

# Conference Summary: Money, Monetary Policy, and Transmission Mechanisms

---

*Kevin Clinton and Walter Engert, Department of Monetary and Financial Analysis*

**T**he 1999 Bank of Canada conference brought together researchers from central banks and universities, as well as participants from international organizations. The work presented suggests that a wide range of models is useful for understanding the various paths by which monetary policy actions might influence the economy.

## Major Themes

Three major themes emerged, which are likely to have a continuing impact on research and policy advice at the Bank of Canada. The first concerned uncertainty about the transmission mechanism by which monetary policy affects output and inflation. The existence of such uncertainty led conference participants to stress that the central bank should employ a variety of approaches for forecasting and policy simulations. These would include projections based on monetary and financial variables, as well as more conventional projections based on an aggregate demand function and an expectations-augmented Phillips curve. Since no single model can incorporate all the channels that might be at work, different approaches—or paradigms—would likely yield insights into different aspects of the transmission mechanism. The conference thus recognized the usefulness of a menu of models that policy-makers might consult in addition to mainstream macroeconomic models.

The second major theme concerned the potential usefulness of monetary aggregates in guiding the economy along a stable, non-inflationary growth path. This could become more important as output approaches its full potential, and the measured output

gap falls within the range of measurement error. At the same time, however, participants noted that financial innovations make it difficult to interpret movements in monetary aggregates. Instability in the relationships among money, prices, and output suggests that innovations in financial products should be closely monitored, and that the central bank should be ready to change its definitions of both broad and narrow monetary aggregates when significant structural changes occur. It was also stressed that central banks should focus on the longer-term evolution of monetary aggregates and not be preoccupied with short-run variability. Authors also explored the idea of treating transactions balances as an unobservable variable (like potential output), the quantity of which can be inferred from a well-specified model.

The third theme was recent developments in dynamic monetary general-equilibrium (DGE) models. These models are built rigorously, along classical lines. The basic assumptions are that individuals maximize expected utility over their lifetimes, while firms maximize the present discounted value of profits. Both individuals and firms are subject to income and liquidity constraints. Monetary policy affects real variables, such as output, only because of frictions in nominal variables. These frictions can include price stickiness, which is a well-known feature of models in the Keynesian tradition. However, a group of models that has received attention lately includes frictions resulting from financial constraints. For example, “limited-participation” models suppose that monetary policy actions at first affect only banks. The balance sheet of the general public changes only later, as banks change their lending. So far, the financial

structures embodied in the models have been extremely simple and stylized because of the difficulty of solving models with more complex and realistic assumptions about financial structure and behaviour. Advances in DGE modelling have, nevertheless, provided theoretical insights into the working of the economy that were not available for the last Bank of Canada conference on credit mechanisms, in 1994. Even so, conference participants generally felt that such models needed further development to become part of the regular tool kit of monetary policy-makers. In particular, in order to account for the actual dynamics of nominal variables such as the price level, DGE models will have to address more explicitly the role of financial intermediation and financial markets. Advances in computing technology and solution methods will help fill this need.

## An Overview of the Papers

The conference began with a topic that has a long history—the appropriate role of monetary aggregates in the conduct of monetary policy. In Canada, broad money and narrow money have behaved differently over the business cycle and over the long run, and the two concepts seem to contain different information about inflation and about the economy more generally. Recent research at the Bank has tended to focus on the M1 aggregate as a potential guide for policy, in the light of findings that it has been a leading indicator in the short run for output and, over a somewhat longer run, for inflation. Nevertheless, very broad aggregates such as M2++ also seem to show some interesting empirical regularities.

**Jean-Pierre Aubry** and **Loretta Nott** attempt to strengthen the link between theory and fact by examining the components of a narrow definition of money to develop an aggregate that behaves consistently with the theory of the demand for transactions balances, and that is not too sensitive to financial innovations. The authors argue that the composition and nature of the deposit accounts used for transactions have changed enormously over the past 25 years. The innovations came in two waves. During the first wave, from 1978 to 1986, banks and other financial institutions offered new products, such as daily interest chequing and savings accounts and corporate cash-management packages. This led to a shift away from demand deposits. The second wave followed the introduction of the zero fractional reserve requirement in 1992. Banks began offering very competitive rates on large demand deposits, which had previously been

burdened with higher reserve requirements. At the same time, wealth-holders began to accumulate large “free-credit” balances at the investment dealer subsidiaries of the banks. These bear attractive interest rates and are classified in the data as demand deposits. The rapid expansion of free-credit balances was associated with the boom in mutual funds—investors temporarily placed their funds in free-credit balances while deciding on a more permanent use. Thus, in the middle of the decade there was a bulge in M1, which partly reflected the buildup of balances to help in the management of financial portfolios, rather than to spend on goods and services.

