THE NEW ZEALAND MONETARY AGGREGATES

Alfred Wong and Arthur Grimes examine the definition of the monetary aggregates and analyse the implications of recent research regarding the information content of the monetary aggregates for monetary policy.

Executive Summary

The monetary and credit aggregates are used by the Reserve Bank as part of the checklist of indicators for monetary policy. Research work within the Bank has analysed the information that these aggregates contain about future inflationary trends.

This research indicates that of all the monetary aggregates, M3 (the broadest aggregate) bears the closest long-run relationship to developments in nominal output. Hence it provides the most information of the aggregates regarding long-run inflationary trends. However short-term movements in M3 (and in the other monetary and credit aggregates) are not a reliable indicator of shorter term trends in nominal income or inflation. For this reason, the Bank interprets the implications for monetary policy of movements in the monetary aggregates in the light of information yielded by the other variables in the checklist of indicators.

Introduction

The Reserve Bank uses the monetary aggregates as part of its checklist of indicators of monetary conditions. It is therefore important to understand what information the aggregates contain about future inflationary trends. This article examines the nature of the aggregates and summarises a body of recent research which analyses the information that these measures provide regarding inflation.¹

Monetary aggregates are measures of various forms of money. The article first examines what money is, and how the monetary aggregates are measured in New Zealand. It then explores some hypotheses as to how the money supply relates to the ultimate objective of monetary policy, the control of the price level. Issues relevant to the potential use of the monetary aggregates for monetary policy are also examined.

The article then refers to recent research work undertaken within the Reserve Bank. These studies have adopted various approaches to ascertaining how the monetary aggregates relate to such variables as the price level and the level of nominal output.

¹ Readers are referred also to an article by John Tait on "The Use of Monetary Aggregates as Monetary Policy Indicators", Reserve Bank Bulletin, Vol. 52, pp. 278-282 (December 1990) for further perspectives on the use of monetary aggregates in New Zealand.
The main findings of these studies are summarised. On the basis of these findings, the article concludes with an assessment of the usefulness of the monetary aggregates in setting monetary policy.

What is Money?
Money has been described as a medium of exchange, a standard of value, a store of wealth, and a standard of deferred payments. As a medium of exchange, money is used as one part of a transaction in exchange for goods or services. Money acts as a standard of value since prices are generally quoted in terms of monetary units (i.e. in terms of dollars and cents in New Zealand). It is also a convenient store of wealth since, in nominal terms at least, money does not lose its value when stored. (However non-interest bearing money does lose its real value in the presence of inflation.)

One can define future financial obligations in terms of money, and money therefore has a role as a standard of deferred value. However this role really derives from money’s two roles as a standard of value and as a store of wealth. It therefore does not constitute an independent role for money.

It is also the case that while money is a store of wealth, so too are many other financial and real assets - for instance, shares, houses and cars. Thus, while money can be used to store wealth, this is hardly a unique monetary characteristic.

This leaves the medium of exchange and standard of value roles as the key characteristics of money. It is not surprising that transactions are denominated in terms of money (i.e. the standard of value role) when money is used to effect them (the medium of exchange role).2

While we may have a good conceptual definition of money, the working definition has never been precise. Most people, when using the term ‘money’, refer to notes and coins issued by the Reserve Bank. However, according to the conceptual definition, chequeable deposits, funds accessible by electronic funds transfers, and credit card limits could also be considered money. All are used to effect transactions. Further, it is only a minor step to include savings deposits at banks which can quickly be transferred to cheque accounts and so be used for transactions. All these assets have varying degrees of ‘moneyness’, and the result is that there is no unique practical definition of money.

Given these considerations, the Reserve Bank adopts several alternative definitions to measure the total quantity of money circulating amongst the public. Each definition incorporates assets with different degrees of moneyness. The monetary aggregates are surveyed and compiled by the Bank monthly, and published in the Reserve Bank Bulletin.3

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2 Some theorists have suggested the desirability of separating these two roles; see Robert Greenfield and Leland Yeager, “A Laissez-Faire Approach to Monetary Stability”, Journal of Money, Credit and Banking, Vol. 15, pp. 302-315, 1983.

