Measuring Transactions Money in a World of Financial Innovation

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Introduction and Summary

It is generally accepted among macroeconomists that a relationship exists between money, output, and prices. A change in the money supply immediately affects financial variables such as interest rates, exchange rates, and asset prices. Changes in these variables affect the liquidity position of financial institutions, and this in turn influences the liquidity of firms and households and their spending decisions. In the short run this chain of events will affect employment and output, while nominal wages and prices will respond with longer lags.

Monetary aggregates, the sum of a subset of holdings of financial instruments by households and firms, enable economists to evaluate the relationship between money, output, and prices. Monetary exchange is seen as the defining characteristic of money and the condition needed to set the monetary transmission mechanism in motion, so an aggregate that most closely reflects transactions is often used to estimate this relationship.[1] Moreover, because the objective of monetary policy is the stability of an

1. Some economists think that the defining characteristic of money is its liquid store of value, and so they support the use of broader aggregates to study the relationship between money, output, and prices. For a more detailed examination of this school of thought, see McPhail (2000).

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aggregate price for goods and services, economists also seek a monetary aggregate that would closely reflect transactions for goods and services.

In an uncertain world, economic agents hold an inventory of cash, which likely varies over time, to buffer against shocks to income that might otherwise disturb their preferred pattern of purchases of goods, services, and financial assets. When a discrepancy between actual and long-run desired money holdings exists, it is a sign that economic agents will engage in monetary exchange to alter the flow of expenditures until money holdings return to their desired level. This process sets in motion a real balance, which is transmitted from agent to agent, triggering prices to rise. Thus, money as a medium of exchange is fundamental to the theory that fluctuations in money affect prices.[2] Transactions money is central to the buffer-stock theory, the cash-in-advance theory, or the search theory of the transmission mechanism.

The narrow aggregate, M1, defined as the sum of both currency held outside banks and demand deposits at chartered banks, has been the commonly used measure of transactions money in Canada during the last 30 years. M1 is intended to measure the money that economic agents hold for the purpose of settling transactions. However, the ability to measure transactions money and evaluate its relationship with output[3] and prices has been greatly altered over the last 30 years by two major waves of financial innovation.

In the first wave, from about 1978 to 1986, financial institutions offered new types of deposits that affected the opportunity cost of holding money and induced depositors to differently optimize their holdings of transactions balances. These new products included daily-interest chequing and savings accounts (which were not included in M1) and corporate cash-management packages. We estimate that the first wave gradually reduced the level of M1 by approximately 30 per cent as individuals and firms shifted transactions balances from traditional demand deposits into new types of deposits classified outside M1.

Around 1993 a second wave of financial innovation began to affect M1. As mutual funds grew, notice deposits held by the household sector started to be used less as savings vehicles, and demand deposits, which are included in M1 and which include investment dealer accounts, became less closely tied to transactions for purchasing goods and services and more to transactions related to the sale and purchase of financial assets. For the business sector the additional incentives for using current accounts (included

2. See Laidler (1999) for details of this characterization of the transmission mechanism.
3. Real GDP (referred to as output) is the most commonly used variable as a proxy for the aggregate volume of transactions for purchasing goods, services, and financial assets.

in M1) encouraged some firms to use these accounts for temporary savings as well as for transactions purposes. Our estimates suggest that, to date, the second wave of innovation, which is a mix of supply and demand shocks, has increased the level of M1 by up to 45 per cent as individuals and firms use traditional M1 deposits increasingly as a store of liquid value rather than as a pure transactions instrument.

As a result of these two waves of financial innovation, M1 has become less adequate and less stable as a representation of the financial instruments used to purchase goods and services. Hence, the relationship between M1, output, and prices has become less clear, and ability to use M1 as a guide for conducting monetary policy has been reduced.

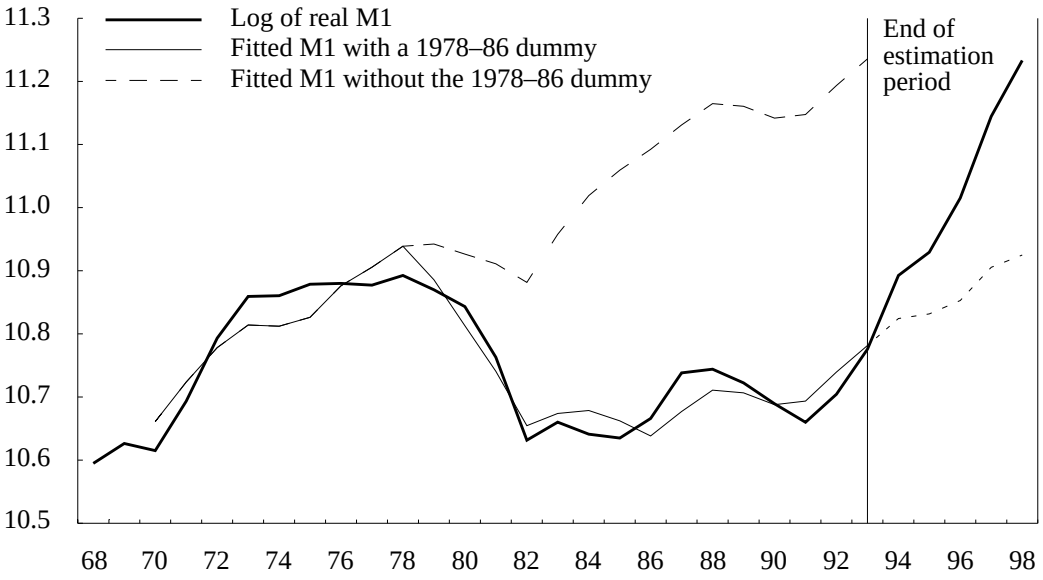
This paper discusses the issues of using narrow-money aggregates as a guide for policy in a world of financial innovation. We hope that further work will be able to identify and measure apparent instabilities in the holding of transactions balances, thereby enabling the construction of stable narrow monetary aggregates. We will show that in order to reduce the instability caused by waves of financial innovation, a robust measure must reflect the evolution of the financial instruments used for transactions purposes. Thus, a narrow monetary aggregate that aims to capture the money used for transactions must reflect agents' evolving choices of transactions instruments and the evolving menu offered to them. Failing to do this requires that great care must be applied in extracting information from a single imperfect narrow aggregate, and monitoring various definitions of narrow aggregates would be even more important for the conduct of monetary policy.

The remainder of this paper is organized as follows. Section 1 examines how in the past 30 years the M1 measure has not kept up with financial innovations and hence has become an inadequate representation of transactions money. Section 2 describes how financial innovations have affected the empirical relationship between narrow-money aggregates, output, and prices. Section 3 proposes work toward an aggregate that responds contemporaneously to financial innovation and briefly discusses the expected gains from such work.

1 Financial Innovation, Instability, and the Demand for M1

Typical money-demand equations, using real GDP and short-term interest rates as explanatory variables, cannot closely track the profile of real M1 during two subperiods of the past 30 years. This point is illustrated in Figure 1, which compares the profile of the logarithm of real M1 with the

Figure 1
Gross M1



Note: Estimation period: 1970–93 (annual frequency).

$$\ln(M1/CPI) = 0.8 + 0.78*\ln(GDP) - 0.12(0.5*R90 + 0.5*R90[t-1]) - 0.45*DUM78\text{–}86$$
$$(0.4)\ (4.7)\qquad (-3.7)\qquad (6.3)$$

RB2 = 0.90 SEE = 0.03 RHO = 0.6 DW = 1.1

fitted values generated by a very simple estimated money-demand equation.[4] However, the two subperiods in which these explanatory variables fail to explain the profile of real M1 correspond to two larger-than-usual waves of financial innovation. Figure 1 shows both the first wave of financial innovation during the 1978–86 period and the second wave, which began around 1993 and still seems to be in effect. In addition to using different econometric estimates to identify these subperiods, we also look at bank-by-bank data for various types of accounts in order to isolate rapid changes related to various innovations (e.g., the emergence of new types of deposits). A detailed presentation of the methodology used to calculate the magnitude of these shifts is presented in the appendix to this paper.

Typical money-demand equations cannot explain the profile of M1 over these two episodes because the explanatory variables used in this type of equation (real GDP, 90-day commercial paper rate [R90], and the consumer price index [CPI]) do not capture well the volume of transactions, the aggregate price attached to them, and the financial incentives offered by

4. Unless specified differently, the charts presented in this paper refer to the logarithm of real balances (using CPI as a deflator), often divided by their 1968 values.

the new types of deposits. Better explanatory variables would significantly reduce the level of instability.[5] This question will be addressed in section 3.

Currency, which represents about 35 per cent of M1, was relatively unaffected by the waves of innovation illustrated in Figure 2. Innovation has certainly affected the level of currency held outside banks (see our appendix for estimates), but it seems that the impact was relatively gradual and much less obvious than the impact on demand deposits.[6] In section 2 we show that the relationship between currency and prices was more stable over time than that of M1. The remainder of section 1 focuses on demand deposits.

1.1 The first wave: 1978 to 1986

In the 1970s, a substantial amount of research showed that there was a fairly stable relationship between a narrow measure of money (M1) and total spending.[7] Furthermore, the demand for M1 seemed to be linked to an interest rate variable by a relatively large and well-determined coefficient, thus facilitating the control of money growth by means of an interest rate instrument. In late 1975 the Bank of Canada announced a specific target range for the growth of M1. The Bank hoped that this quantitative information about the orientation of monetary policy would influence economic decisions throughout the economy in a way that would minimize any disruption involved in reducing the rate of inflation.

At the same time, however, the pace of technological change began to accelerate, chartered and near-banks became more similar and grew more competitive, and, in a high-inflation environment, interest rates were high and volatile. This combination of factors led to a wave of financial innovation and, specifically, the development of new deposit products.[8]

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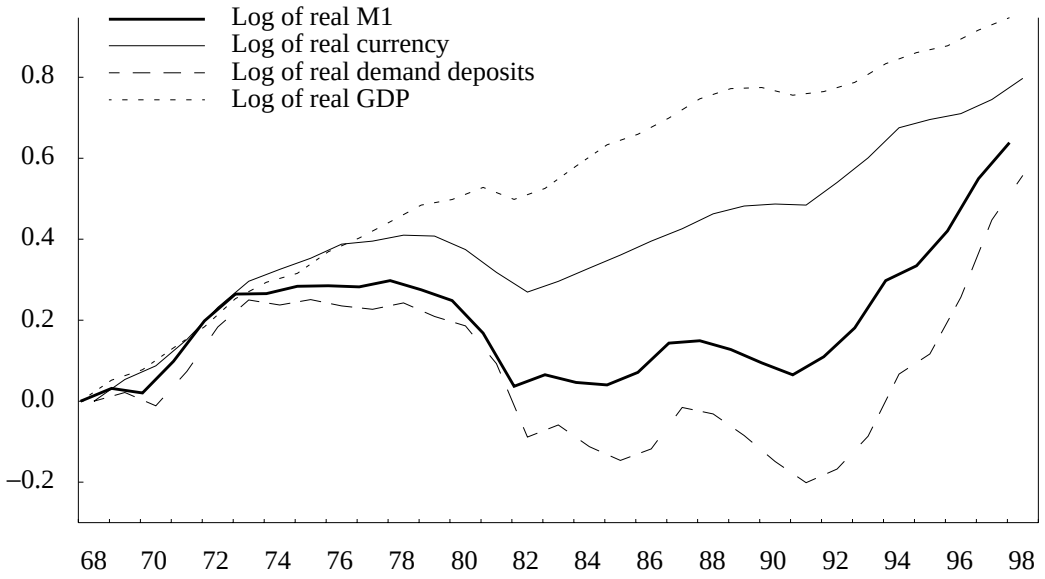
5. For instance, is the profile of transactions money used for purchasing financial assets well captured by the pattern of real GDP? Can we generate interest rate variables that would better capture the evolution of the return attached to various demand and notice deposits? Can we create variables that would reflect various features of transactions deposits (such as accessibility, attached lines of credit, and air-miles points).

6. The use of alternative means of payment (e.g., credit cards and debit cards), the availability of automated teller machines, and the possibility of better optimizing holdings of liquidity with the emergence of deposits paying daily interest (compared to what was possible with deposits paying interest only on the minimum monthly balance) resulted in a reduction of currency held outside banks. On the other hand, the introduction of $1 and $2 coins and, perhaps, some growth in the underground economy (see Laflèche 1994) have resulted in greater use of currency over the last decade. Our appendix presents estimates of the impact of these innovations in the 1978–86 and 1993–98 periods.

7. See Clinton (1973) and White (1976).

8. The historical account of the institutional developments over this period is based primarily on Freedman (1983).

Figure 2
Currency versus demand deposits



Note: Variables were divided by their 1968 value.

The impact of these innovations on both the household and business sectors is outlined below.

1.1.1 The household sector

The daily-interest savings account (DISA), introduced in 1979, was classified as a personal non-chequable notice account and thus was excluded from M1. Before this time, the standard household savings account paid interest on the basis of the minimum balance held in the account over the calendar month. The interest on DISAs was calculated on the daily closing balance, thus offering small savers the opportunity to earn near-market rates of interest on liquid assets held even for short periods of time. This change was a strong financial incentive to depositors to differently optimize their holdings of short-term liquidity. The attractiveness of this new type of account was also increased by the fact that nominal interest rates were seen as being high. Not surprisingly, these accounts proved to be very popular, and funds from traditional deposit accounts were rapidly transferred into DISAs. Although most funds were shifted from other savings products, a small part reflected reduced use of personal chequing accounts, and hence the decline in M1.

The technology that enabled financial institutions to offer such accounts also enabled a number of near-banks to offer daily-interest chequing accounts (DICAs), which were also classified as notice deposits

outside M1. They included features of both the daily-interest savings account and the personal chequing account. Competitive pressures led to a gradual spread of this "all-in-one" account: Major chartered banks offered this option to their clients in late 1981 and early 1982. Typically this account offered a rate of return just under the rate on daily-interest savings accounts on daily closing balances above some minimum balance (e.g., $1,000 or $2,000) and a much lower rate on daily closing balances below the minimum. These accounts became quite popular with the public, and as a result households transferred funds from demand accounts (which are included in M1) to these new chequable notice accounts.[9]

Figures 3, 4, and 5 illustrate the substantial transfer of household funds to these new accounts. The popularity of these accounts was immediate. From 1978 to 1986, we estimate that personal notice deposits (chequable and non-chequable) increased by about $13 billion (19 per cent) above a value extrapolated from their past trend. Of this amount, $2.5 billion was money that was transferred from personal chequing accounts (classified as demand deposits) into DISAs and DICAs. Note that fluctuations in short-term interest rates do not explain such transfers of funds. In fact, in both 1978 and 1986, the R90 was at the same average level of 9 per cent.

