Interpreting a Monetary Conditions Index in economic policy

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Introduction

The main purpose of this paper is to review and interpret the use of a Monetary Conditions Index (or MCI) by central banks in the conduct of monetary policy. Numerous central banks, governmental organizations, and businesses now calculate an MCI as an indicator of the stance of monetary policy. Two central banks, those for Canada and New Zealand, use their MCIs as operational targets.

This paper describes and defines the concept of an MCI, summarizes how central banks implement MCIs in practice, reviews some of the operational and conceptual issues involved, and evaluates the sensitivity of MCIs to an inherent source of uncertainty in their calculation. Empirically, this uncertainty typically results in MCIs that are uninformative as indicators of monetary conditions, so some possible alternatives are briefly considered.

1. A Monetary Conditions Index in practice

Several central banks calculate a Monetary Conditions Index for use in monetary policy. Empirically, an MCI is a weighted average of changes in an interest rate and an exchange rate relative to their values in a base period. The weights on the interest rate and exchange rate reflect the estimated relative effects of those variables on aggregate demand over some period, often approximately two years. MCIs are currently used as indicators of monetary conditions and as operational short-run targets for monetary policy.

A Monetary Conditions Index has several attractive features. Its motivation is simple: exchange rates influence aggregate demand, especially in small open economies. Thus, focusing on exchange rates as well as interest rates may be important in understanding an economy's behavior, and so in policymaking. Also, an MCI is easy to calculate. For central banks, an MCI is an intuitively

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appealing operational target for monetary policy. It generalizes interest-rate targeting to include effects of exchange rates on an open economy, and it serves as a model-based policy guide between formal model forecasts. For institutions other than central banks, an MCI as an index per se may capture both domestic and foreign influences on the general monetary conditions of a country.

MCIs have gained widespread use. The central banks of Canada, New Zealand, Norway, and Sweden each have published an MCI and, to varying degrees, use their respective indexes in the conduct of monetary policy. Additionally, the International Monetary Fund (IMF) and the Organisation for Economic Co-operation and Development (OECD) calculate MCIs for evaluating the monetary policies of many countries; and firms such as Deutsche Bank, Goldman Sachs, JP Morgan, and Merrill Lynch publish MCIs to ascertain the general monetary environment in various countries.

An MCI assumes an underlying model relating economic activity and inflation to the variables in the MCI, with the weights in the MCI reflecting the effects of the interest rate and exchange rate on aggregate demand. Being model-based, those variables' effects are estimated, and the corresponding coefficients have an associated uncertainty from estimation. This paper shows that, empirically, this uncertainty typically renders MCIs uninformative for their ostensible purposes.

Sections 2 and 3 provide a foundation for understanding MCIs in practice, and hence for understanding how estimation uncertainty impinges on their use. Section 2 describes and defines the Bank of Canada's Monetary Conditions Index, summarizes how the Bank utilizes its MCI in conducting monetary policy, reviews some operational considerations, and documents MCI usage by other institutions and for other countries. Section 3 analyzes two facets in the design of an MCI: the choice of weights and variables, and the assumptions of the underlying empirical model. Section 4 presents confidence intervals of estimated relative MCI weights derived from models for Canada, New Zealand, Norway, Sweden, and the United States. In light of the (often) extreme uncertainty present in calculating MCIs, Section 4 then considers some possible alternatives. While intuitively appealing, an MCI appears fraught with difficulties as an indicator of monetary stance and as an operational target for monetary policy.

A previous paper, Eika, Ericsson, and Nymoen (1996a), derives analytical and empirical properties of MCIs in an attempt to ascertain their usefulness in monetary policy. The current paper complements Eika, Ericsson, and Nymoen (1996a) by focusing on the practical implementation of an MCI and the degree to which implementation is affected by uncertainty in the estimated weights.

2. Construction and use of MCIs

The concept of a Monetary Conditions Index was developed at the Bank of Canada and has been used there more extensively than elsewhere, so this section begins by describing the Bank's MCI (Section 2.1), its implementation in practice (Section 2.2), and operational considerations (Section 2.3). Section 2.4 considers MCIs used by other institutions and for other countries. The discussion in the first three subsections relies heavily on Duguay and Poloz (1994), Poloz, Rose, and Tetlow (1994), and Longworth and Freedman (1995) for the role of the Bank's quarterly model in monetary policy; on the Bank of Canada (1994, 1995), Barker (1996), and Zelmer (1996) for details on the MCI itself; on Freedman (1994) for the justification of an MCI in monetary policy; and especially on Freedman (1995) and Thiessen (1995) for overviews encompassing all of these issues.

2.1 Construction of the Bank of Canada's MCI

For the last several years, the Bank of Canada has used an MCI as an operational target in setting monetary policy. This subsection defines the construction of the MCI, briefly describes its empirical underpinnings, and interprets the generated index.

The Bank's MCI is a weighted sum of changes in the nominal Canadian 90-day commercial paper interest rate (R) and a nominal G-10 bilateral trade-weighted exchange rate index

(E), where both variables are relative to values in a base period. The weights on the interest rate and exchange rate reflect their estimated relative effects on Canadian output. The Bank of Canada uses weights of 3 to 1, interest rate to exchange rate. That is, a one percentage point increase in the interest rate induces three times the change in the Bank's MCI as would a 1% appreciation of the Canadian dollar. Algebraically, it is convenient to write the MCI as:

$$MCI_t = \theta_R(R_t - R_0) + \theta_e(e_t - e_0), \qquad (1)$$

where t is a time index, $t = 0$ is the base period, θ_R and θ_e are the respective weights on the interest rate and the exchange rate, and variables in lower case denote logarithms. Thus, the calculated MCI depends upon the weights θ_R and θ_e, the measures of the exchange rate and the interest rate, and the base period. Usually, the exchange rate in (1) is in logarithms or in percent deviations from its baseline value, whereas the interest rate is in levels. Below, logarithms of the exchange rate generally are used, and the choice makes little difference for the countries and sample periods involved.

The relative weight of 3 is derived from a range of econometric evidence on the determinants of aggregate demand. As discussed in Freedman (1994, pp. 469–70 and footnote 27), Duguay's (1994) results are typical of that evidence, so we focus on a representative regression from that paper, Duguay (1994, p. 50, Table 1, column 7):

$$\begin{array}{llllll} \Delta y_t = & +0.13 + & 0.52\Delta y_t^* & + 0.45\Delta y_{t-1}^* & - 0.40[\Delta_8 RR_t/8] & - 0.15[\Delta_{12} q_t/12] \\ & (0.13) & (0.11) & (0.11) & (0.22) & (0.12) \end{array} \qquad (2)$$

$$T = 44[1980(1) - 1990(4)] \qquad \bar{R}^2 = 0.64 \qquad \hat{\sigma} = 0.62\% \qquad dw = 1.96.$$

The series are all quarterly and include real Canadian GDP (Y) and real US GDP (Y^*); and Δ is the first difference operator.[1] The real interest rate *(RR)* is constructed as the nominal 90-day commercial paper interest rate (R) minus the one-quarter lag in the annual rate of change of the Canadian GDP deflator (P). That is, $RR_t = R_t - \Delta_4 p_{t-1}$. The real exchange rate (Q) is the product of the nominal bilateral US-Canadadian exchange rate (E, in US dollars per Canadian dollar) and the ratio of the Canadian GDP deflator to the US GDP deflator (P^*): i.e., $Q = E \bullet (P/P^*)$. Thus, an increase in Q represents an appreciation of the Canadian real exchange rate. The symbols T, $\bar{R}^2$, $\hat{\sigma}$, and dw denote the sample size of the estimation period, the adjusted squared multiple correlation coefficient, the estimated equation standard error, and the Durbin-Watson statistic respectively. The coefficients are estimated by least squares, and estimated standard errors are in parentheses.[2]

In (2), the ratio of the coefficients on the interest rate and the exchange rate is (–0.40)/(–0.15) or 2.67, which is virtually the relative weight of 3 used by the Bank of Canada. While the relative weight is based on estimated relations with real interest rates and exchange rates, the Bank applies the weight to an index with the corresponding nominal variables. Switching from real to nominal variables is convenient operationally, and it has been defended by the short horizon for MCI-based monetary policy and the near constancy of inflation and relative prices over that horizon.

