The Role of Simple Rules in the Conduct of Canadian Monetary Policy

Denise Côté, Jean-Paul Lam, Ying Liu, and Pierre St-Amant, Department of Monetary and Financial Analysis

We would like to dedicate this article to the memory of John Kuszczak, a good friend and colleague, who died earlier this year after a courageous battle with cancer. John was a respected economist and valued adviser, whose career at the Bank spanned more than twenty years, and was notable for his many contributions to the Bank's forecasting and research activities. In the months shortly before his death, John played a leading role in producing the research and organizing the workshop from which this article originates. His sound judgment, dedication, and friendship are sorely missed.

- *Simple monetary policy rules (simple rules) have several advantages. In particular, their construction is straightforward, and the information they yield is easy to communicate to policy-makers. In addition, they are believed by some to be robust, in the sense of generating good results in a variety of economic models.*
- *One criticism levelled against studies purporting to demonstrate the robustness of simple rules is that the models used to support this conclusion are very similar. Recent research at the Bank has shown that simple rules are considerably less robust when evaluated in a large number of models of the Canadian economy.*
- *Simple rules are, nevertheless, more robust than complex rules and retain the above-mentioned advantages. Thus, they can provide policy-makers with useful information for the conduct of monetary policy. The staff at the Bank of Canada regularly simulate several simple rules.*
- *More research is needed to determine how much weight policy-makers should assign to the information yielded by simple rules.*

The Bank of Canada must contend with several sources of uncertainty when deciding on the direction of monetary policy. One means of accounting for uncertainty and of mitigating its impact, is to incorporate projections from a variety of different models into the decision-making process.[1] Another approach, proposed by Levin, Wieland, and Williams (1999) and Taylor (1999), consists of using a "simple monetary policy rule" (simple rule) or a number of such rules, which yield good results in several models.

We define a simple rule as one that allows the monetary authority to determine a level for the short-term interest rate as a function of a small number of variables (at most three or four) observed at the point in time at which monetary policy is set. Complex rules typically incorporate a larger number of variables, some of whose values must be forecast by a model.[2] In keeping with the literature, we say that a simple rule is "robust" if it generates good results in a large number of models and in response to a variety of shocks.

1. For more on this subject, see the article by Jenkins and Longworth in this issue.

2. Our definition of a simple rule thus excludes rules that rely on forecasts of inflation, since they imply using a model to make that forecast.

Some authors, such as Levin, Wieland, and Williams, having studied the properties of simple rules in various models, conclude that they are robust. However, these studies have been criticized, for instance by Hetzel (2000), for using models that were too similar. It is also worth noting that most studies do not account for uncertainty pertaining to the shocks affecting the economy and that they use models and data from the United States. In contrast, other studies, particularly our recent examination of a large number of models of the Canadian economy (Côté et al. 2002), find that simple rules generally yield results that are decidedly worse than those generated by more complex rules in the context of specific models, and that their performance depends on the type of shock affecting the economy.

This article does three things. First, it provides a brief presentation of simple rules.[3] Second, it discusses the literature on the robustness of simple rules. Third, it explains how simple rules feed into the conduct of monetary policy at the Bank of Canada.

Simple Monetary Policy Rules

One popular simple rule is that proposed by John Taylor in 1993. According to the Taylor rule, the target for the policy-determined interest rate responds to three variables: the equilibrium interest rate, the contemporaneous deviations of inflation from the target (the inflation gap), and the contemporaneous output gap. The equilibrium interest rate is the rate that, over the longer run, keeps output at potential. The original Taylor rule can be expressed mathematically as

$$i_t = i_t^* + 1.5(\pi_t - \pi_t^*) + 0.5(y_t - y_t^*), \text{ where } i_t^* = r_t^* + \pi_t^*,$$

and i_t is the target for the policy-determined short-term interest rate, i_t^* is the equilibrium value of that interest rate, r_t^* is i_t^* expressed in real terms (that is, after inflation), π_t is the year-over-year inflation rate, π_t^* is the corresponding inflation target, $(\pi_t - \pi_t^*)$ is the inflation gap, y_t is the log of real output, y_t^* is the log of real potential output, and $(y_t - y_t^*)$ is the output gap.[4] According to the Taylor rule, if inflation was 1 percentage point above the target, and if there was an output gap of 1 per cent, the central bank would set its target for the policy-determined short-term interest rate 200 basis points above its equilibrium value.