1.1.2 The business sector

In the mid-1970s, a combination of technological developments, competitive pressures in the banking sector, and the high opportunity cost of holding non-interest-bearing balances led to the introduction of "cash-management packages" in Canada. Initially these packages were only offered to large corporations and government organizations, but by the early 1980s similar schemes were being offered to intermediate-sized companies as well. The features of these packages varied across the banking sector. In some cases the banks paid interest on current accounts at a rate tied to the prime lending rate, while other accounts delivered implicit interest in the form of foregone service charges. Balances intended to be held overnight were often transferred into non-personal notice deposits, while balances available for more than one day were invested in short-term deposits. Figures 6 and 7 illustrate the shift from current accounts into non-personal notice accounts, mostly chequable notice deposits. We estimate this transfer of funds was in the order of $9 billion (61 per cent of current accounts and 18 per cent of M1) over the 1978–86 period.

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9. Funds from other chequable and non-chequable notice accounts were also transferred into DICAs.

Figure 3
Personal demand deposits

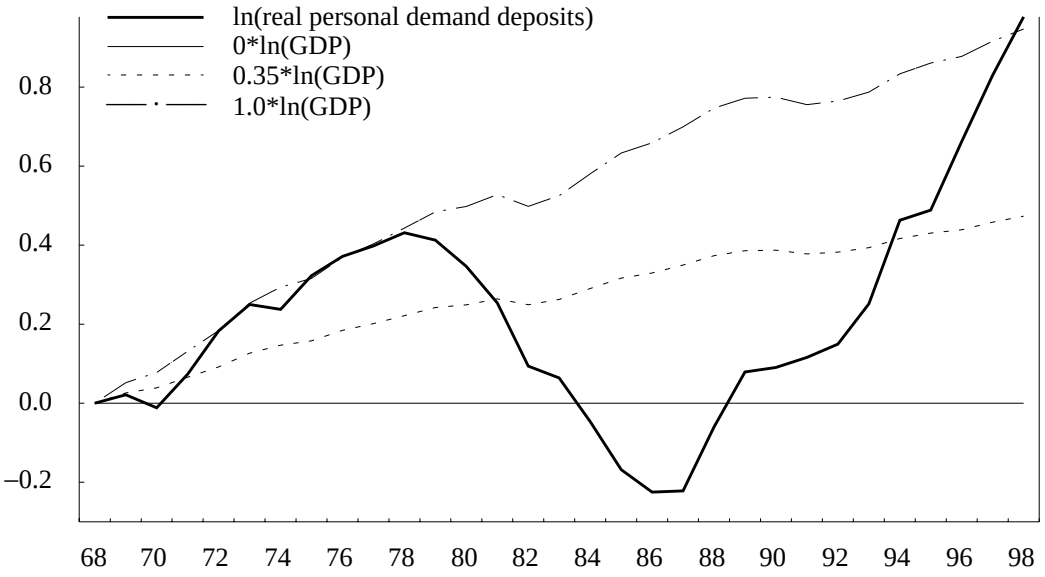


Figure 4
Personal non-chequable notice deposits

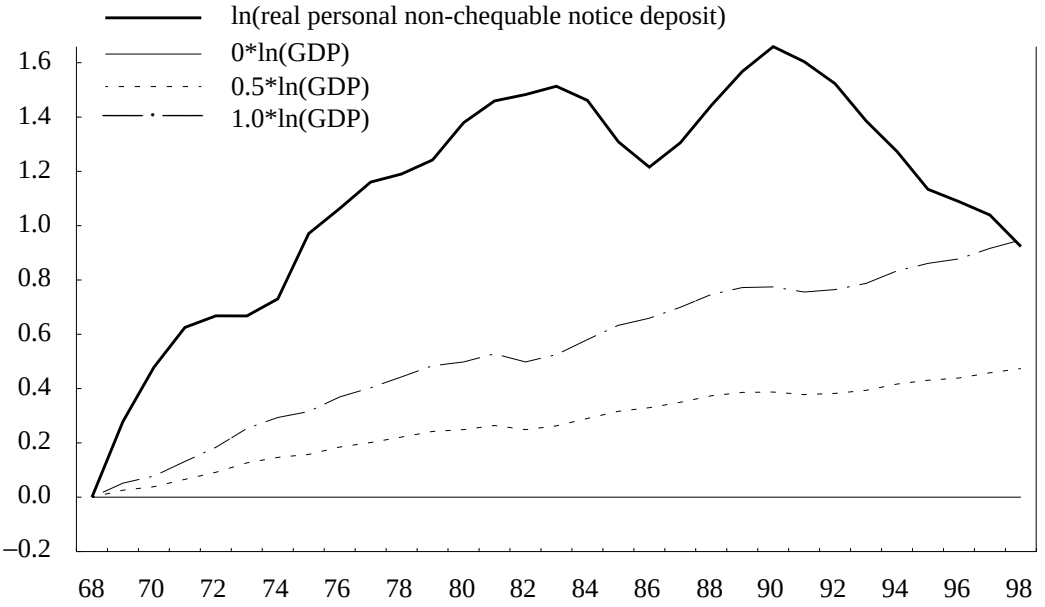


Figure 5
Personal chequable notice deposits

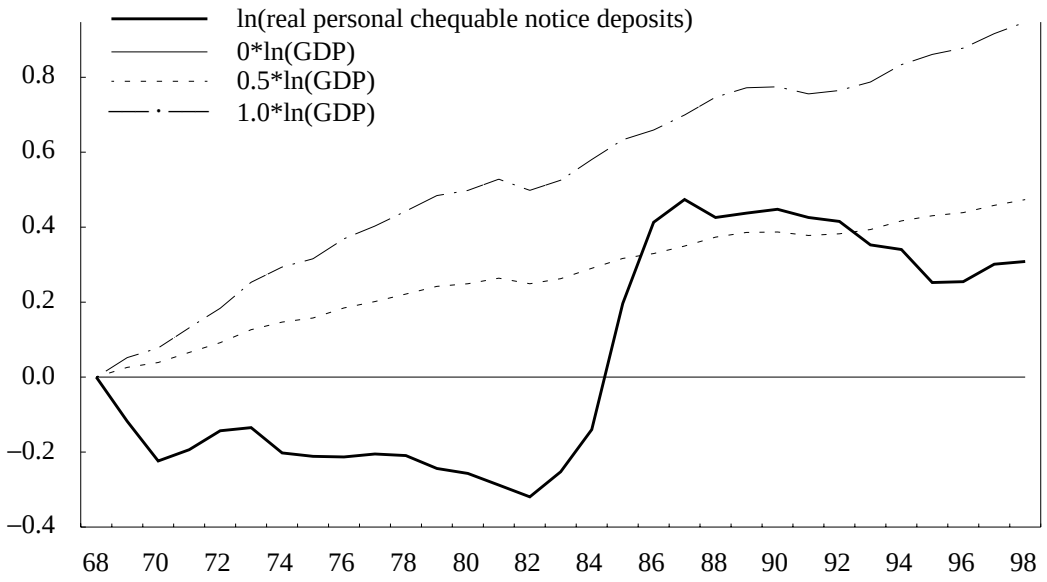


Figure 6
Current accounts

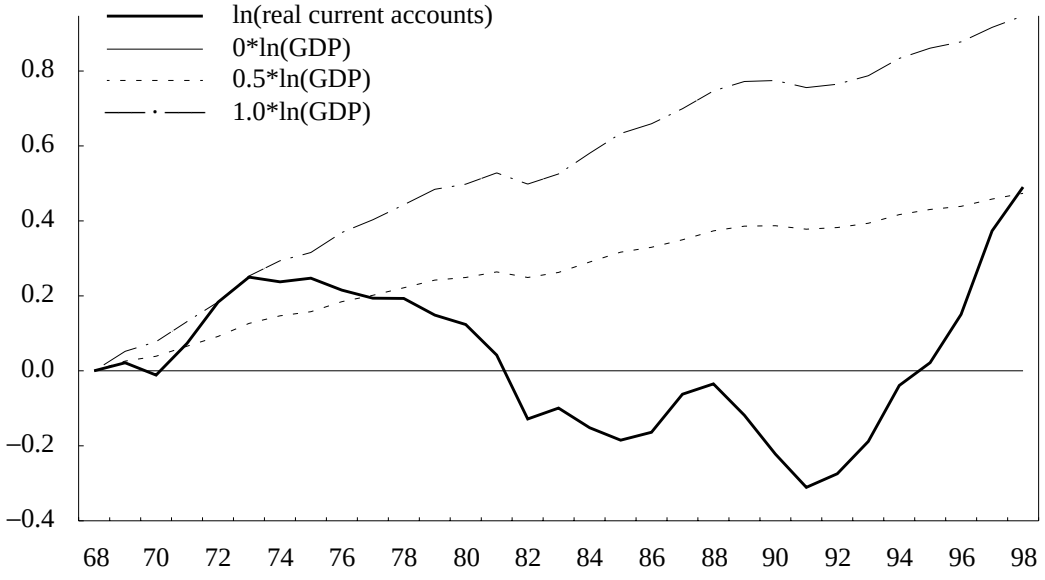
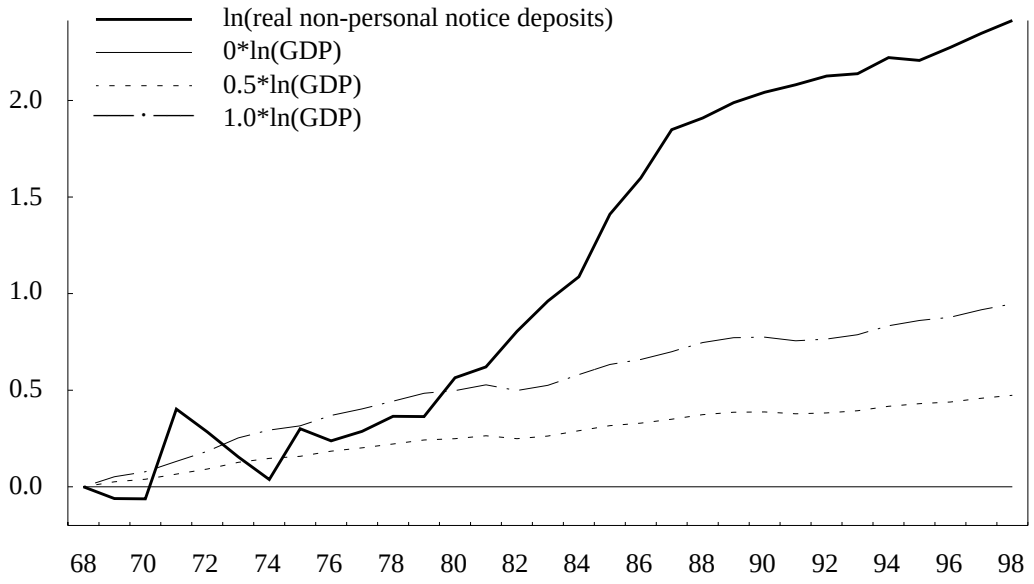


Figure 7
Non-personal notice deposits



Cash-management packages allowed corporations to reduce their levels of working balances by consolidating funds into a single account. The use of techniques such as pre-authorized account withdrawals and payroll service plans further helped businesses reduce their operational balances in non-interest-bearing demand accounts. As can be seen in Figure 6, the development of these packages significantly influenced the demand for current account balances and, hence, M1.

1.1.3 Searching for better measures of transactions balances

Over the 1978–86 period the combined effect of these financial innovations on the household and business sectors was a gradual reduction in the level of real M1 of approximately 30 per cent ($14 billion).[10] This significant shift was so difficult to interpret in the early stages that, by November 1982, the Bank of Canada formally announced it would no longer explicitly target M1.

10. Almost all the empirical studies demonstrate a significant shift in the demand for M1. However, there is quite a large variance in the estimated size of the shifts in these studies. The estimates are highly affected by the specifications, the estimation techniques, the data frequencies, and by the various ways of defining the dummy (e.g., a gradual shift from 1978 to 1981, as in Hendry [1995], versus a gradual shift from 1978 to 1986, as in the equation presented in Figure 1). Hendry's estimates presented in 1995 suggest that the first wave caused a downward shift in M1 of approximately 10 to 15 per cent, while the simple equation presented at the bottom of Figure 1 results in an estimate of 45 per cent.

In search of an alternative measure of transactions money, the Bank of Canada turned to M1A, which is the sum of M1 and daily-interest chequing accounts and non-personal notice deposits. M1A internalized the shift between personal demand accounts and DICAs. From 1980 until 1982 the behaviour of M1A appeared to fairly well reflect its historical relationship with total spending. However, Figure 8 shows that, after mid-1983, M1A began to grow more rapidly than could be explained by usual relationships, as chartered banks began to offer rates on the higher balances of DICAs that were comparable to short fixed-term deposits. People began to transfer money from traditional savings instruments into DICAs. As a result, M1A evolved in such a way that a large component was held for savings, rather than transactions, purposes.[11]

1.2 The second wave: 1993 to the present

By the mid- to late 1980s the pace of innovation affecting transactions balances slowed. Despite the effects of the first wave on the demand for M1, research at the Bank of Canada showed that M1 had again become a good indicator of output and inflation, perhaps because it captured a new stable pattern of transactions balances.[12] In 1995, Hendry found a stable, unique, long-run money-demand function for M1 over the sample period 1956 to 1993. In order to find this stable relationship, however, Hendry had to account for the financial innovation in the 1978–81 period with a dummy variable. His paper eventually became the basis for the development of an internal forecasting model that appeared to provide a promising predictor of inflation up to eight quarters ahead.[13]

However, shortly following the development of this forecasting model, the parameters of the model became unstable. A combination of economic factors and financial deregulation had once again set the stage for a second wave of financial innovation resulting in a shift in the demand for M1. In this second episode, depositors respond to the introduction of a large set of new features attached to standard types of deposit accounts and to a greater access to various types of investments. Nevertheless, both episodes are characterized by changes in the way depositors use their deposit accounts. The effects of this most recent episode on the household and the business sectors are outlined below.