Figure 1 plots the Bank's Monetary Conditions Index. A decline in the interest rate increases aggregate demand and lowers the MCI, as does a depreciation of the Canadian dollar, so a

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[1] The difference operator Δ is defined as $(1\text{-}L)$, where the lag operator L shifts a variable one period into the past. Hence, for x_t (a variable x at time t), $Lx_t = x_{t-1}$ and so $\Delta x_t = x_t - x_{t-1}$. More generally, $\Delta_j^i x_t = (1-L^j)^i x_t$. If i (or j) is undefined, it is taken to be unity.

[2] A minor notational and empirical discrepancy exists between (1) and (2), in that E in the former is the G-10 trade-weighted exchange rate whereas E (through Q) in the latter is the bilateral US-Canadian exchange rate. This distinction is maintained below. MCIs for Canada use the G-10 trade-weighted exchange rate, whereas regressions for Canada use the bilateral US-Canadian exchange rate. Choice between the two exchange rates should make only a minor difference: the US-Canadian exchange rate dominates the G-10 trade-weighted exchange rate, with the former receiving a weight of over 80% in the latter.

Figure 1

The Canadian MCI evaluated at a relative weight of 3

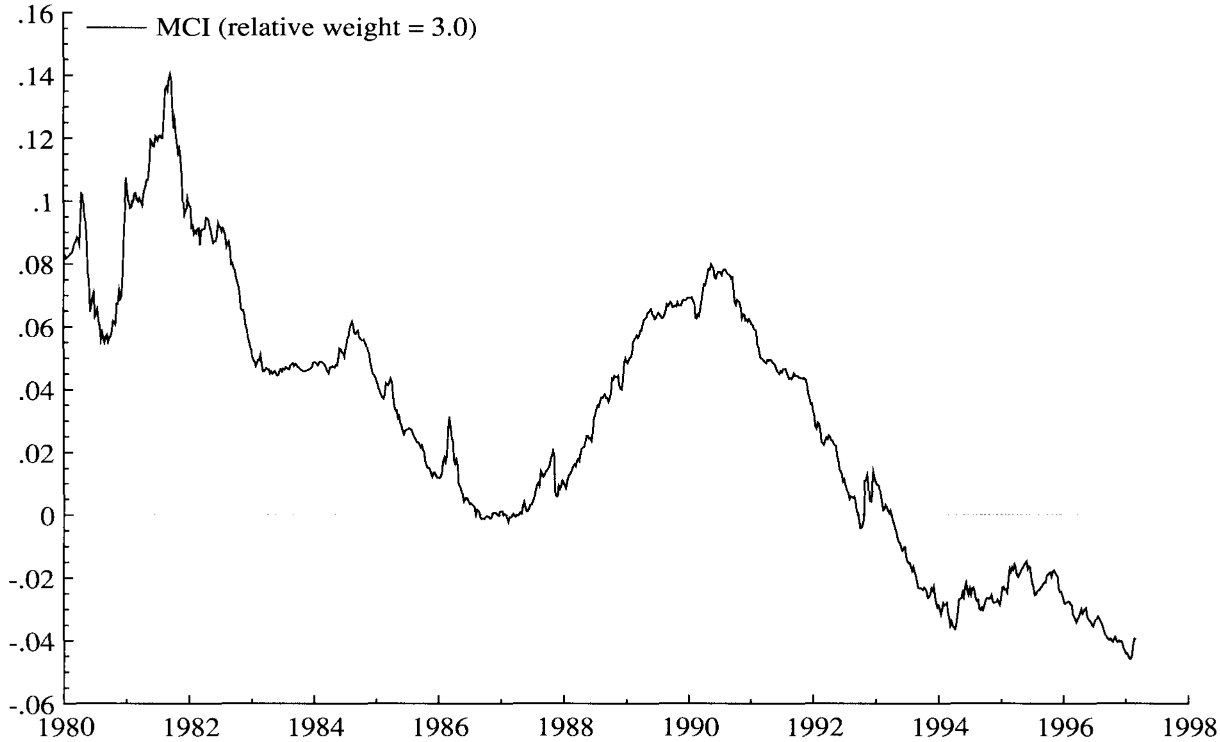
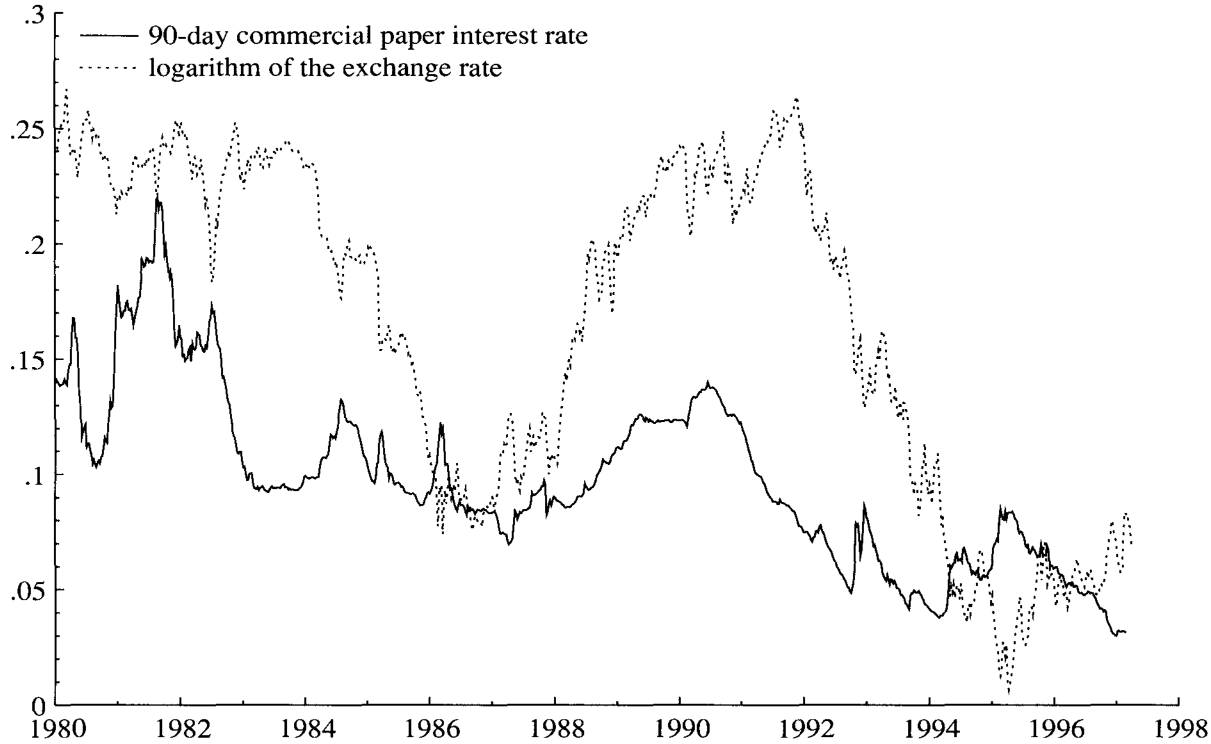


Figure 2

The components of the Canadian MCI: the 90-day commercial paper interest rate and the logarithm of the exchange rate



fall in the index is interpreted as a loosening of monetary conditions. As a policy indicator, the MCI aims to keep track of both interest rate and exchange rate movements and their effects on aggregate demand. From 1990 through 1993, the MCI fell steadily, signaling a general loosening of monetary conditions. In 1994 and early 1995, conditions tightened. Thereafter, the index resumed falling.