The parameters associated with the inflation gap and the output gap were chosen by Taylor so that the equation roughly described the actual behaviour of the Federal Reserve in setting its target for the federal funds rate. Taylor shows that the parameter associated with the inflation gap needs to be greater than one to ensure that inflation is stable. The inclusion of the two gap terms by Taylor reflects the fact that the Fed aims at maintaining a low and stable inflation rate, as well as promoting sustainable output growth. The contemporaneous output gap term also brings a forward-looking dimension to the policy rule, since it is viewed as indicating future changes in inflation.

In recent years, a number of variants of the Taylor rule have been developed. Levin, Wieland, and Williams (1999) include a lagged interest rate in the simple rule, suggesting that this helps reduce the volatility of output, inflation, and interest rates in all four of the models they examine. Their simple rule can be expressed as

$$i_t = \rho i_{t-1} + (1 - \rho)[\, i_t^* + \alpha(\pi_t - \pi_t^*) + \beta(y_t - y_t^*)\,],$$

where ρ represents the degree of smoothing.

Clarida, Galí, and Gertler (1998) estimate reaction functions for different countries and show that the coefficient on the lagged interest rate is relatively high, which implies that, in practice, central banks appear to smooth interest rates. Srour (2001) reports similar results for Canada.[5]

Another important extension of Taylor's work is the open-economy rule proposed by Ball (1999), who argues that a rule with an exchange rate term may be more appropriate for models of small open economies. Ball's specification is

$$i_t = i_t^* + f(\pi_t - \pi_t^*) + g(y_t - y_t^*) + h_1(e_t - e_t^*) + h_2(e_{t-1} - e_{t-1}^*),$$

where e_t is the nominal exchange rate (an increase in the value of this variable means a depreciation of the currency) and e_t^* is the equilibrium exchange rate. In his model, Ball specifies the rate of inflation, π_t, as long-run inflation, a measure of inflation that filters out the transitory effects of exchange rate movements. Svensson (2000), using a model with forward-looking, model-consistent expectations, finds support for this type of rule. One limitation of open-economy rules is

3. See Armour and Côté (1999–2000) for a more detailed presentation.

4. Such a rule can also be derived from a simple IS-Phillips curve model. See Armour and Côté (1999–2000) for an illustration.

5. The question as to whether central banks smooth interest rates and, if so, why, is much debated. This is discussed in Levin, Wieland, and Williams (1999) and Srour (2001).

the large amount of uncertainty surrounding the estimation of the equilibrium exchange rate.

Research on the Robustness of Simple Monetary Policy Rules

Since Taylor's initial presentation of his much-discussed rule, research on simple policy rules has exploded. This research has focused primarily on comparing the performance of simple rules with that of complex and optimal rules and has also investigated whether, and under what circumstances, simple rules are robust.[6]

Levin, Wieland, and Williams (1999) . . . . find that complex rules are not very robust when evaluated in different models.

Levin, Wieland, and Williams (1999) find that rules that include the deviation of inflation from its target, the output gap, and the lagged interest rate (interest-rate-smoothing rules) are robust to model uncertainty, in the sense that they perform nearly as well as the optimal or complex rule in each of their four models.[7] Contrary to simple rules with interest rate smoothing, they find that complex rules are not very robust when evaluated in different models, since their performance tends to deviate substantially from the optimal rule of the particular model being tested. The authors argue that rules with interest rate smoothing work well in their four models because they make future movements in the short-term interest rate more predictable and, hence, allow policy-makers to exert greater influence on long-term rates (via the term structure of interest rates) and subsequently on output and inflation.