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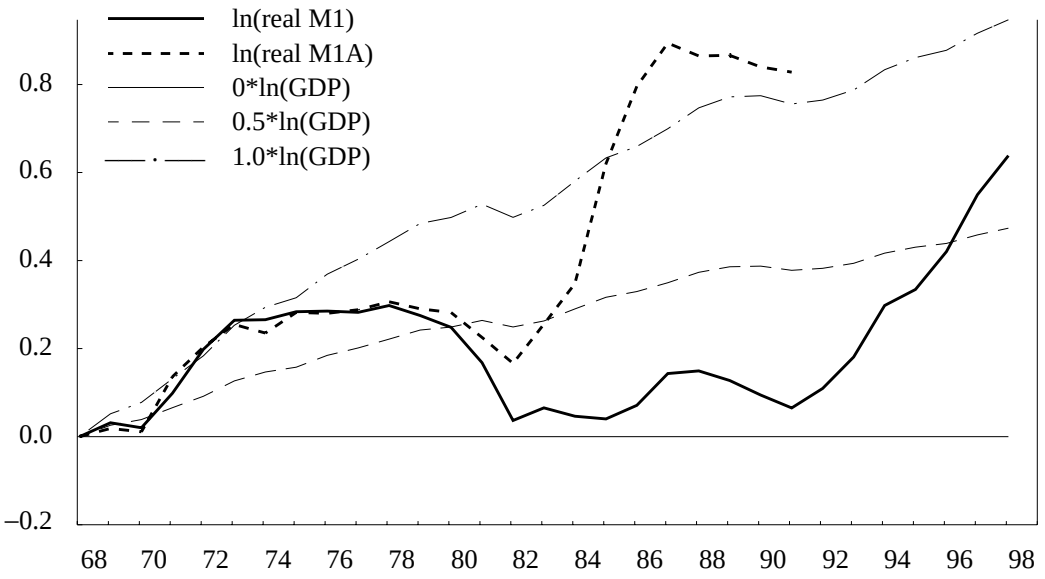
11. For a short time, M1A seemed to be a promising alternative to M1 because it exhibited a closer relationship to output and prices. In the end, the shift in M1A turned out to be significantly larger than the shift in M1.
12. See Poloz (1990).
13. For more detailed information about how this model is used in developing monetary policy advice, see Adam and Hendry (2000) and Engert, Fung, Nott, and Selody (1999).

Figure 8
M1 and M1A



1.2.1 The household sector

One of the reasons that tiered DICAs became so popular as a savings vehicle was their competitive rates of return. After 1990, however, interest rates were on a declining trend. The return on balances held in personal chequable notice accounts fell to about 0.5 per cent, barely more than non-interest-bearing demand accounts. In search of higher yields, households began to move their funds out of deposits and into bond mutual funds as well as equity and mortgage mutual funds.[14] Although mutual funds existed before 1990, low interest rates stimulated demand for them in the 1990s, and banks aided the shift of savings into them by offering these funds over their counters. Savings were transferred from term deposit accounts and notice deposit accounts. It seems that transactions balances held in chequable notice accounts (outside M1) were relatively unaffected by this movement, implying that these accounts were being used increasingly as a household's primary transactions account. To further complicate matters, personal demand deposits—accounts that traditionally represented household transactions mainly to purchase goods and services—have evolved to become more closely tied to savings decisions. In 1987, changes to federal

14. Other possible factors for the popularity of mutual funds may have been their increased accessibility, especially with the growing involvement of the chartered banks and the heightened sophistication of the household investor. For more on these developments, see Engert, Fung, Nott, and Selody (1999).

and provincial legislation allowed chartered banks to enter into the securities industry through subsidiaries. By 1988, the six major chartered banks had either created or acquired investment dealer subsidiaries. These dealers have on their balance sheets cash or margin accounts that maintain idle balances, otherwise known as free credit balances, intended for buying financial assets. In the late 1980s, the Bank decided to consolidate the balance sheets of the banks and their subsidiaries. As a result, the demand deposits arising from the inclusion of customer credit balances, which are available on demand from a dealer, were added to the personal demand deposit series and hence included in M1.[15] The argument for this was that there was virtually no difference in accounts characteristics between a credit-balance account at an investment dealer and an account at a bank. There is, however, a difference in the intended use of the money.

Figure 9 presents the level of free credit balances as a proportion of the total personal demand-deposit series. In a very short time, free credit balances grew to account for approximately half of the personal-demand-deposit series. Free credit balances increased by approximately $6 billion, an 89 per cent increase in personal demand deposits, from 1993 to 1998.[16] The rapid growth of personal demand deposits during the second wave is illustrated in Figure 3. Currently, a large proportion of the monthly fluctuation in personal demand deposits is related to changes in the level of free credit balances.

Although both are maintained for transactions purposes, demand deposits at chartered banks are held primarily for the purpose of buying goods and services, while free credit balances are held for buying financial assets. The rapid increase in the latter in the 1990s reflects the enormous popularity of mutual funds. Both of these accounts represent transactions money. However, free credit balances, money most likely held for the purpose of buying financial assets such as mutual funds, ultimately represent a portion of household savings, and fluctuations represent changes in future, as opposed to current, spending plans. Free credit balances account for only 8 per cent of M1, but it is a highly volatile component used mainly to manage savings rather than to transact for goods and services.[17] The existence of money held for different purposes may imply the need to have a

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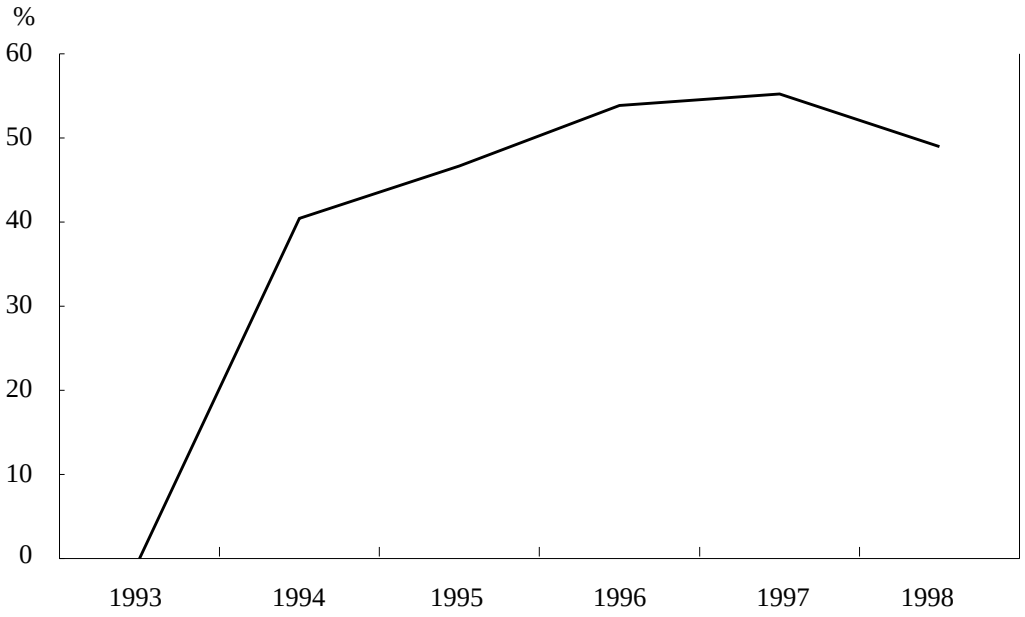
15. Approximately 90 per cent of balances in retail investment accounts are held by individuals. Free credit balances held by the business sector are consolidated into the non-personal-demand-deposit series.
16. Free credit balances form only 2.5 per cent of the current $300 billion stock of mutual funds.
17. Section 3 further explains the importance of distinguishing between money used to buy financial assets and money used to buy goods and services.

Figure 9
Free credit balances as a percentage of total personal demand deposits, annual series



broader set of variables (in addition to GDP, CPI, and R90) to explain the profile of these two types of balances.

Despite the important changes affecting the deposit accounts held by households, most of the instability in the demand for M1 in the 1990s appears to be more closely related to innovation in business accounts, which is the subject of the next section.[18]

1.2.2 The business sector

In the early 1990s, the market for small business funds became very competitive, and some banks began to pay interest on business accounts. One of the reasons the market became so competitive was that banks wanted to improve their relationships with small businesses. In 1994–95, banks developed marketing strategies, on both the asset and the liability sides, geared toward small businesses. Each bank's approach was slightly different. Some banks reduced fees on non-interest-bearing accounts, while others began to offer interest on their demand and notice accounts. Banks that already offered interest on their accounts introduced an attractive tier structure, with the top tier rivalling most short-term cash-management

18. Nevertheless, it is important to understand how household usage patterns have evolved to ensure that empirical measures best match theoretical concepts of transactions money.

instruments. The bottom line for the aggregate deposit market was that these innovations encouraged small businesses to hold their extra cash balances in deposit accounts. In other words, these new features encouraged some firms to put a larger portion of their liquidity into demand deposits and to begin using these accounts for temporary savings as well as for transactions purposes.

Another factor that affected the business sector was the elimination of differential reserve requirements on demand and notice deposits in the early 1990s, removing the incentive for banks to distinguish between demand and notice accounts.[19] There being virtually no distinction between these accounts, except for a withdrawal-notice requirement that is essentially irrelevant, bank classification of deposit accounts has become increasingly arbitrary. Some banks have chosen to classify new business accounts as current accounts and have pursued marketing strategies aimed at moving existing notice-account holders into current accounts by offering a better fee or interest rate structure on these demand-deposit accounts, leading to a shift from notice to current accounts. M1 growth was boosted temporarily. Figure 6 illustrates the large increase in current accounts that has occurred since 1993. We estimate that approximately $17.4 billion was transferred into current accounts between 1993 and 1998, an amount that translates into increases of approximately 80 per cent in the level of current accounts and 31 per cent in M1. Over this period, the use of non-personal chequable notice deposits also increased more than expected ($7.3 billion, or 29 per cent), while non-personal non-chequable deposits declined (–$1.4 billion, or –29 per cent).

Nevertheless, with both non-personal demand and chequable notice deposits now being used for transactions purposes, the classification distinction between demand and notice deposits makes little sense. Regardless of whether a firm's operating account is classified as a demand or a notice deposit, all account holders must give 24 hours' notice before withdrawing large sums of funds.[20] Therefore, by not including chequable notice accounts in our measure of narrow money, we are not adequately capturing the transactions balances of the business sector.[21]

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19. The phase-out of reserve requirements began in June 1992 and was completed by June 1994. Prior to the phase-out, reserve requirements on demand and notice deposits were 10 per cent and 3 per cent respectively. These requirements were imposed on the chartered banks, but not on other deposit-taking institutions.
20. A large sum of funds is considered at most institutions to be $10 million or more.
21. Moreover, given that these deposits are primarily held for operational purposes, they are the closest series, next to currency, to represent money's medium-of-exchange role. Consequently, some have argued for the use of a purely business aggregate to represent transactions money.

1.2.3 Searching for better measures of transactions balances

Our estimates suggest that the combined effects of financial innovation in the second wave caused the level of real M1 to shift by up to 45 per cent.[22] In light of these developments the Bank of Canada has begun to publish two alternative narrow-money aggregates: M1+, which is the sum of M1 and chequable notice deposits; and M1++, which is the sum of M1 and all notice deposits.[23] Although these alternative aggregates internalize the substitutions between demand and notice deposits, they also include deposits that are held primarily for savings purposes. Thus, movements in the demand for these aggregates may reflect changes in savings behaviour, as well as transactions intentions. For example, the faster growth of M1+ reflects mainly the net transfer of liquidity (about $25 billion) by the business sector from other sources into current accounts and non-personal chequable notice deposits. On the other hand, the slower growth in M1++ reflects the net shift from personal deposits to mutual funds (about $30 billion), outweighing the transfer of business liquidity into demand and notice deposits. The relationship between the level of these alternative aggregates and the level of output still appears to be distorted even if some of the transfer of funds discussed above is internalized (Figures 10[24] and 11).[25]

2 Empirical Implications of Financial Innovation

Although it is important to understand how financial innovations affect the nature of deposit products, policy-makers ultimately need to understand how these innovations affect aggregate measures of money and their empirical models. This section illustrates how the financial innovations described in section 1 have affected the correlation between narrow money, output, and prices.

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22. In contrast, simulations performed with Hendry's vector-error-correction model (VECM) suggest that the shift in M1 would be in the order of 25 per cent. See Adam and Hendry (2000).

23. Unlike M1, which includes data from only the Canadian chartered banks, M1+ and M1++ include data from credit unions and caisses populaires, as well as trust and mortgage companies, in order to reflect the similarities and substitutability of deposit accounts at chartered banks and near-banks.

24. In Figure 10, the very rapid growth of M1+ over the 1984–86 period reflects the transfer of funds from savings and fixed-term deposits to DICAs during the first wave of innovation.

25. The more financial instruments are included in a monetary aggregate, the more stable is the aggregate's behaviour. This makes sense given that broader aggregates more closely represent savings behaviour. For further information on the relationship between broader aggregates and inflation, see McPhail (2000).