In Figure 1 and in all other figures of MCIs herein, each MCI is scaled such that its weights sum to unity, i.e., $\theta_R + \theta_e = 1$. A plotted MCI is thus always in units equivalent to the interest rate, measured as a fraction, thereby permitting easy interpretation of and comparison across different MCIs. For instance, the decline in the Canadian MCI from 1990 to 1994 is interpreted as the equivalent of a 12 percentage point (1,200 basis point) decline in the interest rate. Roughly half of this decline is due to the 20% depreciation of the Canadian dollar over that period, leading to Figure 2.

Figure 2 shows the two components of the MCI: the nominal 90-day commercial paper rate and the logarithm of the nominal G-10 trade-weighted Canadian dollar. During 1990 and 1991, the Canadian dollar remained relatively constant while the interest rate declined, with the latter variable being primarily responsible for the fall in the MCI. In 1992 and 1993, both variables moved downward, with both contributing to the MCI's continued fall. From 1994 onward, the two variables have moved in opposite directions, offsetting each other's movements to some extent.

2.2 The Bank of Canada's MCI as an operational target

The Bank of Canada has used its MCI as an operational target for several years. This subsection describes how the Bank has done so, focusing on the role played by the Bank's econometric model.

The Bank of Canada calculates a desired or target path for the MCI from interest rate and exchange rate forecasts from the Bank's Quarterly Projection Model (or QPM). The QPM includes equations for output growth (similar to (2)), inflation, and the exchange rate. In the model, interest rates and exchange rates influence output, which in turn influences inflation through a Phillips curve relationship. The exchange rate is determined through an uncovered interest rate parity condition with a risk premium. Additionally, the model incorporates a monetary response function, which is designed to bring inflation back to the midpoint of the Bank's inflation target range within a specified time, and subject to smoothness constraints on the path of the interest rate. Currently, the Bank has an inflation target range of 1 to 3% per annum at 6 to 8 quarters out. From the model, the Bank derives a solution for the future paths of the interest rate and exchange rate, consistent with the inflation target. The desired path for the MCI is then calculated from those paths on the interest rate and exchange rate.[3]

If, in the short term – from week to week – the actual MCI rises above (or falls below) its target path, this is interpreted as a tightening (or loosening) of monetary conditions relative to those anticipated and desired, and the Bank considers responding. In effect, the MCI is a convenient short-hand calculation for how to adjust interest rates if the exchange rate moves sometime between adjacent formal (quarterly) forecast rounds with the QPM. Operationally, at weekly and mid-quarter meetings, the MCI serves as a starting point in policy discussions, in which the Bank looks at developments that have occurred since the beginning of the quarter in deciding whether to adjust policy. The Bank then may also make adjustments to the desired path of the MCI.

Gordon Thiessen, Governor of the Bank of Canada, summarizes the role of the MCI at the Bank, as follows:

> ... we [at the Bank of Canada] aim at a path for monetary conditions that would bring about a path for aggregate demand and prices consistent with the control of inflation.
>
> Thiessen (1995, p. 54)

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[3] In practice, the Bank controls the overnight interest rate, which is closely linked to the 90-day commercial paper interest rate. For the most part, the discussion below ignores the distinction between the Bank's actual policy instrument and what constitutes a very short-term operational target.

Charles Freedman, Deputy Governor of the Bank of Canada, provides additional details:

> In the last few years, the Bank of Canada has used the concept of monetary conditions (the combination of the movement of interest rates and the exchange rate) as the operational target of policy, in much the same way as short-term interest rates were used in the past.
>
> ... The objective of monetary policy over the next three years or so is to maintain the rate of inflation within a band of 1 to 3 per cent. The quarterly Bank of Canada staff projection takes into account such factors as the movements in foreign variables and domestic exogenous variables as well as the momentum of the economy, and sets out a path for monetary conditions that will result in the rate of inflation six to eight quarters ahead being within the Bank's target band. ... One can think of this path [of the MCI] as the desired or target path for monetary conditions.
>
> Freedman (1995, pp. 53, 54, 56)

Three qualifications should be noted. First, while the QPM is the foundation for generating the forecasts, additional analyses of the domestic and foreign economies also play a role, with iterations between sectoral specialists and the QPM resulting in judgmentally adjusted forecasts. Second, the forecasts are conditional, both on the Bank's views of future domestic monetary and fiscal policy and on its views of future foreign economic outcomes. Third, there are operational considerations, as described in the next subsection.

2.3 Operational considerations

Implementing an MCI as a target involves practical, operational considerations, which are reflected by the Bank of Canada's experience. These considerations include both the timing of policy adjustments and the role of additional information in the policy process. Timing, or "tactical" considerations, has sometimes made an MCI a difficult operational target to achieve.

The Bank has a desired path for the MCI. If the actual MCI is "off course", then the Bank tries to move it back on track as quickly as is tactically possible. "Tactically" is the operational word here, in that the Bank sometimes has allowed actual and desired MCIs to differ for considerable periods – of a quarter or more. The Bank has explained such episodes by arguing, for example, that observed exchange rates were out of line relative to fundamentals, as the Bank believed happened with transitory reactions to the Quebec problem. In such situations, the calculated index may not accurately reflect intended or actual monetary conditions. Freedman (1995) provides a lucid account of this problem:

> ... Suppose an easing of monetary conditions was appropriate, but there was a great deal of uncertainty and nervousness in the exchange market. ... In such circumstances, the Bank would delay any decision to ease monetary conditions because of the risk that an action to reduce the overnight rate could result in significant weakness in the exchange market and lead to the buildup of extrapolative expectations in that market, followed, as we have so often seen in Canada in recent years, by an increase in interest rates in the money market and the bond market. In effect, an attempt to ease monetary conditions could, via the interaction of developments in the exchange market and domestic financial markets, result in an outcome where monetary conditions ended up tighter and not easier. Thus, the tactical aspect involves choosing the timing of changes to avoid undesired market-driven outcomes. (p. 58)

Timing is clearly an issue. Furthermore, market conditions and the market's responses to Bank actions may simply prevent the Bank from achieving its target, at least in the short or medium term.

The MCI is central to the Bank's decision process, in which the use of the MCI is viewed as interest-rate targeting, adjusted for exchange-rate effects on aggregate demand in a small open economy. That said, inputs additional to the MCI do influence the Bank's policy decisions, as Freedman (1995) indicates:

... While the [model-based path for the MCI] recommended by the staff is a crucial input into the views of senior management on the desired path for monetary conditions, senior management may also incorporate into its thinking the possible effects of a broad range of outcomes with respect to the movements of exogenous variables or the momentum of the Canadian economy. Indeed, the staff prepares alternative "risk scenarios" that incorporate some of these factors. Management may also decide in which direction to take or avoid risks (e.g., that it is appropriate to be especially vigilant about a resurgence of inflation). If, following this type of analysis, there is a divergence between actual and desired monetary conditions, the Bank will look for the right time to make adjustments. Among the factors that enter into the timing decision are market uncertainty and market nervousness. (p. 59)

Thus, even for a stable developed economy like Canada, achieving targeted levels of the MCI has sometimes proven infeasible because of tactical difficulties. For countries with much more volatile economies and larger speculative swings in the exchange rate, tactical considerations are even more likely to make an MCI operationally infeasible.