Aubry and Nott estimate that the magnitudes of these waves of innovation were very large: a shift out of M1 of about 30 per cent in the first wave and into M1 of up to 45 per cent in the second. To capture such shifts, the definition of transactions money in Canada needs to be broader than traditional M1. The authors suggest that it is unlikely that an unchanging narrow aggregate, generated as a fixed combination of existing financial instruments, will exhibit a stable relationship with prices and output over time. The central bank should, therefore, monitor a range of definitions, watching for shifts in the use of the various components by studying institutional developments closely.

The usefulness of broad money as a guide for policy in Canada is examined by **Kim McPhail**. The recent adoption of a reference rate for a broad definition of money by the new European Central Bank has given added interest to this issue. McPhail applies two criteria. First, there should be a stable long-run demand function. This would quantify the relationship between money and prices, taking into account other variables that influence the demand for money, but it need not specify a direction of causality. Second, the aggregate should provide reliable leading information on inflation at a horizon of one or two years (in addition to that contained in other variables). This would be in line with the conventional view of the transmission lag in monetary policy. Moreover, growth in broad money balances might also partly reflect inflation expectations over such a horizon, since individuals would anticipate price increases by accumulating larger balances of liquid assets prior to making large purchases.

Contending definitions of broad money comprise a vast number of components, ranging from a very high to a much lower degree of liquidity. Since theory provides little guide to the selection of a cut-off point, the author studies a wide array of definitions. She

searches for stable demand functions over 30 years of data, using the Johansen-Juselius method to identify cointegrating vectors (which represent long-run relationships). Unit price-level elasticity (a one-for-one percentage response of prices to a change in money) is imposed on the relationship, since this is a strong theoretical requirement. For most definitions of broad money, two such vectors can be found, one of which corresponds to a stable long-run demand function. Overall, the results suggest that the kinds of innovation that plagued the demand for the narrow aggregate, M1, are adequately internalized within the broader aggregates. The author tests the ability of these aggregates to predict future inflation in single-equation models. These include, as well as current broad money growth, the deviation between actual money and the estimated long-run demand for it (the “money gap”) and the measure of the output gap from the Bank’s Quarterly Projection Model (QPM). It turns out that the inclusion of broad aggregates does result in more accurate predictions of inflation at both 4-quarter and 8-quarter horizons, and that this result stems from money growth rather than from the money-gap terms. Such findings are in line with the standard quantity theory, which holds that inflation is caused by past money growth without spelling out a precise transmission mechanism, but they provide no support for the buffer-stock hypothesis, which is typically related to money gaps. While the results seem to be fairly robust across definitions, the author is able to identify two broad aggregates that consistently perform well—both include Canada Savings Bonds and, alternatively, either total mutual funds or mutual funds sponsored by financial institutions.

A more sophisticated approach to constructing monetary aggregates employs weighted components instead of the conventional summations. Since in theory the conditions required for the validity of the latter are quite severe, **Apostolos Serletis** and **Terence Molik** compare two measures derived from index-number principles—divisia and currency equivalent—against simple-sum counterparts. That is, three different weighting schemes are applied to five definitions of money. The authors apply a battery of techniques: cyclical correlations of variables (detrended by the Hodrick-Prescott method), cointegration tests, single-equation causality tests, and vector autoregressions (VARs). They find that, for all the aggregates they consider, money is not cointegrated with prices or income, suggesting that real money balances and velocity are non-stationary variables. This would

imply difficulties for monetary targeting. Nevertheless, causality tests, especially for the divisia M1++ aggregate, suggest that aggregates might provide useful information with respect to prices and aggregate demand.

A different perspective on the use of monetary aggregates is provided in the paper by **Charleen Adam** and **Scott Hendry**. Policy actions affect inflation only with a considerable lag. Thus, policy-makers find it useful to have leading information with which to assess whether their actions are having the desired effect. Given the uncertainties about the real world, the authors stress the benefits of employing a variety of models—based on different views of the transmission mechanism—to assist in the conduct of monetary policy.

In Canada, this raises the question of how M1, which has been found in earlier research to have valuable leading-indicator properties, might be used to help in inflation targeting. Adam and Hendry would add the M1-based vector-error-correction model (M1-VECM) to the Bank of Canada’s portfolio of models. As documented by Aubry and Nott, however, the information content of M1 deteriorated in the mid-1990s. Adam and Hendry devise a technique for removing the distortions from M1 and re-estimate the model on an adjusted measure. Their approach essentially treats transactions money as an unobservable variable that can be inferred from the model. The latter features an active-money (or buffer-stock) interpretation of the transmission mechanism, in which discrepancies between the current and the long-run demand for money have a direct impact on output and inflation.