Figure 10: M1+

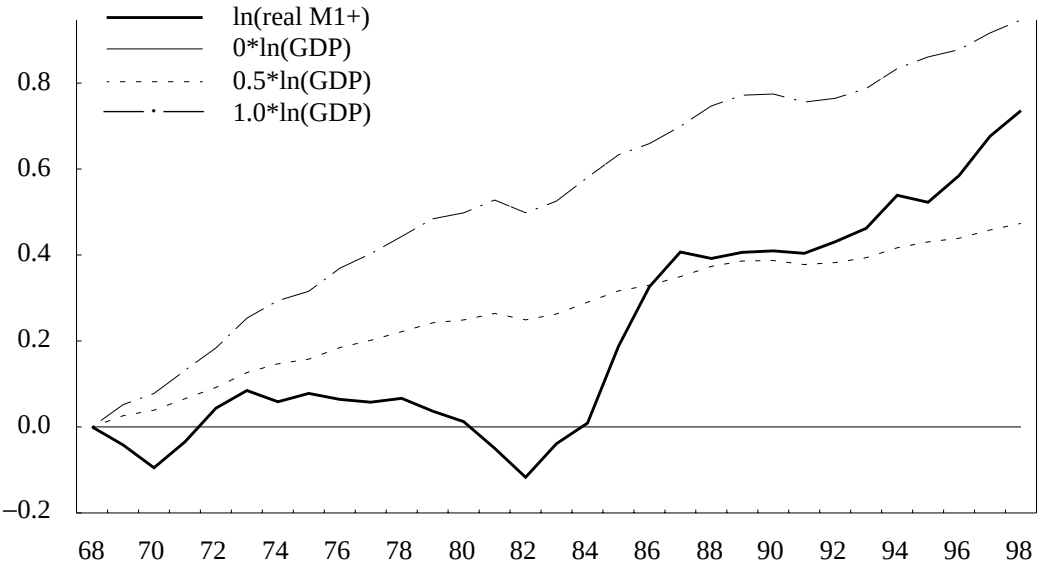
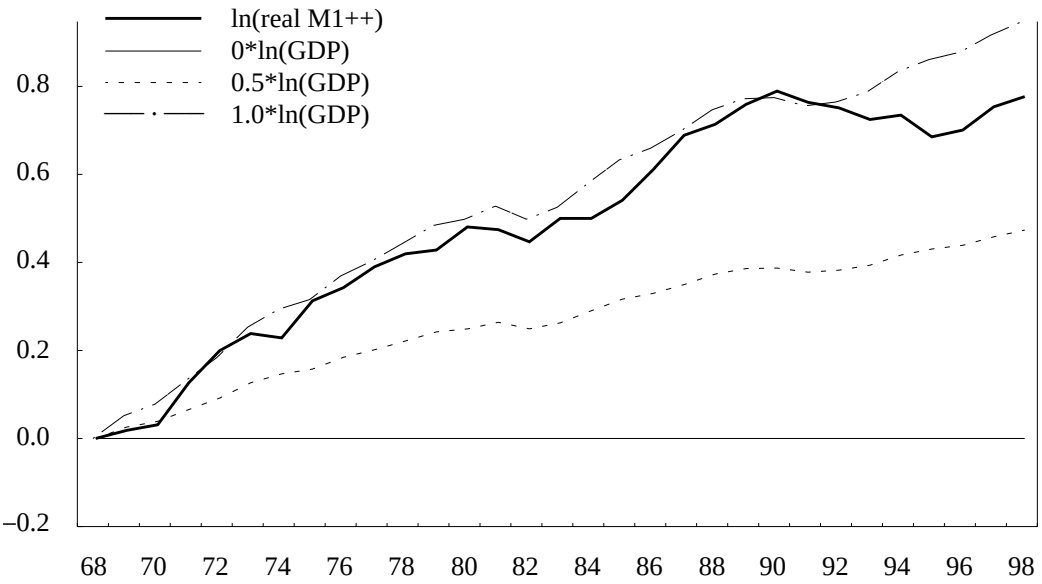


Figure 11: M1++



2.1 Data and methodology

It is well known that the correlation between money growth and inflation is relatively strong over a long horizon, while a relation between money and output growth may be observable over a much shorter period. Research at the Bank (see Muller 1990; Armour, Engert, and Fung 1996; and Fung and Kasumovich 1998) has shown that the effect of a monetary policy shock on

prices reaches its peak after two or three years, while the impact of an output shock is more rapid and can peak after only a few quarters—as early as two or three quarters. Therefore, for the purposes of this exercise, the correlation coefficients for money and prices will be estimated using annual data, whereas those for money and output will be estimated using quarterly data.

Table 1 lists the money aggregates used in this correlation exercise. Since currency almost always represents transactions money, it was chosen to act as an empirical check on the economic theory. M1, M1+, M1++, and M2++ were chosen to see how the waves of financial innovation have affected the Bank's published aggregates. The transactions aggregates TA1 to TA4 were constructed to account for some of the other possible combinations of financial instruments that may better represent transactions money. TA1 and TA2 may better capture transactions money than TA3 and TA4, given that business deposits are primarily held for operational purposes while money held in personal deposits may be used for either transactions or savings. Finally, in order to illustrate the difference between the behaviour of transactions and savings aggregates, as well as between personal and business aggregates, the remaining aggregates (personal M1++, business M1++, and personal savings) were also considered.

2.2 The correlation between money and prices

Table 2 presents the correlation coefficients between the rate of growth of the 12 selected monetary aggregates and the rate of growth of the CPI over the 1969–98 period. We present the correlation coefficients between the selected monetary aggregates and various leads and lags of inflation. In so doing, one can identify whether money is a leading or lagging indicator of future inflation. The time series plotted in Figure 12 illustrate the profile of inflation and money growth relative to their respective means over the 1969–98 period.

As Table 2 shows, aggregates affected significantly by the two waves of financial innovation are found to have weak correlations with inflation. These include M1, M1+, and transactions aggregates TA1 to TA4. However, currency and aggregates that internalize shifts between demand and notice deposits (M1++, personal savings, and M2++) are found to be highly correlated with inflation. These observations support the notion that money is a leading indicator of inflation, even though they include money held for purposes other than transactions. These results (especially the case of currency) lead us to believe that a measure of transactions money that is adequately corrected for shifts due to financial innovation would have done very well in predicting inflation throughout the entire sample period.

Table 1
Concepts and definitions

Monetary aggregates and their main components

Currency (CURR)
Personal chequing accounts (PCAs) (include free credit balances [FCBs])
Current accounts (CAs)
Gross M1
Personal and non-personal chequable notice accounts
M1+
Personal and non-personal non-chequable notice accounts
M1++
Personal fixed-term deposits, Canada Saving Bonds, mutual funds
M2++

Splitting balances between the personal sector and the business sector

Personal M1++ = PCA + personal notice deposits
Business M1++ = CURR + CA + non-personal notice deposits
(We assume that all of CURR [in fact, it is about 80 per cent] is held by the corporate sector.)

Personal savings

Personal savings accounts = FCB, personal non-chequable notice deposit, and (M2++ – M1++)

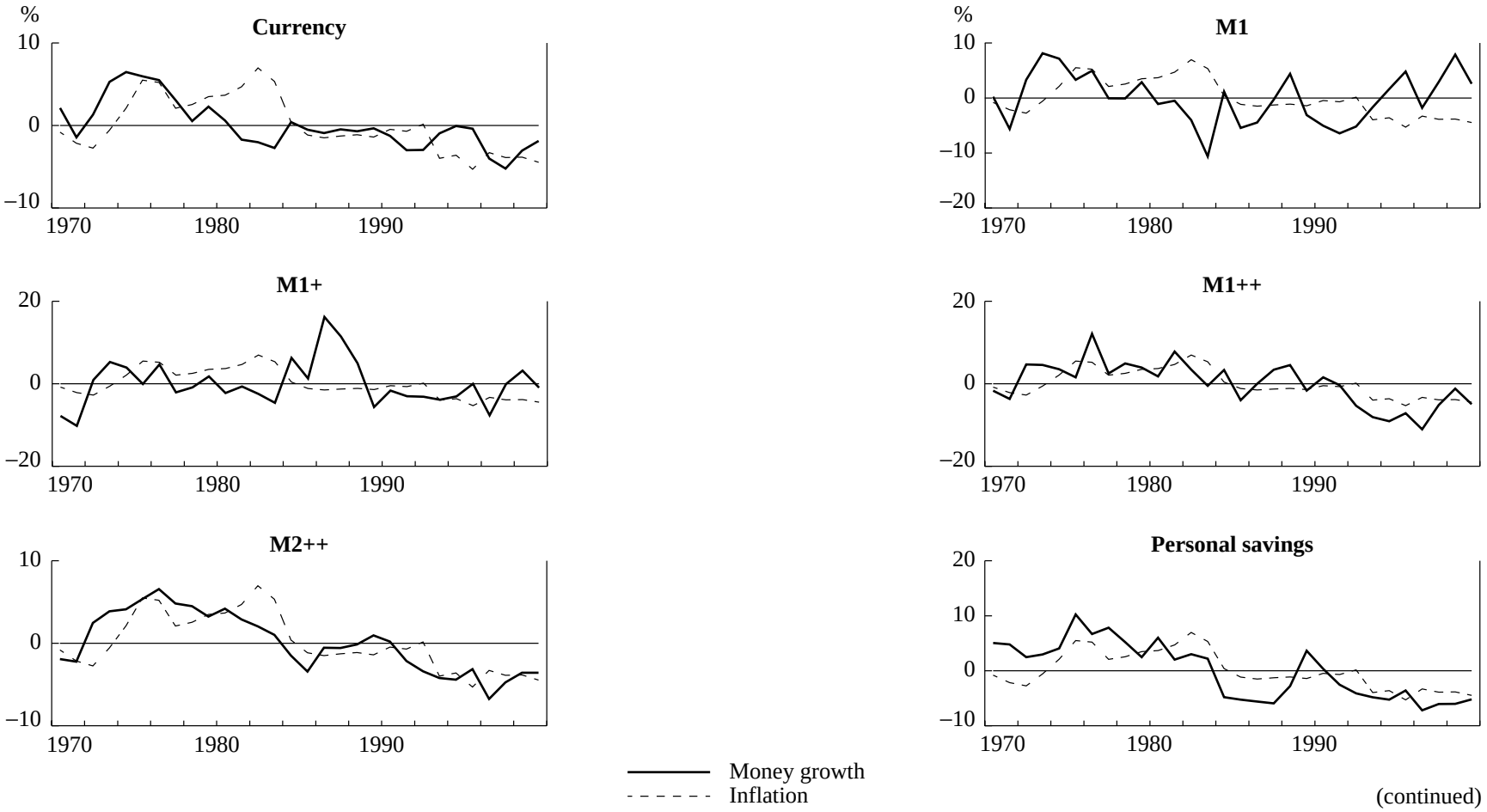
Additional transactions measures

TA1 = currency + current accounts
TA2 = TA1 + non-personal chequable notice deposits
TA3 = TA2 + personal chequing accounts (less free credit balances)
TA4 = TA3 + personal chequable notice deposits

Table 2
Correlation coefficients: Money growth versus inflation, 1969 to 1998, annual frequency

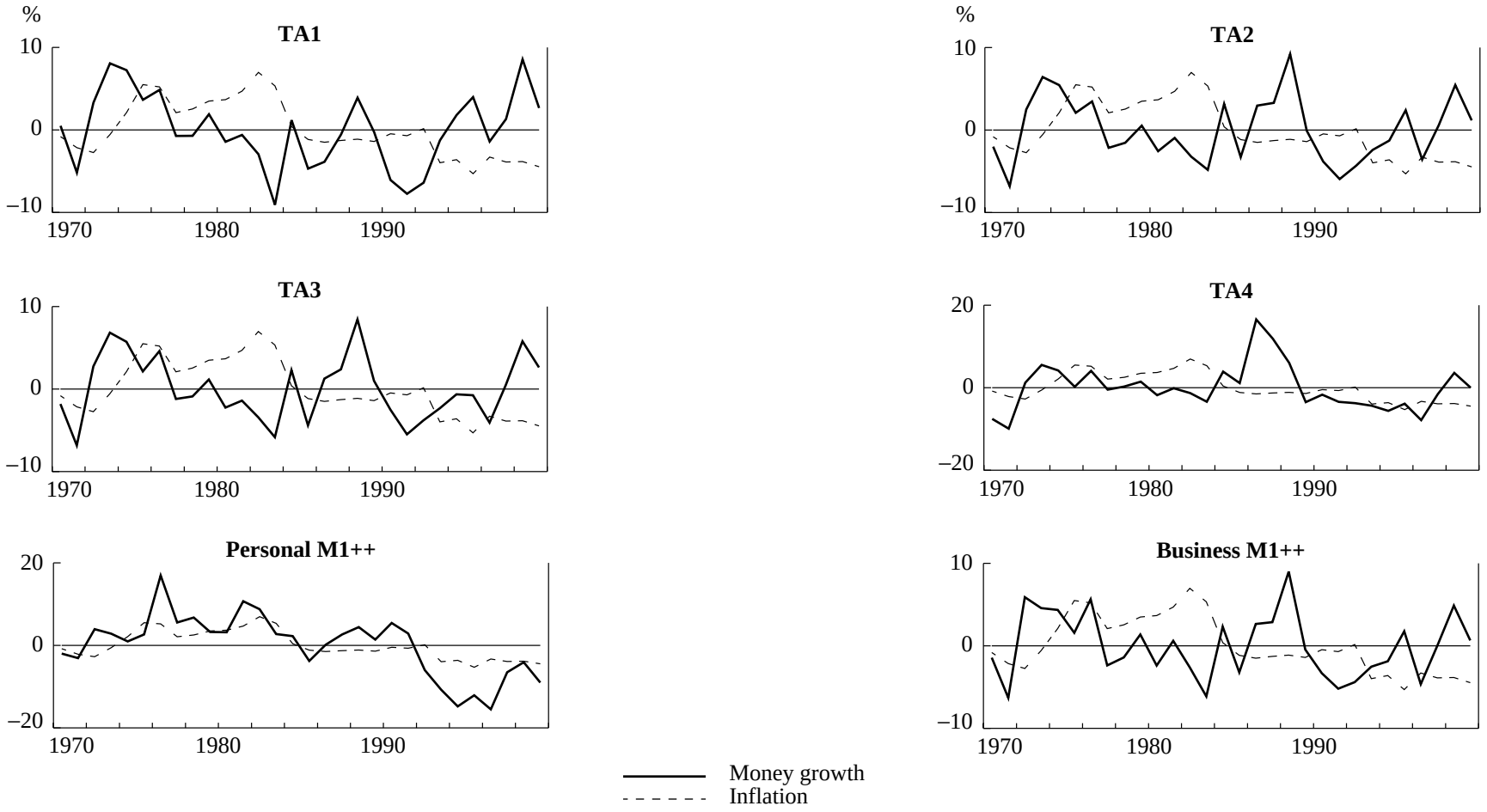
Rate of growth of money (*t*)	**Inflation rate (CPI)**						
	***t*–3**	***t*–2**	***t*–1**	***t***	***t*+1**	***t*+2**	***t*+3**
Currency	0.09	0.19	0.30	0.41	0.56	0.66	0.67
M1	–0.42	–0.36	–0.29	–0.16	0.12	0.40	0.48
M1+	0.24	0.05	0.00	0.01	0.10	0.18	0.17
M1++	0.30	0.43	0.59	0.67	0.73	0.74	0.65
M2++	0.29	0.44	0.63	0.77	0.86	0.88	0.80
Personal M1++	0.35	0.51	0.70	0.76	0.74	0.66	0.56
Business M1++	–0.21	–0.21	–0.14	–0.08	0.13	0.34	0.40
Personal savings	0.60	0.35	0.58	0.71	0.76	0.76	0.73
TA1	–0.41	–0.34	–0.28	–0.15	0.11	0.40	0.48
TA2	–0.24	–0.26	–0.20	–0.12	–0.07	0.28	0.32
TA3	–0.33	–0.27	–0.20	–0.09	0.12	0.37	0.41
TA4	0.25	0.09	0.08	0.10	0.20	0.28	0.25

Figure 12
Money growth versus inflation, deviation from mean growth, annual data



(continued)

Figure 12 (continued)
Money growth versus inflation, deviation from mean growth, annual data



As noted in section 1, aggregates such as M1 and M1+ were subject to dramatic shifts over the 1969–98 period. As a result the long-term relationship between money and inflation has been clouded. This seems to be especially true for M1 in the 1990s (see Figure 12). During a time when the rate of inflation was falling (from 5 per cent to 1.5 per cent), M1 was growing at rates between 15 and 20 per cent. By obscuring the relationship between money and prices, financial innovations have made it more difficult to interpret the information content of M1 for inflation. This simple exercise suggests that during a wave of financial innovation, broader aggregates that internalize the implied shifts, such as and M1++ and M2++, may be more useful leading indicators of price movement.

