan's Figure 4 shows, their stance measure seems to provide information on the direction of future inflation movements over the period 1985 to 1990.

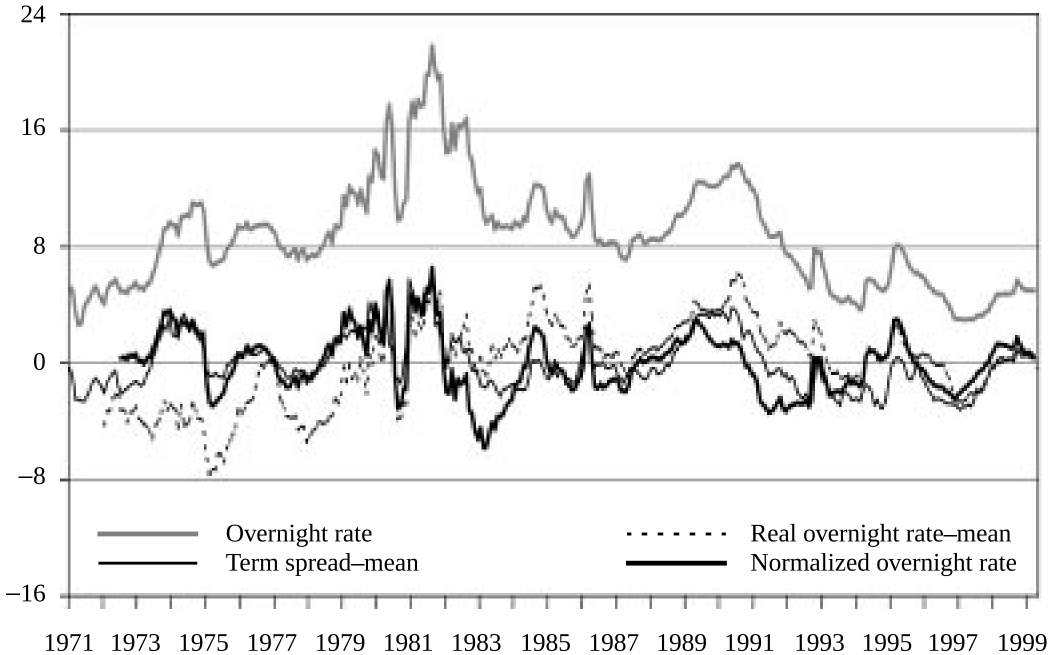
Although I disagree with the empirical representation of neutral policy as an 18-month moving average of the not-normalized stance measure, Fung and Yuan's stance measure does resemble other proposed indicators of the stance. Figure 3 (in this paper) compares the normalized overnight rate with the overnight rate, the difference between the term spread and its sample mean, and the difference between the real overnight rate and its sample mean.[4] Fung and Yuan's measure is not included because it is virtually identical to the normalized overnight rate. High-frequency variation in all four series is similar—most likely because the overnight rate, or another short rate, is the dominant source of high-frequency variation in all four series. The lower three measures in the figure have been adjusted in a way to suggest that positive values indicate tight policy and negative values indicate loose policy. Although these three measures are similar, the signals from the series do not always agree. Divergence is greatest in 1972–73, 1982–84, and 1990–92—periods in which the level of inflation changed considerably.

Concluding Comments

Fung and Yuan set out to empirically answer a very important question: What is the stance of monetary policy? I suggest two modifications to their conclusions. First, the empirical results suggest that the overnight rate summarizes *all* relevant information about the stance of monetary policy in

4. The real overnight rate is constructed as the difference between the overnight rate and inflation over the previous 12 months.

Figure 3
Comparison of measures of the stance of monetary policy



Canada—given the variables they included in the policy block and the assumptions they made to identify structural policy shocks. Second, the proposed stance measure provides information on the relative stance of policy, but it would be premature to claim that the difficulties associated with identifying the absolute stance of policy have been solved.

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General Discussion*

Comments by both Frank Smets and Sharon Kozicki had referred to the choice of variables that Ben Fung and Mingwei Yuan consider in the policy block—the overnight rate, M1, the term spread, and the price of foreign exchange. In addressing the issue of the relative information these four financial variables contain, Fung argued that their choice reflects his and Yuan's intention to capture several channels for the transmission mechanism of monetary policy: the interest rate channel, the money channel, the credit channel, and the exchange rate channel.

Responding to the discussants' comments regarding the identification scheme he and Fung use, Yuan noted that by relaxing the restrictions on the weights of the four variables, he and Fung are attempting to relax prior restrictions on these variables. Fung underlined the difficulty of imposing the right restrictions. The model is allowed to decide upon the right identification scheme so that the authors may use the data as an indicator of the right identifying assumptions.

Fung and Yuan's partial use of Blinder's (1998) approach was another subject discussed by Smets, who had suggested a more complete application of Blinder's methodology. While mentioning that a certain amount of work already in progress at the Bank of Canada is attempting to estimate the neutral interest rate, Yuan noted that the framework they use in their paper allows them to easily capture different types of shocks to the economy, such as technology shocks incorporated in output or price shocks incorporated in the CPI. Isolating this type of shock from monetary policy shocks could yield insights into the transmission mechanism of monetary policy.

* Prepared by Marllena Ifrim.

Fung and Yuan's finding that the overnight rate contains almost all relevant information about the stance of monetary policy prompted Kozicki to remark that this result should be conditioned on the variables in the policy block and the identifying assumptions. Replying to comments about the relative, as opposed to absolute, character of the proposed measure of the stance of monetary policy, Yuan highlighted the major difficulties still facing analysts in defining neutral policy. However, the usefulness of having a reliable relative stance for monetary policy, especially in a context where a monetary policy regime changes as a result of financial innovations, renders value to their exercise.

Referring to the informational content of the overnight rate, Seamus Hogan was puzzled by Fung and Yuan's conclusion that the overnight rate summarizes 99 per cent of the information relevant to the monetary policy stance. He noted that a stance measure should be zero when monetary policy is neutral, and a given deviation should have the same meaning in any given period. Reminding the audience that the MCI is a difficult concept to use because the equilibrium exchange rate is so uncertain and variable, he pointed out that the MCI does not have the same meaning in any given period. Hogan also said that the finding about the overnight rate may indicate difficulties in identifying the neutral policy level of the other three financial variables rather than a lack of information (relevant to the policy stance) within these variables.

In addressing these comments, Yuan referred to the conceptual difference between the MCI and the monetary policy stance, arguing that the stance is solely controlled by the monetary authority, whereas the MCI reflects an overall condition of the economy. He emphasized that the overnight rate's dominance is an empirical result and that their method does not restrict a priori other variables' influence.

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