The narrowest aggregate, 'Notes and Coins held by the Public', refers to the total face value of the currency on issue by the Reserve Bank, except for that part held as till money by M3 institutions. This definition, sometimes known as the monetary base, is of particular importance in that notes and coins are the liabilities of the Reserve Bank and are legal tender. It is ultimately their existence which underlies the efficacy of monetary policy.

The next broadest definition of money, M1, includes notes and coins plus transaction account balances at M3 institutions. (Formally, the M1 definition includes Notes and Coins plus chequeable, EFTPOS or sweep account deposits minus inter-institutional chequeable or EFTPOS deposits minus central government deposits.)

M2 is a broader definition still, which encompasses all call funding (i.e. call deposits). Call funding includes overnight money and funding on terms that can of right be broken without break penalties. (Formally, M2 consists of M1 plus all non-M1 call funding less inter-institutional non-M1 call funding.)

The broadest monetary aggregate, M3 represents all funding by (i.e. deposits with) M3 institutions. (Formally, M3 consists of M2 plus all other funding minus all other inter-institutional deposits.)

Two credit aggregates are also compiled by the Reserve Bank. The first, Private Sector Credit (PSC), consists of the sum of the M3 institutions' total claims on (i.e. lending to) the private sector. The second, Domestic Credit (DC), is a broader concept that consists of PSC plus all claims by M3 institutions on Government (and on marketing and stabilisation organisations or schemes that bank with the Reserve Bank).

In terms of magnitudes, in June 1991, Notes and Coins totalled $1,038 million, M1 $8,581 million, M2 $25,123 million and M3 $52,496 million. These figures demonstrate that notes and coins - most people's impression of money - constitutes only 2 per cent of broadly defined money, M3.

Money, by any definition, is so widely used that seldom do we step back to think how remarkable a device it is. In a barter economy, when no money was used, each and every transaction required an exchange of goods and/or services between two (or more) parties. Any transaction took place only when both parties had something that the other wanted, or when one or other party was prepared to wait for repayment in kind.

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4 M3 institutions are all those financial institutions (currently numbering around 60) which are surveyed by the Reserve Bank in compiling the monetary aggregates.


6 Because the monetary aggregates attempt to measure various forms of money in the hands of the public, those money balances held by the government, or by financial institutions with each other, are taken out of the aggregates.

7 M3 consists of an aggregation of deposits of different maturities with differing degrees of liquidity, and hence can be regarded as a collection of 'apples and oranges'. Attempts have been made using 'Divisia aggregates' to equate the different types of deposits in terms of their liquidity so as to compile a more homogeneous aggregate. The major New Zealand work in this regard is by Ewen McCann and David Giles, "Divisia Monetary Aggregates for New Zealand", University of Canterbury, Department of Economics and Operations Research Discussion Paper No. 87/8, 1987.
(i.e. to extend credit). Money, however, makes it unnecessary to have such a ‘double coincidence of wants’ involved in exchanges, or to wait for payment. Money thus facilitates numerous transactions which would not have taken place in its absence. As a consequence, money represents generalised purchasing power over goods and services.

Given this role, economists have gone on to link the quantity of money with the value of economic transactions in the economy. Since money represents generalised purchasing power, it ought to be linked over time with the nominal value of the total spending and output of goods and services in the economy.

Individuals and firms choose to hold money, narrowly defined, because its use greatly simplifies a wide range of economic transactions. On the other hand, they limit their money balances because holding money has costs in the form of foregone opportunities - the money could be used to purchase other assets (financial or real), or to consume more. The amount of money that is consistent with the level of prices and output will also depend upon factors such as the habits, tastes, technology and regulations in society. If these factors are stable, the relationship between money and the nominal value of economic activity will tend to be stable as well.