Taylor (1999) also finds that simple rules, in particular Taylor-type rules (rules that react only to deviations of inflation from the target and to the output gap), work well and are more robust to model uncertainty than complex rules. He argues that the findings of the 1998 NBER conference on monetary policy rules clearly support simple rules. He also acknowledges, however, that despite the apparent consensus, there are still strong disagreements among researchers on several issues. Although Levin, Wieland, and Williams (1999) find that rules with interest rate smoothing are robust and work well in their four models, many other researchers have challenged this result. For example, in adaptive-expectations models, Rudebusch and Svensson (1999) and Ball (1999) find that rules with an interest-rate-smoothing term perform poorly and can even lead to unstable outcomes. Nevertheless, many regard these results as outliers, since the models used are not forward looking.[8]

Christiano and Gust (1999), however, show that the non-robustness of rules with interest rate smoothing, and of simple rules in general, does not necessarily hinge only on whether the model is backward looking. Using a forward-looking model that emphasizes frictions in financial markets rather than the usual price or wage stickiness, Christiano and Gust show that certain types of simple policy rules can lead to explosive or unstable outcomes. In particular, they find that the likelihood of instability increases with higher coefficients on the output gap. This result conflicts with the conclusions of Levin, Wieland, and Williams who show that a high coefficient on the output gap is a necessary condition for stability. Moreover, Alvarez, Lucas, and Weber (2001) have also shown that a simple policy rule may not be stable in a model with segmented financial markets.[9] These results suggest that, when frictions in financial markets are taken into account, simple rules may not be particularly robust. Given model uncertainty, this implies that policy-makers should be cautious if they use Taylor-type rules in their decision-making process.

In a recent paper, Hetzel (2000) also challenges the result regarding the robustness of simple policy rules. He argues that most researchers who evaluate simple policy rules have opted for a certain class of models—

6. The methodology underlying most of the research on policy rules is simple. A model, or a number of models, is specified, and the performance of one or several simple rules is then evaluated, usually by assuming that the monetary authority minimizes a given loss function. This loss function usually consists of the variance of inflation around its target and the variance of the output gap. The weight assigned to the variance of the output gap is usually smaller than the weight assigned to the variance of inflation around its target.

7. The optimal rule is the one that minimizes the loss function and thereby brings key variables of the models close to their target values. Optimal rules are often complex because complex rules have enough parameters to take into account specificities of the models.

8. In forward-looking models, the expectations that agents hold about the future are explicitly determined by the model (model-consistent expectations), whereas in adaptive-expectations models they are not.

9. In models with segmented financial markets, some agents are typically excluded or do not have access to financial markets (particularly markets where the rates on short-term instruments are determined), at least for some time.

models in which the central bank controls inflation by manipulating the output gap.[10] According to Hetzel, since simple policy rules like Taylor's highlight the role of the output gap and observed inflation, these types of rules fit naturally in models where the output gap plays a central role in explaining the inflationary process. It is, therefore, not surprising that many researchers have found simple policy rules like Taylor's to be robust, since most have used very similar models.

Most researchers who have analyzed the performance and robustness of simple rules have focused on models of the U.S economy. Very few have considered the Canadian economy. Some exceptions are Amano (1998), Srour (2002), Côté and Lam (2001), and Armour, Fung, and Maclean (2002). These studies cannot really evaluate the robustness of simple rules, however, since the performance of these rules is analyzed using only one model.

In papers presented at a recent workshop held at the Bank of Canada, we (Côté et al. 2002) analyzed the performance of many simple rules in 12 models of the Canadian economy. The 12 models considered come from several private sector forecasters—Wharton Economic Forecasting Associates (WEFA), Data Resources of Canada (DRI), the Conference Board of Canada, and the Policy and Economic Analysis Program (PEAP) of the Institute for Policy Analysis—as well as from the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), the Department of Finance (two models), and the Bank of Canada (three models).