2.3 The correlation between money and output

Tables 3 and 4 present the correlation coefficients between various real money aggregates and output over the 1969–98 period as well as over the 1990–98 period. The time series presented in Figure 13 illustrate the profile of real GDP and real money growth relative to their respective means over the 1990–98 period.

Tables 3 and 4 show that all narrow aggregates, including those that were significantly affected by financial innovations, are found to be highly correlated with output. This continues to hold for the 1990s. Our results suggest that the financial innovations that affected the trend growth rate of many narrow aggregates did not significantly affect the profile of the short-term growth deviations around its mean. This implies that narrow aggregates have continued to be informative leading indicators of the cyclical movement of output. Such an outcome is certainly possible: Consider the case where a series of shocks significantly affect the trend profile of a chronological series while its seasonal pattern is largely unaffected.

These correlation coefficients are calculated ex post. Unfortunately, policy-makers rarely have the information necessary to contemporaneously identify and evaluate the impact of a financial innovation on the future trend of a monetary aggregate. Therefore, even though there appears to be a strong correlation between narrow aggregates and output, a good deal of judgment is needed to use these aggregates as leading indicators of future output. Recent work at the Bank of Canada on indicator models for output, using narrow-money aggregates, supports this conclusion.

3 Where Do We Go from Here?

When the first wave of financial innovation occurred, the Bank was explicitly targeting M1. In order to properly determine the appropriate

Table 3
Correlation coefficients: Real money growth versus real GDP growth, quarterly frequency, 1969Q1–1998Q4

Rate of growth of money (t)	Real GDP growth								
	t–4	t–3	t–2	t–1	t	t+1	t+2	t+3	t+4
Currency	0.03	0.14	0.29	0.43	0.55	0.63	0.63	0.58	0.50
M1	–0.09	–0.02	0.10	0.27	0.44	0.57	0.61	0.54	0.43
M1+	–0.01	0.01	0.08	0.20	0.35	0.47	0.50	0.44	0.33
M1++	0.12	0.06	0.09	0.20	0.35	0.50	0.54	0.50	0.38
M2++	0.26	0.34	0.44	0.51	0.58	0.62	0.59	0.51	0.42
Personal deposits	0.18	0.11	0.09	0.11	0.18	0.24	0.25	0.21	0.12
Business deposits	–0.11	–0.05	0.08	0.26	0.46	0.59	0.61	0.54	0.42
Personal savings	0.38	0.49	0.56	0.56	0.52	0.45	0.37	0.30	0.24
TA1	–0.09	0.00	0.14	0.31	0.47	0.59	0.61	0.54	0.44
TA2	–0.09	–0.04	0.07	0.23	0.41	0.56	0.61	0.55	0.44
TA3	–0.08	–0.04	0.07	0.22	0.40	0.56	0.61	0.55	0.44
TA4	0.05	0.08	0.14	0.24	0.37	0.47	0.49	0.43	0.32

Table 4
Correlation coefficients: Money growth versus real GDP growth, quarterly frequency, 1990Q1–1998Q4

Rate of growth of money (t)	Real GDP growth								
	t–4	t–3	t–2	t–1	t	t+1	t+2	t+3	t+4
Currency	0.17	0.06	0.30	0.51	0.65	0.69	0.64	0.53	0.38
M1	0.21	0.34	0.48	0.63	0.78	0.87	0.91	0.84	0.65
M1+	–0.01	0.07	0.21	0.39	0.58	0.75	0.84	0.79	0.58
M1++	0.00	0.03	0.11	0.23	0.39	0.53	0.62	0.58	0.41
M2++	–0.08	0.08	0.28	0.48	0.66	0.78	0.80	0.70	0.49
Personal deposits	–0.13	–0.20	–0.19	–0.10	0.04	0.19	0.29	0.28	0.16
Business deposits	–0.09	0.25	0.43	0.61	0.77	0.87	0.89	0.77	0.55
Personal savings	–0.10	0.06	0.26	0.48	0.65	0.75	0.72	0.57	0.33
TA1	0.19	0.36	0.54	0.71	0.84	0.90	0.90	0.79	0.59
TA2	0.14	0.29	0.47	0.65	0.80	0.89	0.90	0.78	0.55
TA3	0.09	0.20	0.34	0.48	0.62	0.74	0.81	0.78	0.65
TA4	0.00	0.08	0.21	0.35	0.51	0.62	0.68	0.63	0.46

Figure 13
Real money growth versus real output growth, deviation from mean growth, quarterly data

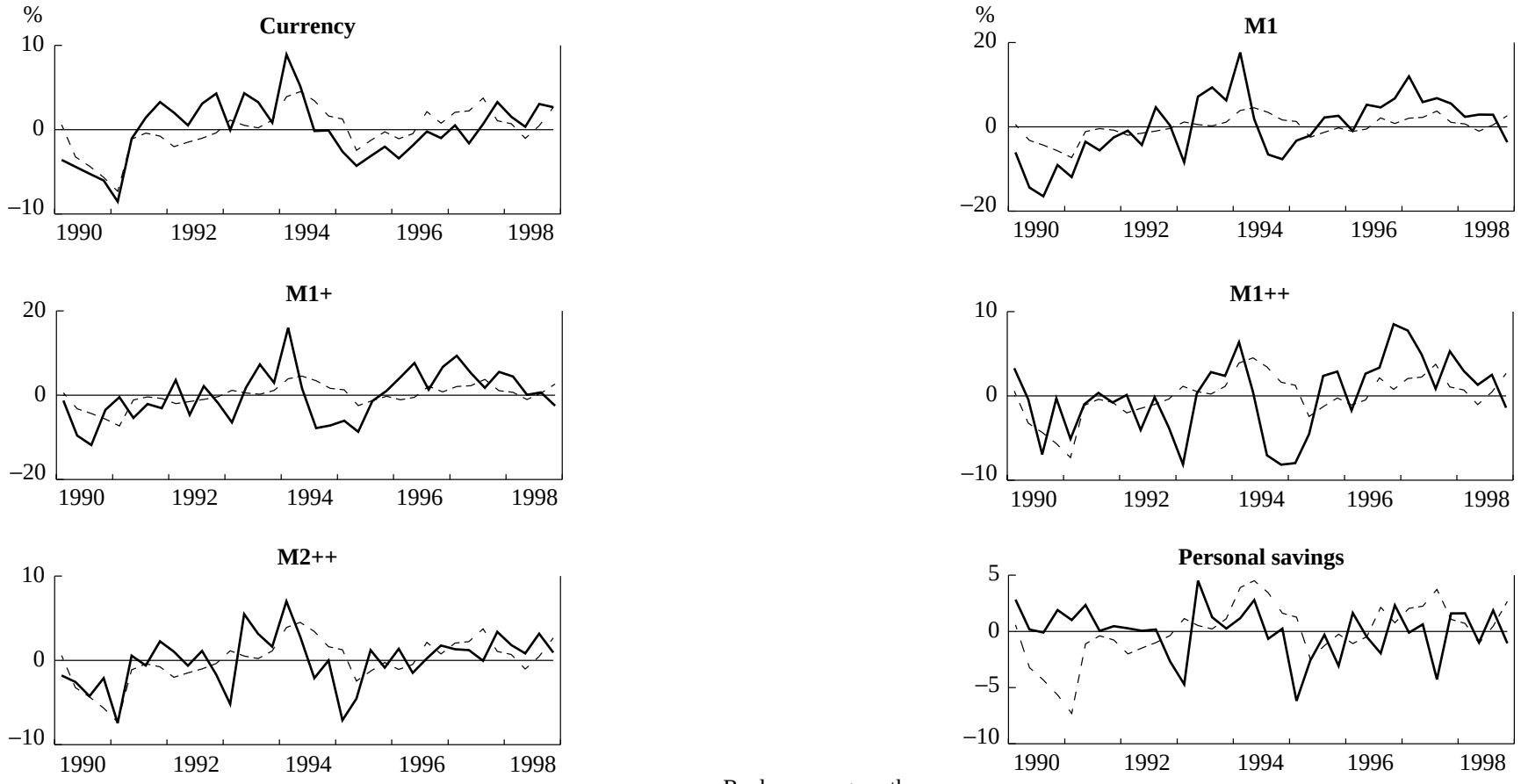


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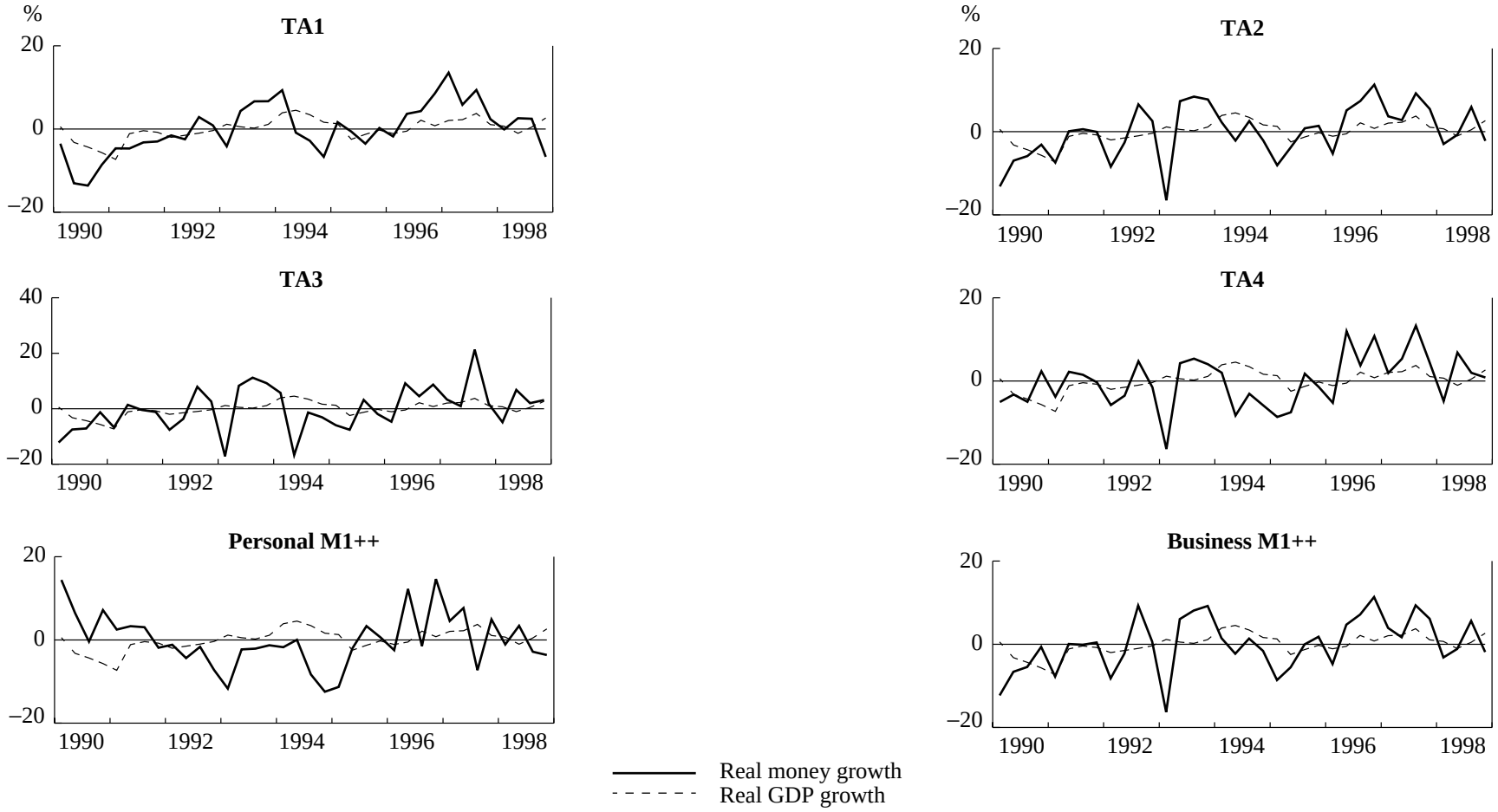
Figure 13 (continued)
Real money growth versus real output growth, deviation from mean growth, quarterly data



interest rate response when M1 deviates from its target range, the Bank requires a tight and stable relationship between M1, output, and prices.[26] After it abandoned monetary targeting, the Bank searched for a new monetary aggregate that demonstrates a stable relationship with total spending and interest rates. The first candidate was M1A, which initially showed promise but shortly after its development was also affected by financial innovation.

As a result, the Bank continued to pursue an alternative aggregate that could be used as a guide for policy. This pursuit eventually led to the publication of a study that empirically tested and compared the properties of 46 different monetary aggregates.[27] This comprehensive examination could not identify a better aggregate than M1 as a leading indicator of output or a better aggregate than M2 or M2+ as a leading indicator of inflation. However, the Bank also concluded that instabilities, mainly originating from financial innovation, would make it too difficult to base monetary policy decisions on targets defined with these aggregates.