The relationship between money and economic activity has attracted wide attention. Theories have been developed to explain how much money people will wish to hold. These theories of the ‘money demand function’ have sparked off a large number of empirical studies. The results of the empirical studies are important because, if one could show that there was, in practice, a stable relationship between a monetary aggregate and the ultimate objective of monetary policy - the level of prices - a central bank could potentially exploit this relationship in the process of monetary policy formulation.

The Money Demand Function

The simplest theory linking the money supply with the price level (and with other variables) is the ‘quantity theory of money’. This theory takes its starting point from the following identity:  

\[ MV = PT \]  

In this identity, M is some definition of the money supply, P is the price level, T is the volume of transactions in the economy and V (which, by definition, equals PT/M) is the ‘velocity of circulation’ of money - that is, the number of times a given money stock is used in the purchase of goods or services over a particular period.

In order to make this concept potentially useful for policy, one must first choose empirical counterparts for each of M, P and T. In practice, T is often proxied by real output (i.e. real GDP) or real consumption expenditures while P is often represented by the price level in which the policy-maker is most interested (such as the CPI in New Zealand).  

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8 For those without a mathematical background, this equation should be read as M times V equals P times T.

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Zealand's case). Alternatively, a nominal aggregate, such as nominal GDP (also known as nominal output or nominal income) or nominal consumption expenditures can be used to proxy the value of transactions, PT. If the quantity of transactions remains unaffected by movements in the money supply, then it follows that a relationship between the money supply and nominal income also implies that there is a relationship between the money supply and the price level, adjusted for the independent effect of changes in real activity. Hence monetary authorities interested in targeting the price level may also be interested in the relationship between the money supply and nominal income.

A number of alternative monetary aggregates may be used to represent M. In doing so, one can test which bears the closest relationship to the value of transactions.

Finally, one comes to V. It will be apparent from the earlier discussion that V will reflect everything that determines how much money people wish to hold relative to the value of transactions that they engage in. If the amount of money wanted to be held is strictly determined at all times solely by what is needed for transactions purposes, then V will be constant.

In the simplest form of the theory, velocity is therefore regarded as a constant. In this case, the quantity of money will move in proportion to the value of transactions in the economy or, equivalently, the real quantity of money (M/P) will move in proportion to the real value of transactions.\footnote{9}

In more complex theories, velocity is not assumed to be constant over time. Standard theories of money demand\footnote{10} suggest that velocity may move in response to changes in the rate of return on money relative to other assets. For instance, an increase in interest rates on savings deposits will tend to induce people to hold less non-interest-bearing money (notes and coins and non-interest-bearing cheque accounts), as people shift a greater proportion of their financial assets towards the higher yielding assets.

Thus, in examining real world behaviour, one would look at the influence of interest rates on money holdings. (Using econometric techniques to estimate a money demand function, one would therefore include interest rates as an explanatory variable.) This approach can lead to the formation of a full financial portfolio model which attempts to explain how people distribute their financial wealth across different financial assets in response to such influences as different rates of return and different risks for varying assets.

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\footnote{9}{We can express this theory as:}

\[
\log M = \alpha + \log P + \log T \quad (2a)
\]

or, equivalently, as:

\[
\log (M/P) = \alpha + \log T \quad (2b)
\]

where \(\alpha = -\log V\) is constant over time.

\footnote{10}{These theories are not covered in detail here since they are surveyed in many textbooks: see, for example, David Laidler, \textit{The Demand for Money: Theory, Evidence and Problems} (3rd ed.): Harper and Row, New York, 1985.}
A further complication is that the demand for real money balances may not be fully proportionate to the volume of transactions in the economy. Instead, for instance, the constant of proportionality may be as low as 0.5,\(^1\) in which case a 10 per cent increase in transactions only leads to a 5 per cent increase in real money balances.\(^2\)

If either this factor or the inclusion of rates of return in the money demand function was relevant, the simple quantity theory equation would not provide a good explanation of the relationship between money and prices. But, provided these additional factors had a stable impact across time on the interaction between money and the economy, the resulting money demand function could potentially still provide policy-makers with a guide for conducting monetary policy, albeit at the loss of some simplicity.