To test for the robustness of simple policy rules in models of the Canadian economy, a different approach was taken from that used in other studies.[11] First, various types of models were used. Most of the models studied give a central role to the output gap in the determination of inflation (the "conventional" paradigm). However, money-based models, an open-economy, limited-participation model, and a vector-error-correction model (VECM) based on the disequilibrium between money supply and long-run money demand were also considered.[12] By considering a wide array of models, we have, to some extent, responded to Hetzel's critique and have made it more difficult and demanding for policy rules to pass the robustness check. Second, with one exception, the models considered are used for policy analysis and/or forecasting. As a result, careful attention was paid to how these models fit the data. Sims (2001) has argued that this is an important issue to consider when evaluating policy rules, something that past studies have largely ignored. His argument is compelling, since, if policy-makers are to use simple policy rules in conducting monetary policy, these rules must be tested in the models that are actually used for forecasting and/or policy simulations. The third distinct feature of our work relates to shock uncertainty. Past studies on simple policy rules have tested their robustness with regard to model uncertainty only.

Using this wide array of models,we find that simple policy rules are not particularly robust. When these rules are tested in several models, their performance tends to deviate substantially from the optimal or base-case rule of the model tested.[13] In particular, we find that interest-rate-smoothing rules, as well as rules that respond aggressively both to the deviation of inflation from the target and to the output gap, are the least robust, since they often induce substantial volatility in output and inflation and are even unstable in many models. In fact, of the numerous simple rules evaluated, we find that only four simple rules are stable in all models. Thus, unlike Levin, Wieland, and Williams, we do not find any strong evidence that simple policy rules are very robust and/or perform nearly as well as optimal or complex rules.

We find that rules with interest rate smoothing work well only in models that give an active role to money. However, these rules work well not because smooth movements in short-term rates allow policy-makers to exert more influence on long-term rates but because of other factors, such as the persistence of the money gap in the case of the M1-VECM and the fact that rules with smoothing prevent expectations from becoming

10. The volume edited by Taylor (1999) contains many models that fit into this category. In the models of Ball (1999), Batini and Haldane (1999), and Rudebusch and Svensson (1999), the output gap has a central role. The four models used by Levin, Wieland, and Williams (1999) are also quite similar, since, in all of them, the output gap plays a significant role in the determination of inflation.

11. Our study is similar in spirit to the 1993 project of the Brookings Institution, where several policy regimes were evaluated using a large number of models. See Bryant, Hooper, and Mann (1993).

12. Even under the "conventional" paradigm, there are important differences between the various models. Uncertainty is captured, in particular, by alternative channels through which monetary policy affects the economy (short-term interest rates or the yield curve), by differences in the inflation process (linear/non-linear Phillips curve), by alternative expectations processes (backward- or forward-looking expectations), and by the sensitivity of output and inflation to changes in interest rates.

13. As previously noted, an optimal rule is one that minimizes the loss function. The base-case rule refers to the existing reaction function of the model. It may or may not be optimal.

self-fulfilling in the limited-participation model. We also find that rules with interest rate smoothing tend to perform poorly or are unstable in more backward-looking models, thus providing support for the findings of Ball (1999) and Rudebusch and Svensson (1999).

We do not find any strong evidence that simple policy rules are very robust.

Even though we do not find a robust rule, we nevertheless present evidence that a simple rule that places a weight of 2.0 on the deviations of inflation from the target and a weight of 0.5 on the output gap performs relatively well in a particular set of models. We argue, however, that if the group of models is broadened, this simple rule no longer appears to be very robust, since its performance can deviate substantially from the base-case rules of some models. In particular, we show that this rule performs poorly in a limited-participation model, a finding similar to that of Christiano and Gust (1999).

We also find that simple rules are not particularly robust to the nature of shocks. Our results indicate that some rules perform well under some shocks in some models but do not perform well when other shocks are simulated using the same model.[14] These findings are similar to those of Srour (2002), who shows that it is not feasible to design a rule that would be robust to all the shocks that could affect the economy. Nevertheless, Srour argues that one can still use the same rule if the focus is limited to demand and supply shocks. But, using the same rule when all possible shocks are considered would clearly lead to suboptimal outcomes.