This past approach of identifying, redefining, and empirically testing various monetary aggregates in the face of recurring financial innovations has yielded mostly unsatisfactory results. Policy requires a stable money-demand function, but unfortunately, in a world of financial innovation it is unlikely that any single aggregate that uses fixed weights of financial instruments will exhibit a time-invariant, stable relationship with prices and income. As a result, when for a period of time a particular aggregate exhibits such a relationship, its duration and economic significance are unclear. Moreover, in an ideal world the goal of policy-makers is to find an aggregate that is based on a strong theoretical foundation (i.e., the concept of transactions money), that exhibits a stable relationship with output and prices, and that can be explained within the framework of a rigorous economic model of the transmission mechanism.[28]

Unfortunately, policy-makers now have few alternatives but to pursue this course of action despite its weaknesses. For example, as discussed in section 1, the Bank has recently published the alternative aggregates M1+ and M1++, which attempt to internalize recent shifts owing to financial innovation. Unlike past attempts, however, the development of M1+ and M1++ is not intended as a first step toward another econometric exercise

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26. As Freedman (1983) points out, in the early stages of this episode the Bank of Canada's options included rebasing the target range, redefining the targeted monetary aggregate, or simulating an artificial series.

27. Twenty-three of them were simple-sum aggregates and 23 were divisia indexes. See Hostland, Poloz, and Storer (1988).

28. There is also the need to be able to influence the profile of the aggregate over time by moving very short-term interest rates.

designed to identify an aggregate that has a more stable relationship with output and prices. Although these alternative aggregates more closely represent transactions money today compared with other aggregates, such as M1, it is likely just a matter of time before another wave of financial innovation will occur and yield another unstable relationship. Thus, M1+ and M1++ are useful only in the limited sense that they provide extra information that can help us understand the impact of recent innovation on M1 demand. Moreover, because the Bank publishes these alternative aggregates, the general public can better appreciate the issues considered by monetary policy authorities.

Clearly, the basket of financial instruments that is available to and desired by economic agents for the purpose of transactions evolves over time. Thus, the set of instruments that best captures transactions money today is not the same as it was yesterday, nor will it be the same tomorrow. Technology reduces operating costs and thus ensures continual financial innovation and evolution of the financial instruments used for settling transactions.[29]

From an econometric perspective the practice of adding a new component to an existing aggregate in order to reflect a recent financial innovation incorrectly presupposes that this new aggregate will be consistent with the historic deposit choices of economic agents. It is unrealistic to expect that such a practice would necessarily result in a sustained and stable money demand. Furthermore, a well-defined aggregate at any particular point in time may be empirically rejected in time-series analysis. A narrow monetary aggregate that aims to capture the money used for transactions must reflect agents' evolving choices of transaction instruments. Failing this, the cycle of redefining monetary aggregates following each wave of financial innovation will continue. As a result, empirical instability and imprecise data will be a frequent concern.

One possible approach to this issue may be to develop an aggregate that responds contemporaneously to financial innovation. This task presents a difficult technical challenge and a difficult identification problem. This challenge should be of interest to policy-makers, bankers, and academics alike. Some of the issues that must be addressed to implement such an approach are:

- Identifying and quantifying a financial innovation as it occurs contemporaneously with respect to deposit products and economic

29. Consider a few examples of change that could have significant impact: e-cash, virtual banking, increased access to the payment system by a wider variety of payment intermediaries, and new types of accounts with various features to fulfill many purposes (e.g., transactions, savings, lines of credit, and air-miles points).

choices. The work of Pierre Siklos[30] and Feldstein and Stock (1992) are examples of research in this direction.

- Modifying the Bank's deposit classification system so that the categories better reflect the nature of financial products the banks offer for the purpose of transactions services. For example, chartered banks are still required to classify deposit products as either demand or notice accounts; however, the elimination of reserve requirements has rendered this distinction essentially irrelevant, so the classification of many deposit products has become quite arbitrary. Many accounts that are used primarily for transactions services are classified as notice accounts despite the fact that these funds are available upon demand.
- Identifying and separating the balances held in financial institutions that are used for transactions purposes, even though financial innovations continue to increasingly blur the line between transactions and savings. What are the characteristics of balances used for transactions purposes? We need better data on the turnover of the various types of deposits as well as on the link between the fluctuations of these balances and the withdrawal of cash and the use of debit and credit cards. Are free credit balances used primarily for buying and selling financial assets rather than goods and services? Is the GDP an adequate variable to explain the volume of transactions? Should we consider other volume and price measures?[31] Should we concentrate modelling efforts on the sum of these two types of transactions balances or should we try to explain each of them separately? If the Bank of Canada's inflation target is defined in terms of the CPI, should we concentrate more on balances held for transacting goods and services?
- Determining a methodology that both satisfies the necessary conditions of aggregation theory and ensures the maintenance of a continuous series despite the fact that the basket of financial instruments included in the narrow-money aggregate changes over time. For example, suppose that M1 best represents transactions money from 1986 to 1994, but from 1994 onwards, M1+ is a better representation. It is a challenge to construct a

30. See Bordo, Jonung, and Siklos (1993, 1997); Siklos (1993); and Raj and Siklos (1988).
31. We need to better understand how the transmission mechanism of inflation is affected by the demand for transactions balances related to the purchase of financial assets and by the price of these assets. These studies may affect the construction of monetary aggregates, the selection of new explanatory variables, or both.

time-consistent measure of transactions money for the last 30-year period, keeping in mind that the stock of M1 is around $90 billion but the stock of M1++ is over $260 billion.[32]

The rewards to following this approach could be substantial. The benefits would not only extend to the Bank, but also to academic researchers, financial institutions, and economic forecasters. Some of the benefits to these groups are:

- **Bank of Canada:** A narrow-money aggregate that adequately captures the theoretical specification of transactions money over time would provide useful insights into current economic activity. This, in turn, would improve the formulation and the implementation of monetary policy.
- **Forecasters:** Forecasts of macroeconomic variables, such as output and inflation, would be improved by a better measure of transactions money. Governments, businesses, and the public employ these forecasts to form their expectations. For instance, forecasts of inflation affect wage negotiations, budget allocations, and interest rate forecasts. Thus, constructing a stable monetary aggregate should improve economic agents' conditional expectations.
- **Academics:** Monetary aggregates are used in a set of macro "fundamentals" that are applied in empirical studies, and monetary general-equilibrium models are calibrated from such data. The literature suggests that such models poorly replicate the nominal features of the economy. The role of problematic monetary data in these results is an important factor deserving macroeconomists' attention.
- **Financial institutions:** Many banks rely on monetary aggregate data to provide insight into both macroeconomic activity and their performance relative to other financial institutions. If the institutional data are imprecise, market-share calculations and marketing decisions are affected.

There are many benefits in assembling a monetary aggregate from a basket of financial instruments with time-varying weights, but assembling it will take time. In the interim, the challenge for policy-makers is how to use the information contained in the existing range of narrow-money aggregates. At this time, the impact of financial innovation on the demand for a particular aggregate is very difficult to assess contemporaneously. Consequently, in order to extract information from money to predict future

32. Some work is being done at the Bank by Scott Hendry and Joseph Atta-Mensah to investigate different ways of constructing and/or estimating time-variant weights that would be used to create narrow monetary aggregates that are more responsive to financial innovation.

movements in output and prices, the Bank has begun to monitor a broad range of narrow-money aggregates. In so doing, it may more easily identify shifts in the patterns of agents' use of various transactions products with each wave of innovation.

It is possible that the ideal—a transactions aggregate that adapts contemporaneously to financial innovations—is unattainable. In the event, two alternative approaches can help policy-makers interpret narrow aggregates in the presence of financial innovation. First, placing greater emphasis on monitoring institutional developments in the banking sector might enable quicker identification of the effects of financial innovation on money demand. Second, investigating why M1 is correlated so closely with output and prices would be worthwhile. Is M1 primarily composed of business deposits? If so, it may be useful to develop and monitor a type of business aggregate.

In a world of financial innovation, no single aggregate, generated as a fixed combination of existing financial instruments, is likely to exhibit a time-invariant, stable relationship with prices and income, given that the basket of instruments used for transactions purposes evolves over time. Thus, narrow aggregates that aim to capture transactions money must be used prudently.

Given the implications of a poorly defined aggregate, much future research is needed. We need a multi-faceted program aimed at developing measures of transactions money that would react more rapidly to financial innovation. In the meantime, however, Bank economists should monitor a broad range of monetary aggregates; this enables us to follow the impact of future financial innovations on the total basket of financial instruments available for transactions services.

Appendix
Measuring Shifts in Narrow-Money Aggregates

Here we describe the methodology used to measure the two significant shifts that have affected narrow monetary aggregates and their components from 1969 to 1998. Given the role played by M1 over that period, special attention is given to this aggregate.

The data used in this exercise are the same as described in Table 1. We also select the annual frequency and use some of the estimated long-run elasticities presented in Hendry (1995). To quantify the amplitude of the two major shifts previously identified, we had to first take into account the impact of interest rates on money balances. So we tried to find a year at the beginning and end of each shift in which the interest rate was at roughly the same level. Fortunately, we were able to find such dates very close to the estimated start and end dates of the financial-innovation waves. In 1978 and in 1986 the average annual R90 value was 9 per cent.[1] Similarly, in 1993 and in 1998 the average value of R90 was 5 per cent.

For each innovation period we define the size of the shift to be the change in real balances between the beginning and end dates of the shift, minus the estimated change related to change in real GDP:

$$\ln(Shift\ /CPI)_i = \ln(M_i\ /CPI)_{end} - \ln(M_i\ /CPI)_{begin} - 0.6\ [\ln(GDP)_{end} - \ln(GDP)_{begin}],$$

where 0.6 is a long-run output elasticity generated by the M1 VECM described in Hendry (1995) and where M_i is any group of accounts listed in Table A1.[2]

This methodology is fairly crude. It assumes that the money balances are not far, on average, from their long-run equilibrium every year and that the long-run output elasticities of the balances are not too distant from each other. We assume that a full adjustment in the current period makes more sense with annual data, which we have used, than with quarterly or monthly data. We have recalculated the shifts related to financial innovation with a unitary income elasticity instead of 0.6. Such modification did not materially affect most of our estimates, and it did not alter our conclusions.

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1. If the increase of short-term interest rates from 9 per cent to 18 per cent is used to explain the reduction of real M1 in the 1978–81 period, it cannot explain why real M1 did not accelerate over the 1982–86 period when interest rates were returning to near the 1978 level.

2. Implicitly, we are using the following simple money-demand equation applied to annual data:

$$\ln(M/CPI) = a + b \ln(GDP) + c\ \text{R90}.$$

We would have liked to use more sophisticated econometric techniques, but it is difficult to rely on them when there is so much instability and when the modelling of financial innovation is so poor.[3] Moreover, for this paper, we are only looking for rough estimates of the size of the major shifts.

In 1986, the level of real GDP was 24 per cent above what it was in 1978. In both these years R90 was 9 per cent. Using an income elasticity of 0.6, real M1 should have increased by about 14 per cent. However, real M1 decreased by 20 per cent. These figures imply that there was a 30 to 35 per cent downward shift in M1 over that period. Similarly, over the 1993–98 period we should have observed an increase of 9.6 per cent in real M1, given the recorded 16 per cent growth of real GDP. We recorded 57 per cent growth in real M1 over that period, implying a shift of about 40 to 45 per cent in M1.[4] Table A1 presents the estimates of the size of the shifts for various narrow aggregate components for both waves.

Table A1
Estimates of the shifts affecting the components of the narrow aggregates, billions of dollars

	First wave 1978–86		Second wave 1993–98	
Currency	–2.2	(–13%)	3.0	(+11%)
Personal chequing accounts	–2.4	(–45%)	6.4	(+89%)
Personal chequing accounts less free credit balances	–2.4	(–45%)	0.0	(0%)
Current accounts	–9.1	(–61%)	17.4	(+80%)
Gross M1	–14.4	(–30%)	24.8	(+43%)
Personal chequable notice accounts	16.8	(+63%)	–7.8	(–13%)
Non-personal chequable notice accounts	7.8	(+773%)	7.3	(+29%)
M1+	11.0	(+13%)	32.0	(+20%)
Personal non-chequable notice accounts	–4.1	(–10%)	–28.0	(–42%)
Non-personal non-chequable notice accounts	–0.3	(–12%)	–1.4	(–29%)
M1++	9.0	(+6.3%)	–10.0	(–4%)

Note: Estimates for the aggregates differ substantially from the sum of the shifts in the components because the shifts for the aggregates are estimated independently from the shifts for the individual components.

3. Relying on econometric techniques is especially challenging if the shifts occurred at the end of the sample period.

4. If a unitary elasticity of money with respect to output had been selected, the estimated impact of the two waves of innovation would have been 40 to 45 per cent (instead of 30 to 35 per cent) for the first wave and 35 to 40 per cent (instead of 40 to 45 per cent) for the second wave.

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Discussion

Angela Redish

The issue of what is money has plagued empirical macroeconomics for at least two centuries. Aubry and Nott examine the difficulties the problem has caused for monetary authorities in Canada in the last quarter of the twentieth century. They emerge from their examination cautiously optimistic that future research will generate a narrow monetary aggregate with a stable relationship to output and that such an aggregate can guide policy. I am less hopeful.

The paper's argument can be put into four propositions:

1. Waves of innovation in financial markets destabilized the relationship between the narrow monetary aggregates and output in Canada over the last 30 years;
2. There exists a theoretical monetary aggregate, "transactions money," that has a stable relationship with output;
3. It is possible to empirically document the measure of transactions money;
4. We should try to empirically document transactions money.

Setting out the propositions of the paper so baldly may be stretching what the authors want to argue, but it does allow one to see where the evidence needs support. I will comment on each proposition in turn.

Proposition 1

The first and far larger part of their paper documents the first proposition. Aubry and Nott examine the extent and causes of "shifts" in money demand and how such shifts have affected the correlations between money and prices and output.

They have done an excellent job of documenting the institutional changes that underlie the waves of innovation. The nature of the problem as they see it can be shown by a simple example:

	Motive for holding monetary asset		
Component	**Time 1**	**Time 2**	**Time 3**
Personal chequing account	Transactions	Transactions	Savings
Personal notice chequable account	Savings	Transactions	Transactions

where times 1, 2, and 3 loosely correspond with the seventies, eighties, and nineties; personal chequing accounts are part of M1; and personal notice chequable accounts are part of M2.