Monetary Aggregates and Monetary Policy

There are a number of requirements for a monetary aggregate to be a useful indicator for monetary policy in addition to the requirement that there exists a stable money demand function. Firstly, not only should this demand function be stable, but it should preferably be a function of only a very small number of variables that are in turn easy to predict. This is because indirect shocks to these variables may be difficult to forecast, so causing problems with interpreting the impact of the resulting movements in the monetary aggregates on inflation.

Secondly, it is desirable that demand for the aggregate be relatively insensitive to interest rate movements. Monetary policy generally has its initial effect through changing short-term interest rates. If demand for a monetary aggregate were very sensitive to these interest rate movements, the monetary authorities would be able to exercise close control over movements in the aggregate. On the surface, this may appear desirable, but in practice this is the opposite of what is desired. If the authorities change interest rates they will be able to change the quantity held of a particular aggregate but the price level will not alter as a result since the change in the aggregate is purely a response to the interest rate change. M and V change, but P and T may not. Thus any link between such an aggregate and the price level will be weak in the presence of significant interest rate changes.

Thirdly, monetary aggregates are most useful as a guide for policy if they provide an indication of future inflation; that is, if they are a leading indicator of inflation.\(^3\) In that case, a policy-maker can observe developments in the monetary aggregates and,


\(^2\) Extending the formulation of the money demand function in footnote 9 to include a constant of proportionality of less than unity and the possible rate of return effects gives a money demand function of the form:

\[
\log(M/P) = \alpha_0 + \alpha_1 \log T + \alpha_2 R_1 + \alpha_3 R_2
\]

where \(R_1\) is the 'own' rate of return (i.e. the rate of return on the monetary aggregate); \(R_2\) is the rate(s) of return on competing assets. It is expected that \(0 < \alpha_1 \leq 1, \alpha_2 > 0\) and \(\alpha_3 < 0\).

\(^3\) Formally, it is desirable that they ‘Granger-cause’ inflation.
if these developments are inconsistent with the desired inflation targets, take action to prevent the adverse inflationary consequences from arising. It is therefore important to test the dynamic relationships (i.e. the relationships over time) between monetary aggregates and the other variables of interest in order to interpret the implications of movements in the monetary aggregates.

Under some policy regimes, it is possible that there is a long-run relationship between monetary aggregates and nominal income but the relationship is such that nominal income is a leading indicator of movements in the monetary aggregates, rather than vice versa. The money supply is called 'endogenous' in this case (i.e. it is determined within the economy rather than directly by the monetary authorities). This could occur, for instance, where the monetary authorities used their monetary policy instruments to affect the exchange rate (and hence affect prices) which would lead to changes in total nominal income as the nominal incomes of tradeable goods producers changed. In turn, the changes in nominal income would lead to changes in the quantity of money demanded in the economy. The monetary authorities would be obliged to satisfy the increase in money demand in order to keep the exchange rate on target. Hence the rise in nominal income would eventually lead to a change in the monetary aggregates.

Under such a regime, the monetary aggregates would contain little or no useful information for the guidance of monetary policy. Some commentators, observing endogenous determination of the money supply in practice (in certain countries), have jumped to the conclusion that monetary policy cannot be used to control the price level. This interpretation is fallacious. The fallacy can most easily be seen by reference to a monetary policy which targets an exchange rate which in turn is chosen so as to be consistent with a particular price target. In this case, the money supply will be endogenous but monetary policy is still being used to control the price level.

One must also be careful not to infer that just because the money supply was endogenous (or exogenous - i.e. directly policy determined) in the past, it will remain so in future. This will very much depend on whether the monetary policy regime remains constant over time. For instance, the monetary authorities may switch from targeting the exchange rate to targeting a particular monetary aggregate, in which case that aggregate may switch from being endogenous to being exogenous.