Adam and Hendry confirm certain properties of the M1-VECM: it is a good forecaster of inflation and the overnight interest rate seems to capture monetary policy actions. Consistent with this finding, a hypothetical monetary policy rule can be incorporated in the model, in which the short-term interest rate responds to deviations from an assumed target path for M1. The authors conduct various experiments, including the derivation of a path for the overnight interest rate consistent with achieving a given rate of inflation over a particular horizon. An interesting technical feature of this work is that confidence bands around the predicted outcomes can be derived for each experiment.

In light of the success of the low-inflation monetary policy in Switzerland, the approach used by the Swiss National Bank (SNB) merits attention. **Michel Peytrignet** provides a discussion on how monetary aggregates

were used by the Swiss National Bank for many years.<sup>1</sup> He describes how monetary policy aimed at maintaining price stability, using a monetary aggregate as an intermediate objective. Although, reflecting the pragmatic attitude of the SNB, the definition of money changed over time in response to economic and structural changes, a continuing characteristic was that central bank money had been featured explicitly. Central bank money, sometimes known as the “monetary base,” is equivalent to the central bank’s liabilities to the private sector, i.e., currency in circulation plus bank reserves. This very narrow aggregate appeals to monetary theorists and practitioners alike because it can be directly controlled by the central bank (at least in principle), and because it can be precisely observed day-by-day. Moreover, since demand for the monetary base is not highly responsive to market interest rates, its movements should tend to adequately reflect the actual impact of policy actions on the economy. (In contrast, Canadian M1 is so sensitive to interest rates that its movements tend to overstate this impact.) However, the SNB has never set out to achieve a given quantitative path unconditionally, and various developments have often led to substantial deviations from previously announced annual targets. These have included major exchange rate shocks, which cannot be ignored in a highly open small economy, and which led to unusually persistent inflation pressures in the early 1990s. Another source of shock has been the introduction of new payments technologies.

To provide more flexibility for dealing with such events, in the 1990s the money-target horizons were lengthened to the medium term, that is, about five years. The target rate of growth for central bank money, 1 per cent, was set on the assumption that it would be roughly consistent with inflation at the same rate. That is, expected long-run output growth of about 2 per cent would be roughly accommodated by the trend increase in velocity arising from innovations in payments practices. The author concludes that the intermediate target had provided an effective means for keeping the longer term in view and, thereby, for taking preventive decisions. The precise definition of money did not seem to matter, as long as it had credibility—which is largely a function of the central

---

1. In December 1999, the Swiss National Bank modified its monetary policy framework to focus on an explicit inflation target. At that time, the Swiss National Bank also announced that it would no longer set money supply targets but that the money stock (as measured by the aggregate M3) would continue to play an important role as a monetary indicator.

bank’s actual performance and an effective communications program.

The paper by **Ben S.C. Fung** and **Mingwei Yuan** takes a different approach to exploiting the potential information in monetary aggregates (and other financial variables). The authors construct a quantitative measure of the stance of monetary policy aimed at indicating whether policy is tight, easy, or neutral, relative to the objective of keeping inflation constant. More specifically, Fung and Yuan hypothesize that the stance of monetary policy is reflected in a weighted set of financial variables. The variables considered include the M1 monetary aggregate, the difference between a short-term and a long-term interest rate, the overnight interest rate, and the exchange rate. The stance of monetary policy is expressed as a linear combination of these four variables, with their relative weights determined from a VAR. The authors find that, among the four variables considered in the stance measure, only the overnight rate plays a significant role in capturing monetary policy actions.

Fung and Yuan use their stance measure to examine the Bank of Canada’s policy actions over the years. In this regard, the authors examine the impulse-response functions of the orthogonalized innovations to the stance measure, and so consider the dynamic responses of other variables in the VAR to monetary policy shocks. The results are consistent with the expected effects of a monetary policy shock; that is, 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. Fung and Yuan also find that the time series of the policy shocks is consistent with the historical record of monetary policy actions. The analysis also suggests that the Bank of Canada generally 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.