In the authors' view the appropriate aggregate is transactions money, and if an empirical counterpart of that aggregate could be found, then it would have a stable relationship with output. But no one-to-one relationship existed between a specific component of the monetary aggregates and the motivation for demanding it. In the 1970s, M1 corresponded with transactions money, but in the 1980s, Canadians began to use personal notice chequable accounts for transactions, reducing their holdings of M1. As a result the M1/GNP ratio fell.[1] In the 1990s, cash ("free credit balances") held at banks' investment dealer subsidiaries became quantitatively significant. These free credit balances are treated as equivalent to personal chequing accounts, but are used primarily for savings rather than for transactions. As a result of this trend the M1/GNP ratio rose. The authors identify other changes with similar destabilizing effects on the relationship between monetary aggregates and output.[2]

The authors estimate the amount of these shifts and their effect on the correlations of output and prices with money growth. Their methodology is not complex, but they are not trying to get precise estimates; they are just trying to make the case that important shifts occurred in 1978–86 and 1993–99. They convince me—but I didn't need much convincing—that the shifts were quantitatively significant and confounded the correlations between M1 growth and inflation.

It is the other three propositions that I think need strengthening.

1. I am abstracting from interest rate effects to clarify the argument only.
2. In addition, they argue that the banks became less careful about classifying accounts after there were no differential reserve requirements to motivate the classification.

Proposition 2

Is there a transactions money that is stably related to output and inflation? Aubry and Nott loosely assert that all monetary theory—for example, cash-in-advance constraint models and search models—says "yes," but those models say "yes" as long as institutions are constant, and their paper is arguing for the importance of institutional change. I don't think we can conclude that an aggregate exists whose transactions velocity will be immutable in the face of changing transactions technology.

Proposition 3

If the ideal does exist, how will it be empirically implemented? This perhaps goes beyond the objectives of the paper, but the authors tantalize the reader with some implicit suggestions, and I would be interested to see at least the grounds for their optimism. For example, they may have in mind that it is possible to estimate the speculative (in the Keynesian sense) part of money demand and then determine the transactions volume residually. Is that what they mean? Is the speculative demand less unstable than the transactions demand?

In a very preliminary attempt to construct a transactions money aggregate, they define (section 2.1, "Data and methodology") four transactions aggregates that "may better represent transactions money" (see Aubry and Nott's Table 1). They compare the correlation between inflation and the growth rates of the existing monetary aggregates and that between inflation and the alternative aggregates. However, the alternative aggregates are not more highly correlated with inflation than are the traditional aggregates.

Proposition 4

How important is it that we identify transactions money? The authors argue that the ideal aggregate will (i) help the Bank know where the economy stands, (ii) improve forecasting of inflation, (iii) help build better macro models, and (iv) help financial institutions determine their market share. All these are probably fair enough (although I admit that I don't know what the last point refers to), but the authors could, I think, have strengthened their argument for a new aggregate by being more precise about its potential benefits.

Interestingly, I read (i) as saying that the ideal aggregate would not be used to implement monetary policy (i.e., as an instrument) but only to improve policy, essentially by giving a better view of the target. This

Table 1
Composition of monetary aggregates

	M1	M1+	M1++	M2++	TA1	TA2	TA3	TA4	PS
Personal accounts									
Personal chequing account	x	x	x	x			x	x	
Free credit balances	x	x	x	x					x
Personal notice—chequable		x	x	x				x	
Personal notice—non-chequable			x	x					x
Personal fixed-term, Canada Savings Bonds, mutual funds				x					x
Business accounts									
Currency	x	x	x	x	x	x	x	x	
Current accounts	x	x	x	x	x	x	x	x	
Non-personal notice—chequable		x	x	x		x	x	x	
Non-personal notice—non-chequable			x	x					

Note: TA, transactions aggregates; PS, personal savings.

reminded me of the insights of Poole (1970). He argued, using a simple stochastic IS-LM model, that interest rates and money stock can be equivalent as instruments of monetary policy in a deterministic model. In a stochastic model, however, the appropriate policy instrument depends on the relative size of shocks to the two curves. If the LM curve moves around much more than the IS (for example, because of the instability of the money-demand function), then an interest rate instrument should be used and the money stock should be permitted to adjust to demand. While there are potential problems of indeterminacy with interest rate rules, this is, I believe, close to what the Bank has been doing for the last few years—with a fair measure of success.

So the bottom line is that although Aubry and Nott have convinced me that there is no stable narrow monetary aggregate, I am less convinced than they are that there exists a theoretical concept—with an empirical counterpart—that satisfies their objectives.

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Discussion

William Robson

Introduction

Their paper, Jean-Pierre Aubry and Loretta Nott state at the outset, is motivated by a view that money is important in the transmission of central bank policy to the economy and that its behaviour ought, therefore, to be the subject of central bank scrutiny. However, the problem the Bank of Canada faces now is that financial innovations are making M1, the commonest measure of transactions money, an unreliable guide for policy.

Just as innovations in the early 1980s allowed easier transfer of unneeded transactions balances into interest-earning accounts, making the stock of M1 lower than it otherwise would have been, innovations in the 1990s—the inclusion of investment dealer accounts in bank deposits, the spread of interest-bearing current accounts, and the end of differential reserve requirements for demand and notice deposits—are making the stock of M1 higher than it otherwise would be. The authors examine institutional factors affecting M1 demand and, in light of their effects, identify alternative measures that would be less sensitive to them. They test these alternative measures by checking whether their growth rates correlate with output and inflation as well as or better than the originals.

They conclude that the shifts affecting M1 demand in the early 1980s and in the 1990s have been large, reducing M1 demand by some 30 per cent in the former case and increasing it up to 45 per cent in the latter. Disappointingly, however, the search for alternative measures of money is not very successful; immunity to shifts is gained at the cost of some of the leading-indicator properties that make M1 so intriguing.

Active versus Passive Money

As a long-standing believer in M1's importance, I am pleased to see this type of investigation going on at the Bank of Canada. Discussion of monetary policy by Bank staff has long emphasized the unique status of interest rates and the exchange rate in transmitting central bank impulses to the economy (see, for example, Freedman 1995). In many such accounts, disequilibria between money stock and money demand prompt conversion to other types of deposits or extinguishment of bank debt, and the tendency of some types of money to lead output and inflation is an incidental product of the pressures exerted by factors such as interest rates, the exchange rate, and bank credit. In such models, monetary aggregates are what commercial forecasters sometimes call "show" variables—displayed to satisfy idiosyncratic clients rather than because of intrinsic importance. The lines of influence between people and money run only one way: People influence money.

Without denying the importance of transmission of central bank impulses to output and inflation through interest rates, the exchange rate, or credit, active-money models claim that money created by one agent's interaction with a bank and then passed to other agents in the purchase of a good or service affects those agents' purchasing and pricing behaviour, and so on. In this view the lines of influence between people and money run both ways. I find this latter type of model convincing for several reasons.

On a macro level, models in which the money stock passively adjusts to what the economy demands leave the general level of prices disconcertingly indeterminate. This is an apt moment for me to suggest that Aubry and Nott's approach would have been more consistent with the active-money view if they had used a more comprehensive measure than the CPI to measure inflation and deflate the monetary aggregates. In a world of passive money where inertia and the output gap determine prices, the CPI might be reasonable. However, in a monetarist world the appropriate measure is the one covering the most transactions—the GDP deflator or a variation on it that excludes imputed items.

More concretely, accounts of retailers whose falling cash receipts lead them first to cut orders to suppliers (who, in turn, trim their purchases of inventories and labour) and then, if falling receipts persist, to cut prices or cancel planned increases (and tell their suppliers to do the same) identify key features of the world that passive-money accounts leave out. Rapid creation and destruction of money to keep individual and collective holdings in line with demand would be conceivable if all agents had complete information about the relevant variables and if changes in receipts of transactions money left each agent's expectations unchanged. In real life,

however, flows of money present compelling information, and the idea that changes in flows affect expenditures, output, and prices looks reasonable. Money doesn't just talk: It pushes.

The Missing Supply Side

This observation leads me to a second, more difficult reservation. Most work on monetary aggregates, including Aubry and Nott's, invokes demand-side variables alone in trying to explain behaviour that cannot be attributed to institutional or measurement changes. However, if the active-money view is right, such attempts leave something important out.

What might that be? A clue may be found in one of the most compelling criticisms of attempts to manage monetary conditions with reference to the level of short-term interest rates—namely that observable interest rates are only one side of the story and that what matters is how they compare to household and business expectations.[1] If the cost of funds is high relative to expected income growth, money is likely to come into existence more slowly and persist for less time; if the cost of funds is low relative to expected income growth, money will be created more rapidly and will persist longer. In previous work, David Laidler and I found that the spread between average private sector forecasts of nominal GDP growth and the rate on 1-month bankers' acceptances (BAs) entered a standard M1 equation significantly (Laidler and Robson 1995). Although the cyclical behaviour of this spread is similar to that of several summary measures of the slope of the yield curve, there are some differences (Figure 1).[2]

If this is a useful indicator of the impetus for money creation, then forces affecting M1 have varied over the past 30 years more than demand-side variables alone would indicate. Two events stand out: First, in the early 1980s a pronounced change in the gap between nominal growth and short-term rates from a positive to a strongly negative value occurred during a period when M1 grew more slowly than money-demand equations predicted; second, more recently a pronounced move from negative to more neutral values occurred during a period when M1 grew more quickly than money-demand equations predicted. In Laidler and Robson (1995), adding the forecast-GDP/BA-rate variable eliminated the dummy variable for the shift in M1 demand that is a major focus of Aubry and Nott's paper.

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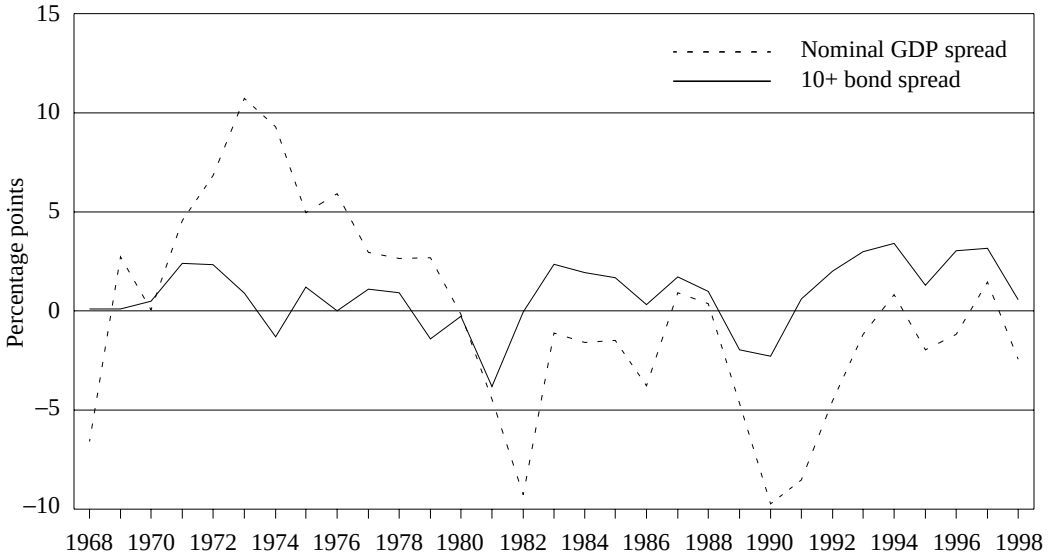
1. Similar criticisms apply to management that makes reference to the exchange rate.
2. In constructing Figure 1, I substitute actual nominal growth in the year shown for expected growth in the following year on the (convenient) assumption that forecasters and other Canadians tend to expect the near future to be much like the recent past.

Figure 1
GDP growth minus 1-month BA yields compared with bond spreads of 10 years or more minus 1-month BA yields



The possibility of perturbations from the supply side raises a further concern about the literature on demand shifts generally and the use of dummy variables in money-stock equations particularly. Much of what happened in the early 1980s—the movement of funds into daily-interest savings accounts and daily-interest chequing accounts that Aubry and Nott document—does not appear qualitatively different from any other response to a higher opportunity cost of holding non-interest-bearing money. Lowering the coefficient on opportunity cost by adding a dummy to an equation risks making it underpredict the response when the opportunity cost changes again—as now, when the trend toward compensating holders of transactions-oriented deposits is reducing the opportunity cost of holding them more than declines in rates on alternative assets would suggest. On this point it might pay to extend this research by using flow data to produce own-rate-of-return series for transactions balances, in case the interest rates Aubry and Nott use in calculating the 1990s shift overstate the opportunity cost in recent years.[3]

3. See Boessenkool, Laidler, and Robson (1997) for an exercise involving such a constructed series. I am informed that the Office of the Superintendant of Financial Institutions still collects data that could be used in this manner, and it may make sense for the Bank of Canada to review the surveys that produce these data to see if information more directly relevant to money demand could be obtained.

Some Further Comments on Empirical Relationships

Let me turn now to the second major investigation in the paper: the correlations between growth of various measures of money on the one hand and output and inflation on the other.

When it comes to correlations with inflation, the statement that currency almost always represents transactions money caught my eye. Currency is pretty heterogeneous stuff. Over the past 30 years the value of $100 and $1,000 notes in the total value of all bank notes outstanding has grown from less than 20 per cent to more than 50 per cent (the share of $1,000 notes alone has grown from 1 per cent to more than 10 per cent). One would expect a rising price level to generate higher demand for large-denomination notes, but the most rapid increase in their share occurred in the early 1990s. Since I imagine that few of us in this room keep half our cash in large-denomination notes, I wonder if their role in the economy is different from that of their small-denomination counterparts.

The only evidence I bring to this discussion (Table 1a) is from an exercise similar to that underlying Aubry and Nott's Table 2, which looks at the correlations between different money growth rates and inflation. With the exception of the series for large- and small-denomination bank notes,[4] I report results only for the money measures I was able to construct from the data on CANSIM; also, I use the deflator for "money" GDP—GDP less imputed rent (the most important expenditure item that does not involve money)—so as to focus on a price index more consistent with the quantity theory of money.