2.4 General usage of MCIs

While much discussion in the literature focuses on the Bank of Canada's use of its Monetary Conditions Index, MCIs have widespread use among other institutions and for other countries. The central banks of New Zealand, Norway, and Sweden each have published an MCI and (to varying degrees) use it in conducting monetary policy. The Reserve Bank of New Zealand (starting in late 1996) uses an MCI as an operational target in much the way that the Bank of Canada does; see the Reserve Bank of New Zealand (1996). The central banks of Norway and Sweden use MCIs in a more limited fashion – as indicators of monetary conditions when formulating their monetary policies; see Norges Bank (1995) and Hansson and Lindberg (1994). In a recent paper, Dornbusch, Favero, and Giavazzi (1998) construct an MCI for the European Central Bank over a region spanning most of the European Monetary Union (EMU). The IMF and the OECD also use MCIs in evaluating monetary policies across countries; and businesses such as Deutsche Bank, Goldman Sachs, JP Morgan, and Merrill Lynch calculate MCIs to evaluate different countries' monetary conditions.

Table 1 compiles alternative relative weights for MCIs across selected countries, as published or made available by the institutions and authors just mentioned. This table is indicative of the range of countries and sources, rather than being exhaustive. While MCIs are about *monetary* conditions, institutions other than the central bank of a given country may well calculate an MCI for that country, even if that central bank does not publish or use an MCI in policy. For many countries, several estimates of the relative weights are available, and the estimates vary considerably. In light of the range in available weights, Section 3 considers inter alia the empirical consequences of using different weights.

The range of estimated weights in part reflects the use of different models and different sample periods. However, a given range of estimated weights across a set of models and sample periods has no implications for the confidence intervals of any model's estimated relative weight, not even for those of a correctly specified model's estimated relative weight. A consensus in estimated weights across models would reflect just that – a consensus – and nothing more. For instance, Freedman (1994, pp. 469-70) reports similar estimates of relative weights across a range of Canadian models. That consensus implies nothing about confidence intervals for those estimated weights. Such a consensus could easily arise if the different models of a given economy used more or less the same data: specifically, the different models' estimated relative weights are unlikely to represent *independent* random draws on some unknown relative weight. Section 4 thus examines the uncertainty of the estimated weights and the empirical consequences that such uncertainty has for using an MCI as an indicator or target.

Table 1

Selected alternative relative weights for MCIs

Country	Source							
	Central banks	**IMF**	**OECD**	**Deutsche Bank**	**Goldman Sachs**	**JP Morgan**	**Merrill Lynch**	**Dornbusch et al.**
Australia			2.3			4.3	4	
Austria				3.3				
Belgium						0.4		
Canada	2, 3	4, 3	2.3		4.3	2.7	3	
Denmark						1.9		
EMU								2.17
Finland						2.5		
France		3	4	3.4	2.1	3.5		2.10
Germany		2.5, 4	4	2.6	4.2	2.3	4	1.39
Italy		3	4	6.6	6	4.1		2.89
Japan		10	4		8.8	7.9	10	
Netherlands				3.7		0.8		
New Zealand	2							
Norway	3					1.4		
Spain			1.5	2.5		4.2		1.46
Sweden	3–4		1.5	0.5		2.1		8.13
Switzerland				6.4		1.7		
United Kingdom		3	4	14.4	5	2.9	3	
United States		10	9		39	10.1	10	

Notes: Weights are those on interest rates relative to those on exchange rates.

Sources: Bank of Canada (1995, p. 14), Reserve Bank of New Zealand (1996, pp. 22–3), Norges Bank (1995), Hansson and Lindberg (1994, p. 16), International Monetary Fund (1996a, p. 16; 1996b, p. 19; 1997, p. 24), OECD (1996, p. 31), Gräf and Schonebeck (1996), Davies and Simpson (1996), Suttle (1996), Merrill Lynch (1997), and Dornbusch, Favero, and Giavazzi (1998, Table 5.6), with additional information on specific MCI weights for Deutsche Bank, Goldman Sachs, and JP Morgan from personal communications with Theodor Schonebeck, John Simpson, and Carl Strong.

3. Two facets of MCI design

This section analyzes two facets in the design of an MCI: the choice of weights and variables (Section 3.1), and the assumptions of the underlying empirical model (Section 3.2), with the latter leading directly into Section 4 on coefficient uncertainty. Empirically, MCIs appear very sensitive to even minor changes in weights, variables, and assumptions.

3.1 Choice of weights and variables

The choice of weights and variables in an MCI is central to constructing the index itself, and MCIs can be empirically sensitive to that choice. For example, Figure 3 plots three alternative MCIs for Canada: one using the Bank of Canada's relative weight of 3, and the other two using the smallest and largest Canadian weights appearing in Table 1 (weights of 2 and 4.3 respectively). In 1986 and 1987, the MCI is nearly invariant to the relative weight because the exchange rate was virtually constant; see Figure 2. From 1988 through 1994, weights matter considerably because the Canadian dollar appreciated and then depreciated. In late 1996, some versions of the index actually move in different directions. To focus on this phenomenon, Figure 4 plots the MCIs from the