Provided the long-run money demand relationship remains the same across policy regimes, the authorities may be able to use a mathematical representation of the long-run relationship, estimated under a regime with endogenous money supply, to determine appropriate long-run monetary movements under a regime of targeted money supply. A problem occurs, however, if (as predicted by 'Goodhart’s Law') the long-run relationship changes once the particular monetary aggregate becomes targeted. This may occur if the chosen monetary control mechanism changes people’s holdings of the particular aggregate relative to their holdings of other financial assets. It is therefore necessary to understand fully the fundamental reasons as to why people

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14 Ironically, however, if one could observe a movement in a monetary aggregate and then move to take action to prevent the inflationary consequences, the result must be to break down the stability of the relationship between the aggregates and inflation. This will make future interpretation of these relationships more difficult.
hold a particular aggregate and to test the stability of the relationships between monetary aggregates and other variables before a monetary aggregate can be used confidently as a target by the monetary authorities.15

New Zealand Studies

There has recently been a number of econometric (i.e. statistical) studies conducted by Reserve Bank staff in the area of money and monetary aggregates. This research includes projects by Greville (1989)16, Cruse (1989)17, Wong, Grimes and Meads (1989)18, McDermott and Wong (1990)19, Wong (1990)20, and Margaritis (1991).21 All of them aim to exploit the estimated historical relationships between one or more monetary aggregates and other economic variables in an attempt to examine the information content of the aggregates regarding monetary conditions.

The studies all have different emphases. Greville adopted a conventional approach, attempting to estimate standard money demand functions for a number of the New Zealand monetary aggregates. For each of the aggregates, he estimated a long-run relationship (of the type shown in equation (3) in footnote 12) which related real money balances to the level of transactions (proxied variously by real GDP or, for the narrower aggregates, by real consumption), rates of return (including the return on competing financial assets, such as shares) and other variables including a variable representing changing transaction technologies. Where a long-run relationship could be found, he also examined the short-run relationships between the variables.

Cruse’s framework, based essentially on the quantity equation, tested the long-run relationship between various monetary and credit aggregates and nominal income. He also examined the causality patterns (i.e. the leading indicator relationships) between the two.

Wong, Grimes and Meads, emphasising the portfolio choices of investors, was more concerned with the substitutability of the different financial assets within a financial portfolio. In particular, the study examined how private non-bank financial wealth is allocated amongst the categories of M1, savings accounts (i.e. M3 less M1), and government stock, according to the different rates of return across these assets.

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15 The stability of the relationships may also be affected by changes in technology and/or regulations that cause people to change their holdings of a particular aggregate for any given levels of prices, income and rates of return.
McDermott and Wong estimated a system of money-income equations. They then studied the issue of whether the money supply can be considered exogenous.

Wong investigated a model, recently advocated by some United States Federal Reserve Board economists, which is claimed to be able to accurately assess the tightness of the monetary policy stance and inflationary pressures. This model is based on the quantity equation. It asserts that the equilibrium level of prices, $P^*$, is given by the quantity equation with actual velocity ($V$) and transactions ($T$) replaced by their long-run values ($V^*$ and $T^*$). Hence the equilibrium price level is given by:

$$P^* = \frac{MV^*}{T^*}$$  \hspace{1cm} (4)

When velocity and/or the level of transactions deviate from their equilibrium values, the price level is hypothesized to converge to $P^*$ as velocity and/or transactions move towards equilibrium. If this were indeed the case, this relationship could be used to predict future inflation.

Finally, Margaritis examined the long-run relationship between M3, real GDP and the price level and, like Cruse, also examined the causality patterns amongst these variables. He also tested for the stability of the relationships across different policy regimes. A related study was conducted (outside of the Reserve Bank) by Orden and Fisher (1990).²²

**Major Findings**

Rather than detail the results of each of the studies, it is intended here to distil the major findings across all the studies.