Like many other researchers, we find that rules that react exclusively to the deviations of inflation from its target and to the output gap often outperform rules that also include the exchange rate. In those models where open-economy rules lead to an improvement in the loss function, the gains are very small. There are several possible explanations for the poor performance of open-economy rules in models of the Canadian economy. In particular, in most of the models considered, the exchange rate acts as a shock absorber and thus plays a central role in stabilizing the economy from shocks. As a result, any attempt on the part of the central bank to smooth fluctuations in the exchange rate impedes the adjustment process of the economy and thus introduces more volatility into the economy.[15]

Although Levin, Wieland, and Williams (1999), Taylor (1999), and other researchers have argued that simple policy rules are robust to model uncertainty, our work casts serious doubt on this claim. Past studies may have considered models that are too similar to each other. As a result, establishing robustness was not particularly difficult. In our study, when a more diverse set of models is considered, simple rules do not pass this robustness check.

One major drawback of all the studies mentioned above, including our own, is their reliance on ex post revised data instead of real-time data to calculate the output gap, an important input in any simple policy rule.[16] Several authors, most notably, Orphanides (2001) and Kozicki (1999), have shown that the policy recommendations from a Taylor rule that uses a measurement of the output gap based on real-time data can differ dramatically from those based on ex post revised data.

Simple Monetary Policy Rules Used at the Bank of Canada

There is considerable uncertainty regarding the structure of the Canadian economy and the shocks affecting that economy. Consequently, advice regarding monetary policy should be based not solely on one characterization of the economy, but rather on several alternative viewpoints. Accordingly, the Bank of Canada uses information from more than one model to conduct monetary policy.

Most models used at the Bank in conducting monetary policy embody monetary policy feedback rules. Under these rules, the monetary authorities respond in a systematic way to deviations between the actual or forecast values and the target levels of the variables considered. While these rules differ in many respects,

14. Finding a rule that is robust to shock uncertainty may not necessarily be useful for policy-makers. If current and future shocks are unknown, one has to choose a rule that will perform well given the expected distribution of shocks and not with respect to a specific shock.

15. This is consistent with the conclusions reached by Djoudad et al. (2001) and Djoudad, Gauthier, and St-Amant (2001), who use different methodologies.

16. Real-time data are those that are available to policy-makers at the time when policy decisions are being made.

they all embody the Bank's primary policy objective of achieving a target rate for inflation of 2 per cent.

Advice regarding monetary policy should be based not solely on one characterization of the economy, but rather on several alternative viewpoints.

The monetary policy rules considered at the Bank are "forward looking," albeit in different ways (Selody 2002). Because monetary policy actions take time to work, forecasting the factors that will influence the future rate of inflation is essential in order to determine the appropriate policy actions required today to keep the future rate of inflation at its target of 2 per cent. Forward-looking policy rules allow the monetary authorities to anticipate future inflation and to react to inflationary shocks in a timely manner. Monetary policy rules can, however, anticipate future inflation in different ways.

One way of embodying forward-looking behaviour in a monetary policy rule is to include the forecast values for inflation that come directly from an economic model. This type of feedback rule is called an inflation-forecast-based rule (IFB). An alternative way of incorporating forward-looking behaviour in a monetary policy rule is to use current values of variables that are believed to be good indicators of future inflation such as the output gap, the yield spread, and money growth. As noted earlier, when only a few such indicators of inflationary pressures are used, this type of feedback rule is called a simple monetary policy rule.

Inflation-forecast-based rules have the advantage of providing a direct link in a model between the policy instrument and the expected deviation of inflation from its target. These rules have also been found to perform well in certain models, such as in the Quarterly Projection Model (QPM), the Bank of Canada's main model for economic projection.[17] Nevertheless, because these rules are usually fine-tuned to account for the specific dynamics of a particular model, they tend to be very sensitive to the peculiarities of that model and are therefore less robust across a group of models than simple rules.[18] Simple rules use current variables that can predict future inflation. This makes them more robust, since the indicator variables are less dependent on the structure of the model and tend to work well in models that rely on the same economic paradigm.

The QPM uses an IFB rule for policy recommendations. This rule sets the value of the yield curve gap[19] as a function of the core inflation gap, the current output gap, and the lag of the yield curve gap. The core inflation gap is the difference between the core inflation rate forecast by the model at a six- to seven-quarter horizon and the inflation target of 2 per cent. Targeting at this horizon tends to reduce the variability of inflation and output and is consistent with the forward-looking behaviour of private agents in the model. The output-gap term reduces output variability by allowing the monetary authorities to distinguish between price shocks and demand shocks. Although this IFB rule uses few determinants, it is not considered a simple rule according to our definition because it depends on the model's forecast of inflation.