Figure 3

The Canadian MCI evaluated at relative weights of 3, 2 and 4.3

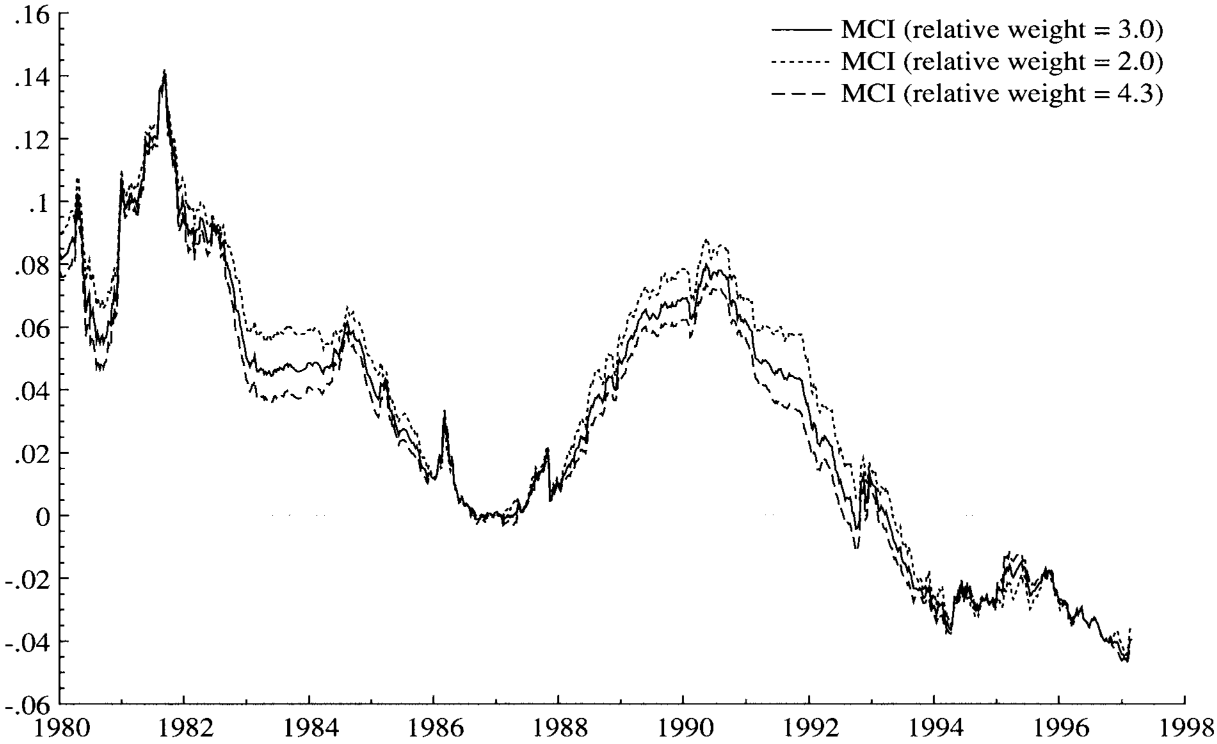
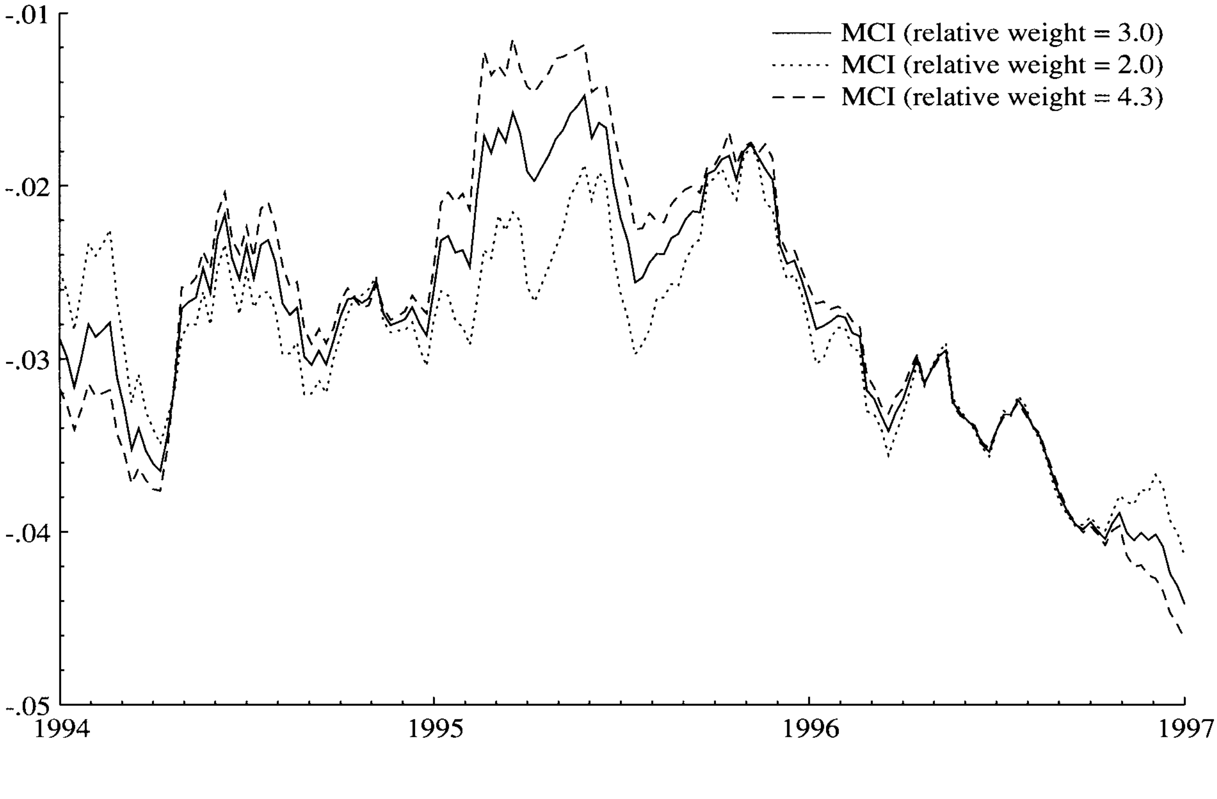


Figure 4

The Canadian MCI evaluated at relative weights of 3, 2 and 4.3 over a recent subsample



beginning of 1994 onwards. The MCI with the smallest relative weight indicates a moderate tightening of monetary policy in the autumn of 1996, whereas the indexes with larger weights on the interest rate show a moderate or considerable loosening. Similar episodes occur in 1983–84, while noting that the extreme scale of Figure 3 necessary for capturing 17 years of data does dwarf the discrepancies in the various MCIs' behavior. In general, the weights can and do affect the magnitude and the sign of changes in the index. Notably, the Bank of Canada initially used weights of 2:1 and then switched to 3:1, with a substantial effect on the measured MCI.

The selection of variables in the MCI is an open issue as well. MCIs in this paper's figures are calculated from only a single interest rate and a single exchange rate. Many possible interest rates and exchange rates are available, and using different variables in the MCI can induce differences in movement similar to those encountered in the choice of weights.

For example, the Bank of Canada currently uses a nominal G-10 bilateral trade-weighted exchange rate. Such an exchange rate is appealing in trade equations, and hence in an aggregate output equation such as (2). However, for short-term to medium-term monetary policy, international exchange markets may be more speculative and financial in nature, in which case bilateral *trade* weights are less germane. A conflict may well exist between the data appropriate for the underlying econometric model and those appropriate for policy analysis.

A range of alternative interest rates also exists. Numerous short-term rates are available, and MCIs need not be restricted to short-term rates alone. Deutsche Bank and Goldman Sachs in particular use weighted averages of long-term and short-term interest rates in calculating their MCIs. Furthermore, an MCI may be calculated from real (rather than nominal) variables, with the measurement of expected inflation implying yet an additional choice in variables. Without substantially better information on the choice of weights and variables, currently calculated MCIs may well be misleading about underlying changes in monetary stance, both in magnitude and in sign.

The choice of variables also can be viewed as an issue in aggregation, with four forms of aggregation occurring. First, an MCI includes only exchange rates and interest rates, to the exclusion of other potential variables; see Section 3.2 below. That exclusion constitutes aggregation, with weights of zero on those other variables. Second, bilateral exchange rates are aggregated into a single exchange rate index. Third, available interest rates are aggregated, often into a single interest rate. Fourth, combining a given exchange rate index and a given interest rate into an MCI constitutes aggregation. All four senses of aggregation involve losses of information, and use of an MCI implicitly assumes that the information lost is not important for policy. Specifically, because many combinations of an interest rate and an exchange rate give rise to the same value of the index, the lost information is important if the mix of the two variables is of concern.

In practice, the Bank of Canada does look at the two variables separately, especially when considering how to alter monetary conditions; see Freedman (1995, p. 58), as quoted above. For example, rapid depreciation of the exchange rate can translate into risk premia across the yield spectrum, in which case the exchange rate may be weaker in conjunction with higher interest rates, but overall monetary conditions can be unaffected. As Figures 1-4 show, episodes exist (such as early 1994) when the interest rate increased but the exchange rate weakened even more, with the MCI moving in the *opposite* direction from the interest rate.

3.2 Assumptions of the underlying empirical model

The use and interpretation of an MCI rest upon the assumptions of the underlying model. Several issues arise for that model, including dynamics, data nonstationarity and differencing, exogeneity and feedback, parameter constancy, the choice of model variables, and the uncertainty arising from estimating the model. This subsection summarizes these six issues, relating them to the corresponding model assumptions. These assumptions are often testable and, if violated, directly affect the economic interpretation of the MCI. Eika, Ericsson, and Nymoen (1996a) present a more detailed analytical assessment, and their empirical evaluation confirms such difficulties in models for the Canadian, Swedish, and Norwegian MCIs. Gerlach and Smets (1996) and Alexander (1997) discuss possible economic theoretical underpinnings of an MCI and the associated, rather stringent assumptions required for an MCI to be an optimal policy target.

First, the relationships between the policy instruments, the exchange rate, the short-term interest rate, output, and inflation generally are *dynamic*, implying different short-run, medium-run, and long-run multipliers. Thus, the policy horizon may affect the relative weight. If policy is concerned with several horizons, the weight for a single horizon may not be adequate.

Second, the temporal properties of the data themselves bear on the construction of an MCI. In particular, *nonstationarity* of the data (e.g., as in a series with drift) may affect the distribution of the error terms in the associated model and thereby affect statistical inference. Nonstationary data also may be cointegrated. If so, the relevant equations should include levels of the series, and calculations of multipliers should account for those levels. By contrast, output equations for calculating MCI weights are typically estimated with differenced or detrended data, with no testing for cointegration. Furthermore, the MCI itself is calculated on the levels of the data. Adjustment of the MCI relative to a base period simply subtracts a constant from an unbased MCI and does not constitute working with differenced data. The mixed use of differences and levels affects the interpretation of the weights: short run for differences, contrasting with long run for levels.