The figures for large and small notes in Table 1a cover those both inside and outside banks, so they are not strictly comparable to the other measures in the table. They hint, however, that there may be different information in the two series and that large notes are the more powerful leading indicator of inflation—suggesting that further investigation of how different denominations of notes are used might yield some insights into the behaviour of currency as a whole.

The other results from Table 1a are similar to those presented by Aubry and Nott (although the contemporaneous and year-ahead correlations between currency and M1 growth on the one hand and the money-GDP deflator on the other are 14 to 18 percentage points higher than those between money growth and the CPI). However, I read them slightly differently. The broader aggregates are informative about where inflation is now, but as for where it is likely to go next, the changes in the correlation

4. I am grateful to Suzanne Perreault and Matthew Leman at the Bank of Canada for their assistance in obtaining these series.

Table 1a
Correlation coefficients: Money growth versus inflation, 1969 to 1998, annual frequency

	Inflation rate (money-GDP deflator)						Difference in coefficients*		
Money growth (*t*)	***t*–2**	***t*–1**	***t***	***t*+1**	***t*+2**	***t*+3**	***t*+1 – *t***	***t*+2 – *t***	***t*+3 – *t***
Currency	0.31	0.42	0.55	0.70	0.69	0.59	0.15	0.14	0.04
Large notes	0.36	0.36	0.48	0.69	0.67	0.49	0.21	0.19	0.01
Small notes	0.46	0.57	0.66	0.75	0.77	0.69	0.09	0.11	0.03
Demand deposits	–0.40	–0.27	–0.21	0.01	0.21	0.24	0.22	0.42	0.45
Net M1	–0.25	–0.13	–0.04	0.25	0.45	0.42	0.28	0.48	0.46
Gross M1	–0.30	–0.14	0.01	0.30	0.48	0.42	0.29	0.47	0.41
M1++	0.50	0.69	0.64	0.68	0.65	0.53	0.04	0.01	–0.11
M2+	0.52	0.69	0.85	0.84	0.75	0.58	–0.01	–0.10	–0.27

* Difference in coefficients: [coefficient at] *t*+1/*t*+2/*t*+3 minus [coefficient at] *t*.

coefficients from time *t* to times *t*+1 and *t*+2 suggest M1 (and TA1 in Aubry and Nott's results) are more useful. (Strictly speaking, the difference in the coefficients' absolute values conveys new information, but turning points seem interesting enough to warrant attention to the total difference.)

By way of emphasis, Table 1b shows a more dynamic and, I think, more intuitive representation of the same relationship: the correlation between real money growth and changes in inflation (again, using the deflator for money GDP in both series). The ability of all forms of money to predict changes in inflation one year ahead shows starkly in this table; items in which currency looms large outperform broader measures.

When it comes to output, I have only minor additions to Aubry and Nott's observations. The correlations between quarterly growth in money deflated using the money-GDP deflator and quarterly growth in money GDP differ somewhat from those they report. The contemporaneous correlations are lower and the leading-indicator properties of M1 and TA1 (as measured by the difference between correlations at time *t* and times *t*+1, 2, or 3) are stronger. Tables 2a and 2b show correlations between year-over-year growth rates in money (deflated by the money-GDP deflator) and money GDP; year-over-year growth is used to reduce the importance of the fact that the large- and small-note series are not seasonally adjusted.

For the currency component it is interesting to see that the leading-indicator properties that the inflation data suggest exist in the series for large-denomination notes appear in the correlations for the entire period from 1976 to mid-1999. However, they are less apparent in the 1990s, perhaps indicating that large notes are less "active," at least in the above-ground economy, than they were previously. Turning to bank deposits, it is clear that, especially during the 1990s, the narrower aggregates more subject

Table 1b
Correlation coefficients: Real money growth versus changes in inflation, 1969 to 1998, annual frequency

	Change in inflation rate (money-GDP deflator)						Difference in coefficients*		
Real money growth (*t*)	***t*–2**	***t*–1**	***t***	***t*+1**	***t*+2**	***t*+3**	***t*+1 – *t***	***t*+2 – *t***	***t*+3 – *t***
Real currency	–0.32	–0.35	–0.16	0.54	0.46	0.32	0.70	0.62	0.48
Real large notes	–0.43	–0.44	–0.09	0.64	0.39	0.13	0.73	0.48	0.22
Real small notes	–0.23	–0.29	–0.16	0.50	0.55	0.36	0.66	0.72	0.53
Real demand deposits	–0.15	–0.07	–0.09	0.32	0.24	0.04	0.41	0.34	0.13
Real net M1	–0.25	–0.18	–0.11	0.45	0.37	0.11	0.56	0.48	0.22
Real gross M1	–0.23	–0.13	–0.03	0.48	0.33	0.06	0.51	0.36	0.09
Real M1++	–0.10	–0.01	–0.36	0.37	0.28	0.14	0.74	0.64	0.51
Real M2+	–0.17	–0.04	0.14	0.41	0.38	0.15	0.27	0.24	0.01

* Difference in coefficients: [coefficient at] *t*+1/*t*+2/*t*+3 minus [coefficient at] *t*.

to shifts—demand deposits and net M1 above all—have been strong leading indicators of output. Frustratingly, broader aggregates intended to internalize shifts tend not to have that attractive quality; M2+ stands out for the inverse correlation between its real growth rate and that of aggregate spending.

Where Do We Go from Here?

Let me close with two observations on future directions for research. First, if money plays an active role in the transmission mechanism, the Bank of Canada ought to continue searching for aggregates that it can monitor to ensure that its actions are having their intended effect before any problems show up in output and inflation. I have noted my reservations about dummy variables and the possibility that defining opportunity cost in terms of money market rates alone understates recent declines in the cost of holding transactions money. That said, Aubry and Nott's paper sheds welcome light on potentially reliable measures of money.

Second, however, if money plays an active role in the economy, we need ways of describing its behaviour with reference to more than just variables affecting demand for it. Aubry and Nott's approach is oriented entirely around demand, asking what balances agents hold for transactions purposes. But if portfolio reallocation in preparation for spending drove

Table 2a
Correlation coefficients: Real money growth versus output growth, 1976Q1 to 1999Q2, quarterly frequency, year-over-year changes

Money/credit growth (t)	Growth of money GDP							Difference in coefficients*			
	$t-2$	$t-1$	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+1-t$	$t+2-t$	$t+3-t$	$t+4-t$
Currency	0.09	0.24	0.35	0.41	0.43	0.41	0.38	0.06	0.08	0.06	0.02
Large notes	–0.01	0.19	0.37	0.49	0.55	0.54	0.50	0.12	0.18	0.17	0.13
Small notes	0.20	0.30	0.37	0.40	0.41	0.39	0.37	0.02	0.03	0.02	–0.01
Demand deposits	–0.06	0.09	0.26	0.42	0.52	0.50	0.41	0.16	0.26	0.23	0.14
Current accounts	0.01	0.17	0.33	0.45	0.50	0.46	0.37	0.12	0.17	0.13	0.04
Net M1	–0.06	0.11	0.30	0.46	0.56	0.55	0.46	0.16	0.27	0.25	0.17
Gross M1	–0.02	0.15	0.32	0.45	0.51	0.47	0.39	0.13	0.19	0.15	0.07
M1+	0.06	0.15	0.28	0.39	0.44	0.41	0.34	0.11	0.17	0.13	0.06
M1++	0.04	0.09	0.20	0.29	0.34	0.29	0.20	0.10	0.14	0.10	0.00
M2+	0.25	0.19	0.12	0.04	–0.04	–0.11	–0.17	–0.08	–0.16	–0.23	–0.29
TA1	0.02	0.20	0.36	0.47	0.52	0.48	0.39	0.11	0.17	0.12	0.04
TA2	–0.03	0.12	0.29	0.44	0.53	0.51	0.43	0.15	0.23	0.21	0.13
Consumer credit	0.66	0.67	0.61	0.46	0.28	0.10	–0.04	–0.15	–0.33	–0.51	–0.65
Business credit	0.48	0.32	0.11	–0.13	–0.34	–0.47	–0.52	–0.24	–0.46	–0.58	–0.64

* Difference in coefficients: [coefficient at] $t+1$/$t+2$/$t+3$ minus [coefficient at] t.

Table 2b
Correlation coefficients: Real money growth versus output growth, 1990Q1 to 1999Q2, quarterly frequency, year-over-year changes

Money/credit growth (t)	Growth of money GDP							Difference in coefficients*			
	$t-2$	$t-1$	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+1-t$	$t+2-t$	$t+3-t$	$t+4-t$
Currency	0.15	0.35	0.50	0.58	0.55	0.48	0.37	0.07	0.05	–0.03	–0.13
Large notes	–0.13	0.08	0.26	0.38	0.41	0.38	0.31	0.12	0.15	0.12	0.05
Small notes	–0.03	0.12	0.29	0.44	0.53	0.51	0.43	0.15	0.23	0.21	0.13
Demand deposits	0.34	0.47	0.62	0.81	0.91	0.89	0.79	0.19	0.29	0.27	0.17
Current accounts	0.50	0.64	0.75	0.86	0.88	0.83	0.72	0.10	0.13	0.08	–0.03
Net M1	0.33	0.47	0.63	0.82	0.92	0.89	0.78	0.19	0.29	0.26	0.16
Gross M1	0.43	0.57	0.73	0.86	0.90	0.85	0.72	0.13	0.17	0.12	–0.00
M1+	0.13	0.29	0.47	0.63	0.67	0.59	0.44	0.15	0.20	0.12	–0.04
M1++	–0.02	0.03	0.09	0.12	0.08	–0.03	–0.18	0.03	–0.01	–0.12	–0.27
M2+	–0.77	–0.78	–0.76	–0.78	–0.79	–0.79	–0.75	–0.02	–0.03	–0.03	0.01
TA1	0.48	0.64	0.78	0.88	0.90	0.83	0.72	0.10	0.12	0.05	–0.06
TA2	0.40	0.57	0.73	0.85	0.87	0.79	0.65	0.12	0.14	0.06	–0.08
Consumer credit	0.57	0.48	0.37	0.19	0.03	–0.07	–0.13	–0.18	–0.34	–0.44	–0.50
Business credit	0.39	0.23	0.06	–0.09	–0.21	–0.23	–0.24	–0.16	–0.27	–0.30	–0.31

* Difference in coefficients: [coefficient at] $t+1$/$t+2$/$t+3$ minus [coefficient at] t.

money growth, one might expect to see correlations between credit and output growth similar to those between money and output growth. Tables 2a and 2b show that not to be the case.[5]

What may be more helpful is to ask not where active money originates, but where it ends up—in what basket, to mix metaphors, do these hot potatoes land? From that perspective, we would include business current accounts not so much because they hold money about to be spent, but because they hold money that has just been spent. Similarly, we would exclude free credit balances at investment dealers not because their holders do not use them for buying goods and services, but because their holders did not receive them from selling goods and services. In short, if we want to find "active" money in the economy, we need to look not for situations in which people are influencing money, but for situations in which money is influencing people.

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5. Intriguingly, in the 1990s, consumer credit *acceleration* is more closely correlated than consumer credit growth with growth in transactions balances.

General Discussion

Aubry agreed with Robson that it would be worth trying to put more emphasis on the active-money view, but he noted that even when focusing on the supply side, it is still important to distinguish between money shocks that occur when the structure of financial institutions is stable versus shocks that occur in an environment of institutional changes. Robson noted that he prefers to use the GDP deflator minus imputed rent. Aubry also liked the idea of focusing on price measures other than total CPI, either broader measures like the GDP of final domestic demand deflators or narrower ones like core CPI. He used the CPI largely because it is the series that the Bank targets.

Tom Rymes pointed out that because shifts in banks' liabilities must be matched by similar shifts in banks' assets, one should try to measure the price of banking services. To this end, one should look not only at interest rate levels and spreads, but also examine how service charges on all kinds of deposits are changing over time. He could not see how one can understand the monetary transmission mechanism without a good model of the banking sector's output. Aubry liked this suggestion and added that we do not currently have good measures of incentives associated with different types of instruments and that this makes empirical work difficult.

Stefan Gerlach asked if one could not use purely statistical criteria to determine a measure of transactions money, as is done with determining underlying inflation. For example, one could disaggregate a narrow aggregate like M1 into its various sub-components and pick the components that have the strongest correlation with the macro variables of interest. Also, he pointed out that in order to get a good measure of transactions money,

* Prepared by Agathe Côté.

one also needs a good measure of transactions themselves. He wondered if real GDP is the right measure given the changes that take place over time in financial market activity and other sectoral shifts. Aubry replied that it might not be appropriate to use only statistical criteria to determine transactions money. Because this approach, which has often been used in the past, has not provided very satisfactory results, he argued, we should use statistical criteria in combination with theory and knowledge of the institutions.

Marc Pinsonneault asked if any evidence exists of a link between deposits at investment dealers and either output or inflation. Aubry replied that it is difficult to verify the existence of such a link given that the data on dealer accounts have only been available for a short period and that this period is characterized by a sharp increase in the popularity of these accounts. The jury is still out as to whether dealer accounts behave more like transactions accounts or like savings accounts. Even if dealer accounts are more like savings accounts, they may still have some predictive power for output and inflation, since other studies presented at this conference (e.g., Kim McPhail's) will show that broad monetary aggregates also help predict output and inflation. Serge Coulombe wondered if there might not be an aggregation problem with the current definitions of monetary aggregates (i.e., if components do not all have the same transactions velocity and their share varies over time, then we may end up with an aggregate that is not meaningful). Aubry replied that variable-weight aggregates (e.g., divisia) may help deal with institutional changes as well as with the aggregation bias.

William Whitesell wondered if Robson's finding of a higher correlation between inflation and money, compared with what Aubry and Nott found, might be due not only to his use of an alternative measure of prices, but also to the use of annual rather than quarterly data. Whitesell's own research suggests that the correlations are stronger with lower-frequency data. He also inquired how the long lags between money, output, and inflation could be consistent with a cash-in-advance model. These lags might instead reflect a wealth effect. Robson clarified that he used annual data for inflation but quarterly data for output, the same as Aubry and Nott did. He also argued that the long lags cause a problem for both the active- and the passive-money views and that they could reflect some form of non-linearity. For example, it may well take more than one month of unexpected cash receipts before retailers decide to change their behaviour. Aggregating such information over millions of individuals can possibly produce the sort of lags that are found in macroeconomic studies.