Although the base-case staff projection conducted with the QPM is developed with the IFB rule described above, simple rules have also been used in the QPM. Following the work by Armour, Fung, and Maclean (2002), one particular simple rule was chosen for regular use in the projection exercise as an alternative monetary policy rule. It takes the following form:

$$i_t = i_t^* + 3.0(\pi_t - \pi_t^*) + 0.5(y_t - y_t^*) .$$

This rule sets the value of the nominal short-term interest rate relative to its equilibrium value as a function of the deviation of current core inflation from the inflation target and the current output gap. It is thus very similar to the original Taylor rule but responds more agressively to the inflation gap. The coefficients of 3.0 and 0.5 were chosen such that the rule performs well in the QPM. We find that this simple rule performs relatively well in models where the movements of inflation tend to be less sensitive to interest rate changes. It performs poorly in various other models, however.

In the Bank's projection exercise, monetary and credit aggregates are also analyzed for their leading

17. See Coletti and Murchison in this issue.

18. See Amano, Coletti, and Macklem (1999).

19. The gap between the 3-month minus 10-year interest rate spread and its equilibrium value.

information about growth in spending and inflation. The M1-Vector-Error-Correction Model (M1-VECM) (Adam and Hendry 2000), another model in use at the Bank, formalizes the role played by the monetary aggregates in determining future inflation. The M1-VECM uses an estimated monetary policy rule for policy recommendations. This rule embodies many indicator variables such as money growth, inflation, output growth, the output gap, the exchange rate, the U.S. short-term interest rate, and lags of these indicators. This complex monetary policy rule, while not optimal, has been shown to perform better than any simple rule in this model (Côté and Lam 2001).

As a result of our recent work (Côté et al. 2002), one particular simple rule was chosen for regular use in the Bank's projection exercise. It takes the following form:

$$i_t = i_t^* + 2.0(\pi_t - \pi_t^*) + 0.5(y_t - y_t^*) .$$

The weight assigned to deviations from the inflation target is larger than that used in the Taylor rule but smaller than that in the QPM simple rule. Policy recommendations based on this simple rule are obtained by using current values for core inflation and real output and, as such, are model-independent. Private sector forecasts for inflation and output can be used in developing a projected path for the policy rate, so that projected interest rates are not dependent on forecasts from the models used at the Bank. Economists at the Bank also use forecasts from the QPM to assess the differences in policy advice resulting from differences in economic outlook between private sector forecasters and Bank of Canada staff. Our simple rule is also simulated within the QPM (replacing the IFB rule) to assess the magnitude of the feedback between the policy rule and a model, which is quite forward looking.

Currently, a low weight is given to the advice coming from these simple rules, because we have found that they are not as robust as was suggested in the earlier literature and also because this research is still at an early stage. As well, policy-makers may have strong prior beliefs about which specific models capture the current economic reality and thus may be less concerned with robustness across a wide range of models. Nevertheless, this does not imply that simple policy rules have no role to play in the conduct of monetary policy. Since simple monetary policy rules have significant advantages, including the fact that they provide a useful benchmark against which to gauge interest rate recommendations coming from other sources and the fact that they are probably more robust than complex rules, it is worth investigating when and how these simple rules can be useful. It is therefore possible that simple monetary policy rules will be given increased weight as economists conduct more research on their properties.

Even if simple monetary policy rules were given more weight in the future, advice on monetary policy would not rely solely on the recommendations of monetary policy rules.[20] In fact, the analysis presented to the Governing Council in preparation for a fixed action date is not derived solely from forecasting models with well-identified monetary policy rules. The monetary authority must survey the entire economic and financial spectrum in conducting monetary policy. This involves considering all relevant information in order to have the best possible understanding of what is happening in the economy.

20. See Longworth and Freedman (2000) and Macklem in this issue.

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