Third, the postulated *exogeneity* of the policy instruments and other variables is potentially misleading. In the MCI itself, the weights are interpreted as elasticities of aggregate demand with respect to the interest rate and the exchange rate. This interpretation assumes no feedback from aggregate demand or inflation onto exchange rates and interest rates over the relevant policy horizon. Such feedback may occur under any policy regime and seems likely to occur under inflation targeting by design. With feedback, the estimated weights need not reflect the total effects of the exchange rate and interest rate on aggregate demand. As an alternative, the feedback could be estimated and subsequently incorporated into the elasticities from which an MCI is derived.

Fourth, *parameter constancy* is critical to the interpretation of an MCI, and it turns on all three of the aforementioned issues. Statistically nonconstant weights may arise empirically from misspecified dynamics, improper treatment of nonstationarity, or incorrect exogeneity assumptions. Because the MCI is designed for policy, it is important to establish the invariance of the weights to changes in policy, yet this conjectured invariance generally has not been investigated empirically. With nonconstant parameters, estimation over different sample periods would result in different estimates of the weights, and so different choices of weights. Eika, Ericsson, and Nymoen (1996a, Section IV) illustrate how that choice of weights can affect policy inferences with an MCI.

Fifth, the *choice of model variables* determines the variables omitted from the model. Significant omitted variables in the model's relationships may affect dynamics, cointegration, exogeneity, and parameter constancy in the model.

More generally, the use and interpretation of an MCI in policy assumes the existence of direct and unequivocal relationships between the variables involved. Possible additional influences in those relationships can confound the strict interpretation of an MCI as an index of monetary conditions.

One such relationship is that between the actual policy instrument (such as the central bank's overnight interest rate) and the exchange rate and short-term interest rate. If variables other than the policy instrument play an important role in determining the exchange rate and interest rate, neglect of those other variables has substantive implications for policy with an MCI. For example, changes in world oil and commodity prices may alter a country's terms of trade, thereby affecting the exchange rate. The MCI would then change, even if monetary stance remained unchanged. Likewise, changes in world interest rates and inflation rates and changes in domestic asset portfolio preferences may alter the domestic short-term interest rate, and so the MCI. The variables from which the MCI is constructed may reflect phenomena other than just direct monetary policy, so movements in the MCI are not tied unequivocally to changes in monetary stance. Conversely, by following or targeting an MCI, a central bank could be misled into adopting an overly tight or loose monetary policy, simply because some external shock affected the exchange rate or the domestic short-term interest rate.

An additional relationship is the one between exchange rates, interest rates, and output growth, which is the basis for calculating the relative weight in the MCI. Exchange rates have other effects on the economy, such as influencing domestic prices directly; cf. Froot and Rogoff (1995), Juselius (1992), and de Brouwer and Ericsson (1998) for examples of theoretical and empirical research supporting such a channel. The interest rate also may have other channels to inflation. Specifically, interest rates may affect mortgage payments and hence inflation through the calculated cost of housing. Neglect of these transmission mechanisms is likely to result in the MCI being a misleading index of monetary conditions per se, particularly if the MCI is being used by the central bank in targeting inflation. An MCI focuses on only one of many potential channels and on only two of many potential variables in the monetary transmission mechanism.

Sixth, the relative weight in an MCI is based on an estimated empirical model, and so is subject to coefficient *uncertainty* from that estimation. Thus, the estimated weight may be numerically nonconstant, even if it is statistically constant. Numerically nonconstant weights may arise from the lack of information content in the data, leading to large standard errors. Section 3.1 above shows that the calculation of an MCI can be sensitive to the choice of weights. Uncertainty from estimation has not been previously examined for MCIs, so the next section (Section 4) turns to quantifying that uncertainty and assessing its consequences for using an MCI in practice.

4. The uncertainty of MCI weights and some consequences

This section assesses the statistical uncertainty from estimating the MCI weights in models for Canada, New Zealand, Norway, Sweden, and the United States. This section then summarizes the policy consequences of uncertainty in an MCI's relative weight and considers some alternatives. See Ericsson, Jansen, Kerbeshian, and Nymoen (1997) for details on the statistical framework employed.

To assess the uncertainty of an MCI weight, an equation is estimated in the form:

$$\Delta y_t = a\Delta RR_t + b\Delta q_t + other \ \ variables + error . \qquad (3)$$

The relative MCI weight μ is a/b, and its estimated value $\hat{\mu}$ is $\hat{a}/\hat{b}$, where a circumflex denotes estimation. Confidence intervals for the estimated MCI weight can be constructed from a Wald statistic, a likelihood ratio statistic, or a Fieller statistic inter alia; see Wald (1943), Silvey (1975, pp. 115-8), Fieller (1940, 1954), and Kendall and Stuart (1973, pp. 130-2). As Gregory and Veall (1985) discuss in general and Ericsson, Jansen, Kerbeshian, and Nymoen (1997) discuss for the MCI relative weight in particular, the likelihood ratio approach has distinct advantages over the other two approaches, so it is used below.[4] Similar issues arise in calculating the estimated uncertainty of NAIRUs; see Staiger, Stock, and Watson (1997).

Table 2 lists estimated MCI relative weights and their confidence intervals from models for Canada, New Zealand, Norway, Sweden, and the United States. Confidence intervals are calculated for 95%, 90%, and 67.5% (i.e., "±1 standard error") levels. For each country, the interest rate is measured as a fraction and the exchange rate is in logarithms. The models are taken from Duguay (1994, p. 50, Table 1, column 7), Dennis (1997, p. 14, Table 2, Equation A), Jore (1994, Equation 2), Hansson (1993), and Ericsson, Jansen, Kerbeshian, and Nymoen (1997) respectively. See also Eika, Ericsson, and Nymoen (1996a, 1996b) and Hansson and Lindberg (1994) for additional analysis of the Norwegian and Swedish models. Following the various central banks' practices, the Canadian MCI is nominal, whereas those for New Zealand, Norway, and Sweden are real. The Federal Reserve Board does not publish an MCI, so the choice of a nominal MCI versus a real MCI is open for

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[4] That said, the confidence intervals for the estimated MCI weights in Dornbusch, Favero, and Giavazzi (1998, Table 5.6) are calculated using the Wald statistic.

the United States. Below, the nominal MCI is used for the United States. Ericsson, Jansen, Kerbeshian, and Nymoen (1997) provide additional details on all five models.

Table 2

MCI relative weights and their estimated confidence intervals

Calculation	Country				
	Canada	New Zealand	Norway	Sweden	United States
MCI relative weight					
Published	3	2	3	3–4	–
Estimated	3.56	1.75	2.15	2.02	–3.69
Confidence interval					
95% level	[0.74, ∞]	[0.30, 7.31]	[0.00, ∞]	[1.06, 2.96]	[–∞, ∞]
90% level	[1.06, ∞]	[0.52, 5.05]	[0.36, 26.6]	[1.27, 2.76]	[–∞, ∞]
67.5% level	[1.80, 9.60]	[0.97, 3.04]	[1.00, 4.98]	[1.61, 2.43]	[–8.45, 1.84]

Notes: The published MCI relative weights are those used by the corresponding central banks; see Table 1. The estimated MCI relative weights are calculated for a long-run horizon from the models reported in Ericsson, Jansen, Kerbeshian, and Nymoen (1997). The estimated confidence intervals are constructed from likelihood ratio statistics for those models at the reported significance levels.