The long-run relationship between nominal output and each of the narrow monetary aggregates (and the credit aggregates) was generally found to be weak or ill-defined, although there was some evidence to support a relationship between Notes and Coins and nominal consumption, albeit complicated by other factors. On the other hand, reasonably robust long-run relationships were found for the broad M3 aggregate. A number of the studies found that M3 tracked nominal income well over long periods of time. Others found that real M3 balances tracked real output well over time, provided the income elasticity of real money balances (i.e., the constant of proportionality, $\alpha$, in equation (3), footnote 12) was less than unity. In addition, a number of studies found that this relationship changed in a step fashion after the deregulation of the financial system in 1984; real money balances increased at that time over and above the level that the historical relationships predicted, but the historical relationships then reasserted themselves.

One implication of the existence of this long-run relationship between real M3 and real output is that the long-run demand for M3 balances has not been affected significantly by interest rate movements. This is not too surprising given that savings balances (and

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some chequeable balances) in M3 earn interest and this interest rate can adjust in line with interest rates on other non-M3 assets. However, there is evidence that the demand for M3 does alter temporarily in response to interest rate differentials between M3 and non-M3 assets.

The narrow aggregates (Notes and Coins, and M1) are found to respond significantly to yields on competing assets. The relationships between the narrow aggregates and nominal income also appear to have been affected by technological changes, such as the introduction of credit cards. As noted in the general discussion, these factors complicate the relationship between monetary aggregates and any target variable (the price level or nominal output), so reducing the usefulness of narrow aggregates as monetary indicators.

The relatively stable long-run relationship between M3 and nominal output means that M3 may have some use as a monetary indicator. However, the short-run relationship between these variables is not close. For example, in the year to March 1990, M3 grew by only 1.4 per cent while nominal output grew by 7.8 per cent. In the following year, M3 grew by 12.1 per cent, while nominal output growth slowed to 4.9 per cent.

In addition, the dynamic relationship between M3 and nominal output is complicated. Studies that have attempted to ascertain whether there is a leading indicator relationship one way or the other between the two variables (i.e. that have examined which variable ‘causes’ the other) have found bi-directional causality. Thus, rises in nominal output tend to induce subsequent rises in M3, but rises in M3 also tend to induce subsequent rises in nominal output. This relationship probably reflects past monetary actions which at times accommodated movements in nominal output, and at other times attempted to influence future movements in nominal output.

These complicated dynamic relationships are reflected also in the P* model in New Zealand. The forecasting ability of P* largely depends on the stability of the behaviour of velocity and output. Various methods were used in defining the long-run values of velocity and transactions (V* and T*) and various monetary aggregates were tried. But, because of the dynamic instabilities mentioned, the P* (constructed under alternative definitions) could not forecast inflation any more accurately than a naive model which uses the last quarter’s inflation rate to predict this quarter’s inflation rate. This finding is indicative of the fact that the monetary aggregates, by themselves, are poor tools for forecasting short-term movements in inflation or nominal output.

Conclusion

In theory, the monetary aggregates may be of considerable use to monetary authorities in guiding the setting of monetary policy. In practice, however, their usefulness is limited.

Instability in both the long-run and short-run relationships between the narrow monetary aggregates (and the credit aggregates) and the target variables of policy means that movements in these aggregates give little information as to likely inflationary trends. These instabilities are particularly severe in times of rapid technological change and are further complicated by the effect of changes in interest rates.

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The broad monetary aggregate, M3, has a much more stable long-run relationship with nominal output (although this relationship was probably affected by financial sector deregulation in the mid-1980s). However, the short-run relationship is far from stable, and it is difficult to infer whether the observed changes in M3 are a reaction to past changes in nominal output or whether they are likely to lead to future nominal output changes. In the former case, the information is of little use for monetary policy, whereas in the latter case, the information is of use.

Because of the difficulties in interpreting the information contained in the monetary aggregates, the Reserve Bank uses the aggregates as just one of a number of indicators of monetary conditions. Monetary policy will generally not respond to movements in just one of the aggregates, because these movements do not bear a close enough relationship, on average, to movements in inflation. However, if most of the aggregates are moving in a similar fashion, and particularly if these movements are consistent with movements in the other monetary indicators, the Bank will incorporate this information into its monetary policy decisions.