On the second day of the conference, discussion moved on to a topic that is at the leading edge of current monetary research—dynamic general-equilibrium modelling. **Robert Amano**, **Scott Hendry**, and **Guang-Jia Zhang** emphasize the role of financial intermediaries. Their paper focuses on the role that liquid assets can play in the decision-making of financial intermediaries and thus in the transmission of



monetary policy actions. The authors extend the standard limited-participation model by incorporating banks that optimize profits by allocating funds between long-term loans and short-term liquid assets. These financial intermediaries operate in an uncertain environment in which they have to guess at the future actions of the central bank.

The analysis suggests that an expansionary monetary policy may have smaller, but more protracted, effects when banks do not clearly understand the intent of the policy action. To the extent that financial intermediaries invest in liquid assets, rather than make loans, a monetary easing has a smaller positive real impact, and there is less inflationary pressure. Banks release the new liquidity created by a central bank action into the lending market only when they are certain that the central bank will not unwind that liquidity in the near future. The stance and direction of monetary policy can be misinterpreted for various reasons, including low policy credibility, policy shocks, or an environment clouded by other financial shocks. Such factors would complicate the efforts of financial institutions to understand the stance and direction of monetary policy.

Consistent with empirical observations, the effects of monetary policy actions are variable in this model. When the true intent of policy is clear, the transmission lag between the policy action and the economy is relatively short. In contrast, when the direction of monetary policy is unclear, the effect of monetary policy on output and inflation is more muted and delayed. Overall, the effects of monetary policy actions in this class of model depend on the degree to which policy uncertainty exists and on the ability of banks to adjust their lending behaviour in view of such uncertainty. More generally, Amano, Hendry, and Zhang argue for better modelling of the financial sector in DGE models, so that the dynamic responses generated correspond more closely to observed regularities in the actual economy.

The paper by **Mingwei Yuan** and **Christian Zimmermann** also explores the role of financial intermediaries, which allocate assets to loans or risk-free government securities, within a DGE framework. These authors focus on credit crunches and the effectiveness of monetary policy. A credit crunch (i.e., unusually conservative lending behaviour by banks) can occur in response to certain shocks. In the model, banks manage risk by choosing investments to satisfy a target loss/deposit ratio (derived from a benchmark

or normal state of the economy). When there is a downturn, this ratio can become binding, in which case banks reallocate their assets from loans to government securities. A credit crunch of this kind magnifies the overall reduction in lending and economic activity.

Yuan and Zimmermann carry out some experiments with their model, in the context of a credit crunch. An easing in monetary policy encourages banks to lend but also to increase their holdings of government securities. As a result, the policy easing may be relatively ineffective in ameliorating the effects of the credit crunch. In a second experiment, the banks relax their target loss/deposit ratio. This is much more effective in stimulating economic activity. One implication is that the behaviour of financial intermediaries—as well as rules that aim to underpin financial stability—has important effects on the transmission and effectiveness of monetary policy actions.

The final paper, by **Lawrence Christiano** and **Christopher Gust**, examines reasons for the surge of inflation in the United States in the 1970s. Of particular interest to the authors is the motivation of the Federal Reserve in stimulating rapid monetary expansion. The authors hypothesize that a rise in inflation expectations created a virtually irresistible incentive for increased money growth, which the authors call an “expectations trap.”

Christiano and Gust explore this hypothesis using a limited-participation model that incorporates a monetary policy rule estimated for the 1970s, when the response of the Fed to anticipated inflation was relatively weak. In their model, following a negative technology shock, output and employment fall, and inflation rises. The central bank reacts to the increase in inflation expectations by reducing liquidity to push up interest rates. However, given the accommodative 1970s-style reaction function, individuals understand that the nominal interest rate will go up by less than the increase in inflation expectations. That is, expected real interest rates fall. Consequently, individuals reduce their savings deposits, draining funds from the financial intermediaries. To compensate, and to try to reduce the upward pressure on nominal interest rates, the central bank injects liquidity into the financial intermediaries. Although this is in line with inflation expectations, output and employment, nevertheless, fall. In the model, the resulting stagflation persists for years.

With their model, Christiano and Gust show that a more aggressive response to the jump in inflation expectations would improve subsequent economic

performance. With a less accommodative monetary policy, output and employment would be better maintained, and inflation would also be lower. Finally, the authors argue that a conventional IS-LM model, with sticky prices, cannot account for major features of the 1970s as well as their limited-participation model does. In particular, they argue that the IS-LM model predicts that a self-fulfilling outburst of inflation is associated with an *increase* in employment and output, at odds with the experience of the 1970s.

Christiano and Gust conclude that avoiding future expectations traps and self-fulfilling inflation outbursts requires properly designed monetary policy institutions. These should put the central bank's commitment to price stability beyond doubt, so that jumps in inflation expectations will not occur in the first place.