For Canada, the estimated relative MCI weight is 3.56, somewhat larger numerically than the estimate of 2.67 from Duguay's equation, but well within the range of estimates typically obtained for Canada (see Table 1). The 95% confidence interval is enormous: [0.74, ∞]. It includes equal weights on the interest rate and exchange rate ($\mu = 1$) as well as a zero weight on the exchange rate ($\mu = \infty$). Even the 67.5% confidence interval, equivalent to a plus-or-minus one standard error band for single coefficient estimates, is large: [1.80, 9.60]. This high degree of uncertainty is unsurprising, given the marginally significant coefficient on the exchange rate in (2).

For New Zealand, the estimated relative MCI weight is 1.75, and the 95% confidence interval is [0.30, 7.31]. While the confidence intervals for New Zealand are not as large as those for Canada, the presence of small relative weights in the confidence interval can have a marked effect on the calculated MCIs.

For Norway, the estimated relative MCI weight is 2.15, and the 95% confidence interval is [0.00, ∞], even larger than those calculated for Canada and New Zealand. All non-negative weights fall within the 95% confidence interval, and completely different accounts of monetary conditions are feasible with different empirically acceptable estimates of the MCI relative weight.

For Sweden, the estimated relative MCI weight is 2.02, and the 95% confidence interval is quite small: [1.06, 2.96]. However, the calculated confidence intervals are probably unreliable, given that the over-identifying restrictions in the Swedish model are rejected against the corresponding unrestricted reduced form; see Eika, Ericsson, and Nymoen (1996a, Appendix). Even if a 95% confidence interval of [1.06, 2.96] is assumed, MCIs still can differ by a few hundred basis points, depending upon which value of the relative weight is chosen from that interval.

Although the Federal Reserve Board does not publish an MCI for the United States, other institutions do, as Table 1 shows. To calculate the uncertainty of an estimated MCI weight for the United States, we estimate a model for the growth rate of real US GDP that is similar in form to the Canadian and Norwegian models. The real interest rate has a negative coefficient whereas the real exchange rate has a positive coefficient, so the estimated relative MCI weight is negative: –3.69, numerically. A negative coefficient such as this is difficult to interpret economically. However, the 95% confidence interval is the entire real line, [–∞, ∞]. Even the 67.5% confidence interval is large: [–8.45, 1.84].

For the models examined, the large estimation uncertainty associated with the MCI weights renders calculated MCIs uninformative for policy. The model for the Swedish MCI is itself misspecified, so it is difficult to interpret MCIs based on that model. For all five countries, the estimation uncertainty often implies discrepancies in the calculated MCI of 100 basis points or more for statistically acceptable choices of the relative weight. Such discrepancies occur even at one quarter ahead, which is a short horizon for policy based on an MCI. Furthermore, the choice of weight often affects the MCI's direction of movement, and not just the magnitude of its movement. That feature is particularly problematic, in so far as an MCI is interpreted as an *indicator* of monetary stance. See Ericsson, Jansen, Kerbeshian, and Nymoen (1997) for further graphical evidence of the marked numerical consequences on the MCIs from estimation uncertainty.

These results on estimation uncertainty could not have been known a priori: the confidence intervals could have been small, but they were not. Confidence intervals could still be small for relative MCI weights derived from *other* models of these countries' economies, or from models of other countries' economies. However, for the models studied, which were developed at the countries' respective central banks, these confidence intervals are large empirically.

While MCIs as such appear impractical for use in policy, their motivation is sensible. In a small open economy, foreign economic activity is likely to affect the domestic economy through the exchange rate; and empirical models are a potentially sensible way of capturing the exchange rate's effects.

That said, tools other than MCIs are available for policy input in this context. In the conduct of monetary policy, central banks historically have considered a wide range of economic variables, including but not limited to interest rates and exchange rates. Central banks have changed their emphasis across those variables over time, for instance, in light of financial innovation. Instead of summarizing model-based calculations in a single index such as an MCI, those calculations may be presented directly, as time-dependent effects across a variety of economic aggregates. Such model-based calculations also may then be part of the economic information feeding into the policy process itself.

Policy-oriented examples of model-based calculations for Canada, Norway, and the United States appear in Poloz, Rose, and Tetlow (1994), Norges Bank (1996), and Mauskopf (1990). Good graphical and tabular techniques can ease the burden in communicating inherently multivariate results; see Tufte (1983, 1990, 1997). Furthermore, better design of empirical models for policy appears possible, using econometric tools and corresponding software developed over the last decade or so. Spanos (1986), Banerjee, Dolado, Galbraith, and Hendry (1993), and Hendry (1995) describe some of those tools; Doornik and Hendry (1996) exemplifies the software available; and the papers in Ericsson and Irons (1994) inter alia show how such tools and software can aid empirical modeling.

Conclusions

An MCI is an appealing operational target for monetary policy – it broadens an interest-rate target to include effects of the exchange rate on an open economy. In doing so, an MCI also incorporates model-based estimates of the effects of monetary policy on the economy. Notwithstanding the intuitive attraction of a Monetary Conditions Index, substantive limitations in the index's use arise from tactical difficulties, the choice of weights and variables, the underlying model's assumptions, and the associated uncertainty of the estimated relative weight. The latter three issues pertain to summary indicators and model-based calculations generally, but they appear particularly important empirically for MCIs. As a policy target and as an indicator of monetary conditions, an MCI focuses on only two of many potential variables in the monetary transmission mechanism. While the Bank of Canada and the Reserve Bank of New Zealand currently use MCIs as operational targets, they are well aware of the shortcomings involved. This paper has reviewed and interpreted the use of an MCI, focusing on the implications of estimation uncertainty for the practical implementation of MCIs in monetary policy.

References

Alexander, L. S. (1997): "Notes on the Poole Model and MCIs". *Memo*, Division of International Finance, Board of Governors of the Federal Reserve System, Washington, D.C., January 2.

Banerjee, A., J. J. Dolado, J. W. Galbraith, and D. F. Hendry (1993): *Co-integration, Error Correction, and the Econometric Analysis of Non-stationary Data*, Oxford University Press, Oxford.

Bank of Canada (1994): "Recent Economic and Financial Developments – L'Évolution Économique et Financière Récente". *Bank of Canada Review – Revue de la Banque du Canada*, Autumn, pp. 3-21.

Bank of Canada (1995): *Monetary Policy Report*. Bank of Canada, Ottawa, Canada, May.

Barker, W. (1996): "The Relationship Between Daily Bank of Canada Operations and the Monetary Conditions Index", in M. Zelmer (ed.) *Money Markets and Central Bank Operations*, Bank of Canada, Ottawa, Canada, pp. 169-209 (with discussion).

de Brouwer, G., and N. R. Ericsson (1998): "Modeling Inflation in Australia". *Journal of Business and Economic Statistics*,16, forthcoming.

Davies, G., and J. Simpson (1996): "Summary". *The International Economics Analyst* (Goldman Sachs), 11, 7/8, pp. iii-xviii.

Dennis, R. (1996): "Monetary Conditions and the Monetary Policy Transmission Mechanism". *Memo*, Reserve Bank of New Zealand, Wellington, New Zealand, November.

Dennis, R. (1997): "A Measure of Monetary Conditions". *Discussion Paper* G97/1, Reserve Bank of New Zealand, Wellington, New Zealand, January.

Doornik, J. A., and D. F. Hendry (1994): *PcGive Professional 8.0: An Interactive Econometric Modelling System*. International Thomson Publishing, London.

Doornik, J. A., and D. F. Hendry (1996): *PcGive Professional 9.0 for Windows*. International Thomson Business Press, London.

Dornbusch, R., C. A. Favero, and F. Giavazzi (1998): "The Immediate Challenges for the European Central Bank". *NBER Working Paper*, No. 6369, National Bureau of Economic Research, Cambridge, Massachusetts, January.

Duguay, P. (1994): "Empirical Evidence on the Strength of the Monetary Transmission Mechanism in Canada: An Aggregate Approach". *Journal of Monetary Economics*, 33, 1, pp. 39-61.

Duguay, P., and S. Poloz (1994): "The Role of Economic Projections in Canadian Monetary Policy Formulation". *Canadian Public Policy – Analyse de Politiques*, 20, 2, pp. 189-99.

Eika, K. H., N. R. Ericsson, and R. Nymoen (1996a): "Hazards in Implementing a Monetary Conditions Index". *Oxford Bulletin of Economics and Statistics*, 58, 4, pp. 765-90.

Eika, K. H., N. R. Ericsson, and R. Nymoen (1996b): "Hazards in Implementing a Monetary Conditions Index". *International Finance Discussion Paper*, No. 568, Board of Governors of the Federal Reserve System, Washington, D.C., October (also available on the World Wide Web at http://www.bog.frb.fed.us/pubs/ifdp/1996/568/default.htm).

Ericsson, N. R., and J. S. Irons (eds.) (1994): *Testing Exogeneity.* Oxford University Press, Oxford.

Ericsson, N. R., E. S. Jansen, N. A. Kerbeshian, and R. Nymoen (1997): "Understanding a Monetary Conditions Index". *Memo*, Board of Governors of the Federal Reserve System, Washington, D.C.

Fieller, E. C. (1940): "The Biological Standardization of Insulin". *Journal of the Royal Statistical Society, Series B*, 7, 1, pp. 1-54 (with discussion).

Fieller, E. C. (1954): "Some Problems in Interval Estimation". *Journal of the Royal Statistical Society, Series B*, 16, 2, pp. 175-85.

Freedman, C. (1994): "The Use of Indicators and of the Monetary Conditions Index in Canada". Chapter 18 in T. J. T. Baliño and C. Cottarelli (eds.) *Frameworks for Monetary Stability: Policy Issues and Country Experiences,* International Monetary Fund, Washington, D.C., pp. 458-76.

Freedman, C. (1995): "The Role of Monetary Conditions and the Monetary Conditions Index in the Conduct of Policy – Le Rôle des Conditions Monétaires et de l'Indice des Conditions Monétaires dans la Conduite de la Politique". *Bank of Canada Review – Revue de la Banque du Canada,* Autumn, pp. 53-9.

Froot, K. A., and K. Rogoff (1995): "Perspectives on PPP and Long-run Real Exchange Rates". Chapter 32 in G. M. Grossman and K. Rogoff (eds.) *Handbook of International Economics*, Volume 3, North-Holland, Amsterdam, pp. 1647-88.

Gerlach, S., and F. Smets (1996): "MCIs and Monetary Policy in Small Open Economies under Floating Rates". *Memo*, Bank for International Settlements, Basle, Switzerland, November 18.

Gräf, B., and T. Schonebeck (1996): "DBR MCI in August: Little Change". *Market Issues: Economics* (Deutsche Morgan Grenfell), October 7, pp. 2-3 (also available on the World Wide Web at http://www.rdt.com/rdt/dmg).

Gregory, A. W., and M. R. Veall (1985): "Formulating Wald Tests of Nonlinear Restrictions". *Econometrica*, 53, 6, pp. 1465-8.

Hansson, B. (1993): "A Structural Model". Chapter 5 in T. Franzén, K. Andersson, A. Alexius, C. Berg, B. Hansson, C. Nilsson, and J. Nilsson (eds.) *Monetary Policy Indicators*, Sveriges Riksbank (Swedish Central Bank), Stockholm, Sweden, pp. 55–64.

Hansson, B., and H. Lindberg (1994): "Monetary Conditions Index – A Monetary Policy Indicator". *Quarterly Review* (Sveriges Riksbank – Swedish Central Bank), 1994, 3, pp. 12-7.

Hendry, D. F. (1995): *Dynamic Econometrics.* Oxford University Press, Oxford.

International Monetary Fund (1996a): *World Economic Outlook: May 1996.* International Monetary Fund, Washington, D.C., May.

International Monetary Fund (1996b): *World Economic Outlook: October 1996.* International Monetary Fund, Washington, D.C., October.

International Monetary Fund (1997): *World Economic Outlook: May 1997.* International Monetary Fund, Washington, D.C., May.

Jore, A. S. (1994): "Beregning av en indikator for pengepolitikken". *Penger og Kreditt* (Norges Bank – Bank of Norway), 94, 2, pp. 100-5 ("Calculation of an Indicator for Monetary Policy").

Juselius, K. (1992): "Domestic and Foreign Effects on Prices in an Open Economy: The Case of Denmark". *Journal of Policy Modeling*, 14, 4, pp. 401-28.

Kendall, M. G., and A. Stuart (1973): *The Advanced Theory of Statistics: Volume 2. Inference and Relationship*. Charles Griffin and Company, London. Third Edition.

Longworth, D., and C. Freedman (1995): "The Role of the Staff Economic Projection in Conducting Canadian Monetary Policy", in A. G. Haldane (ed.) *Targeting Inflation*, Bank of England, London, England, pp. 101-12.

Mauskopf, E. (1990): "The Transmission Channels of Monetary Policy: How Have They Changed?" *Federal Reserve Bulletin*, 76, 12, pp. 985-1008.

Merrill Lynch (1997): "Central Bank Watch". *Currency and Bond Market Trends* (Merrill Lynch), August 7, pp. 32-7.

Norges Bank (1995): "Norges Bank's Monetary Conditions Index". *Economic Bulletin* (Norges Bank – Bank of Norway), 95, 1, p. 33.

Norges Bank (1996): "Inflation Report: Projections to the Year 2000". *Economic Bulletin* (Norges Bank – Bank of Norway), 96, 4, pp. 259-81.

OECD (1996): *OECD Economic Outlook*, Volume 59. Organisation for Economic Co-operation and Development, Paris, France, June.

Poloz, S., D. Rose, and R. Tetlow (1994): "The Bank of Canada's New Quarterly Projection Model (QPM): An Introduction – Le Nouveau Modèle Trimestriel de Prévision (MTP) de la Banque du Canada: Un Aperçu". *Bank of Canada Review – Revue de la Banque du Canada,* Autumn, pp. 23-38.

Reserve Bank of New Zealand (1996): *Monetary Policy Statement*. Reserve Bank of New Zealand, Wellington, New Zealand, December (also available on the World Wide Web at http://www.rbnz.govt.nz/monetary/mpspdf.htm).

Silvey, S. D. (1975): *Statistical Inference*. Chapman and Hall, London.

Spanos, A. (1986): *Statistical Foundations of Econometric Modelling*. Cambridge University Press, Cambridge.

Staiger, D., J. H. Stock, and M. W. Watson (1997): "The NAIRU, Unemployment and Monetary Policy". *Journal of Economic Perspectives*, 11, 1, pp. 33-49.

Suttle, P. (1996): "Monetary Conditions Worldwide". *World Financial Markets* (JP Morgan), March 29, p. 26.

Thiessen, G. G. (1995): "Uncertainty and the Transmission of Monetary Policy in Canada – L'Incertitude et la Transmission de la Politique Monétaire au Canada". *Bank of Canada Review – Revue de la Banque du Canada,* Summer, pp. 41-58.

Tufte, E. R. (1983): *The Visual Display of Quantitative Information*. Graphics Press, Cheshire, Connecticut.

Tufte, E. R. (1990): *Envisioning Information*. Graphics Press, Cheshire, Connecticut.

Tufte, E. R. (1997): *Visual Explanations: Images and Quantities, Evidence and Narrative*. Graphics Press, Cheshire, Connecticut.

Wald, A. (1943): "Tests of Statistical Hypotheses Concerning Several Parameters When the Number of Observations Is Large". *Transactions of the American Mathematical Society*, 54, 3, pp. 426-82.

Zelmer, M. (1996): "Strategies Versus Tactics for Monetary Policy Operations", in M. Zelmer (ed.) *Money Markets and Central Bank Operations,* Bank of Canada, Ottawa, Canada, pp. 211-78 (with discussion).