## Comments from the Panel

Three different perspectives are evident in the commentaries of the panellists. **Charles Freedman** traced the evolution of research and the use of monetary aggregates at the Bank of Canada. Modelling has become more sophisticated, and increased attention has been paid to longer-run empirical relationships with the application of cointegration techniques. The VECM approach has taken centre stage in the Bank's analysis of M1. At the same time, the Bank has continued to carefully examine the effects of innovations on the demand for money and to consider whether new measures might be more helpful.

The Bank has adopted a new approach towards assessing the information contained in the monetary aggregates and comparing this with the staff projection (which is derived from a model in which money plays no explicit role). Economists from the Department of Monetary and Financial Analysis now make a separate presentation at the Bank's formal quarterly projection meeting of the alternative forecasts derived from the aggregates. (The Bank's regional representatives also give an independent assessment of the outlook, based on their surveys of about 100 businesses across the country.) The weight that will be placed on the various sources of information will ultimately depend on their track record. At the present time, economic activity in Canada is approaching potential, at least according to traditional measures of capacity output. But since there is considerable uncertainty about these measures, the Bank is placing increasing

weight on various indicators of future inflation, including the monetary aggregates.

Freedman added that since a short-term interest rate is the instrument of policy, central bankers found it difficult to accept models in which policy exogenously sets the money supply. The development of models in which money is endogenous, and yet is an active influence on the economy, provides a more persuasive argument as to why monetary aggregates might capture influences not picked up elsewhere in mainstream models.

Monetary general-equilibrium models contain a key role for financial intermediaries and yield some interesting insights. Nevertheless, Freedman thought that to gain acceptance in the tool kit of practising central bankers, these models would have to incorporate more recognizable features of actual financial systems. Perhaps if general-equilibrium modellers worked more closely with central bank specialists in financial structure there would be a fruitful two-way interchange.

The other central banker on the panel, **Marvin Goodfriend**, discussed why the macroeconomic models currently at the forefront of monetary policy analysis make no reference to the behaviour of money. One reason is that, since central banks have already established credibility for controlling inflation, policy changes in nominal interest rates translate directly into real interest rate changes. This favourable situation could break down. It was the collapse of credibility in the 1970s that caused the U.S. Federal Reserve to replace a federal funds rate target with a quantitative policy target from 1979 to 1982.

According to Goodfriend, money deserves a special place in monetary policy strategy, and circumstances may arise in which it becomes a necessary element. Building the public's confidence in a central bank's ability to reverse an inflation or a deflation would minimize beforehand the likelihood of such problems. Goodfriend (and later David Laidler) went on to describe a process in which changes in money in themselves contain inflationary or deflationary shocks above and beyond those captured by short-term interest rates.

Econometricians must be careful in empirical studies that employ techniques such as VARs, because policy actions and economic shocks are intertwined. Goodfriend argued that an autoregressive structure may be too restrictive to capture policy responses to shocks that include unintended effects of previous changes to

the policy instrument itself. These are likely to be more prominent in the current situation, where central banks generally want simply to hold inflation at about where it is and, hence, to avoid policy shocks.

**David Laidler** took a distinctly different approach to the potential role of the money supply. He suggested that monetary aggregates might be less useful to policy-makers in periods of unstable inflation, because monetary instability was itself likely to cause the erosion of existing empirical regularities. The difficulties with monetary targeting in the 1970s and 1980s illustrate this problem. Milton Friedman's money-growth rule was originally put forward in the 1950s as a means of ensuring that low inflation and steady growth, which had been achieved, would be maintained.

Low inflation has been restored in the 1990s using a macroeconomic framework in which monetary aggregates play no visible role. But now that the output gap is less than the margin of error in its measurement, the main problem for monetary policy has again reverted to keeping a well-performing economy out of trouble.

Laidler thought that the monetary aggregates are well adapted to this task, since their role in determining the long-run time path of inflation is uncontroversial and since in Canada the narrow aggregates are useful leading indicators of output. He admitted, however, that there was not a strong case for the reinstatement of monetary targeting, because there remain problems associated with institutional change.

Laidler concluded by encouraging DGE modellers to pay more attention to the money-creating activities of financial intermediaries. He recognized that this was a very difficult task, but the payoff could be a better understanding of why deposits, particularly those used for transactions, seem to play a causal role in spending decisions.<sup>2</sup> Such an understanding would increase our confidence in the information that we extract from the behaviour of monetary aggregates.

---

2. Laidler's views in this regard are provided in more detail in "Passive Money, Active Money, and Monetary Policy." *Bank of Canada Review* (Summer 1999): 15-25.

