A FRAMEWORK FOR
ANALYSIS OF THE MONEY SUPPLY PROCESS
IN AUSTRALIA

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PAPER NO. 1
ISBN 0 909426 112

MARCH 1975
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An earlier version of this paper was presented at staff seminars in the Department of Economics, Australian National University and in the Research Department, Reserve Bank of Australia. The author is indebted to L. Hargreaves and T. P. Truong for research assistance and to Viv Hall, Jim Henderson and Michael Parkin for comments on the earlier draft. The Reserve Bank of Australia generously provided the financial support necessary to undertake the project.
1. **INTRODUCTION**

"In the market for Government securities the Reserve Bank will, with the concurrence of the Government, press its open market operations with the aim of significantly increasing sales of Government securities. This will both mop up funds in the hands of the private sector and reduce private sector holdings of financial assets.

In the process, a sharp rise can be expected in interest yields on existing issues of Australian Government securities, and in due course, any rates to be offered on new issues. Substantial increases in other interest rates will follow, as effects of the operation spread through other markets for funds.

Increasing the interest rate is not something to be undertaken lightly, but curbing an increase in liquidity and the money supply is an essential precondition if inflation is to be countered at all." (The Prime Minister, Mr. Whitlam, 9-9-1973)

In recent years, Central Banks in the United States and Great Britain have changed their monetary policy strategies from an interest rate oriented policy to a more direct control of the money supply. Also, if one takes the final paragraph of the above quote seriously, control of the money supply may be becoming increasingly important in the Australian policy context. However it is generally acknowledged that the effectiveness of such a policy strategy depends on the existence of a channel of influence from the money supply to the ultimate policy objective, aggregate economic activity. In addition the money supply must be susceptible to control by the monetary authorities. That is, the money supply should not be subject to a strong feedback effect from economic activity nor should it be subject to large variations because of the portfolio behaviour of the banks and the non-bank private sector.
This paper focuses on the second issue, the degree of control of the money supply which may be exercised by the regulatory authorities. The general approach adopted involves the development of a framework in which the primary determinants of changes in the money supply may be analysed. In this respect there are several alternative frameworks which may be utilised. Two of these have previously been applied to analyse the Australian money supply - the formations table approach\(^1\) and the traditional textbook money supply/multiplier approach\(^2\). In Part II of this paper we critically evaluate the appropriateness of these approaches in the Australian environment as a prelude to the development of a somewhat more appropriate framework of analysis in Part III.
II. A CRITIQUE OF TWO ALTERNATIVE FRAMEWORKS

(a) The Formations Table

A formations table is an accounting table in which the balance sheet items of the Reserve Bank of Australia and the Trading and Savings Banks are aggregated and then re-arranged. As the components of the money supply, with the exception of Treasury coin outstanding, are liabilities of these institutions the money supply must, by utilisation of the accounting balance sheet identity, equal their total assets less non-monetary liabilities and net worth. In Table 1 the formations table approach has been used to compare the changes in the Australian money supply in 1971/2 and 1972/3.

While one may not reject the identity underlying the formation table approach as being invalid, from the point of view of economic analysis it is not particularly useful. For example, one cannot easily derive, from Table 1, an estimate of the effect of a change in the Statutory Reserve Requirement on the money supply because the specific policy variable under the control of the authorities (i.e. the SRD ratio in this case) is not explicitly included in the analysis. This criticism also applies to open market operations where the control variable is the change in the amount of government securities in the Reserve Bank's portfolio. However, the quantity reflected in the formation table as item 2 is the Banking System's holdings of government securities which is determined partly by the authorities and partly by investment policies of savings and trading banks. One may respond to
this criticism by indicating that it is a relatively easy matter to disaggregate the Banking System's holdings into sector components so that the actual control variable is separated from the holdings of the savings and trading banks. But even then the formation table approach is inadequate as it implies that the change in Reserve Bank holdings of government securities results in an equal change in the money supply. There is of course the possibility that loans and advances of savings and trading banks will subsequently increase but this linkage is not explicitly made in the formation table approach. That is, it does not explicitly incorporate the existing institutional framework whereby the provision of reserves by the monetary authorities can result in a multiple expansion of the money supply if the banks hold a partial reserve backing against deposits. Within the formation table approach, one is therefore unable to examine the effect of institutional and policy changes upon the money supply. Because it does not of itself provide any theoretical explanation of the money supply process the formation table approach is not suitable for the purpose of this study.

Table 1

Formation Table

Analysis of Changes in the Australian Money Supply in fiscal years 1971/2 and 1972/3 ($ million)

<table>
<thead>
<tr>
<th>Description</th>
<th>1971/2</th>
<th>1972/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Gold and Foreign Exchange of Reserve Bank</td>
<td>+ 1535</td>
<td>+ 440</td>
</tr>
<tr>
<td>2. Banking System Holdings of Government Debt</td>
<td>+ 113</td>
<td>+ 1030</td>
</tr>
<tr>
<td>3. Other Assets and Liabilities of Reserve Bank</td>
<td>- 987</td>
<td>+ 513</td>
</tr>
<tr>
<td>4. Miscellaneous Factors (incl. coin on issue)</td>
<td>+ 12</td>
<td>+ 20</td>
</tr>
<tr>
<td>5. Total (1 + 2 + 3 + 4)</td>
<td>+ 673</td>
<td>+ 2003</td>
</tr>
<tr>
<td>7. Loans and Advances of All Savings Banks</td>
<td>+ 294</td>
<td>+ 463</td>
</tr>
<tr>
<td>8. Other Assets and Liabilities of Banks</td>
<td>+ 132</td>
<td>+ 40</td>
</tr>
<tr>
<td>9. Total (5 + 6 + 7 + 8) = Volume of Money</td>
<td>+ 1657</td>
<td>+ 4495</td>
</tr>
</tbody>
</table>
(b) **The Textbook Theory of Money Supply Determination**

In order to facilitate the reading of this section we will illustrate the textbook theory of money supply determination using a very aggregative model which ignores many of the institutional features of the monetary sector of the Australian economy. Nevertheless, it will serve to illustrate the basic elements of the theory. For the interested reader, the Appendix to this section contains a more complex but disaggregated development of the theory.

We begin by defining two concepts for our highly simplified economy: the money supply and the monetary base. The money supply includes the non-bank private sector's holdings of currency (C) and bank deposits (D):

\[ MS = C + D \]  \hspace{1cm} (1)

or \[ MS = (1 + k) D \]  \hspace{1cm} (2)

where \[ k = \frac{C}{D} \]  \hspace{1cm} (3)

That is, 'k' indicates the non-bank private sector's preference for currency relative to bank deposits. The monetary base, (B), or the volume of high powered money, is defined as the net monetary liabilities of the monetary authorities and consists of currency held by the non-bank private sector, (C), and the banks' holdings of excess cash reserves, (ER), and required reserves, (RR):

\[ B = C + ER + RR \]  \hspace{1cm} (4)

Let the required reserve ratio set by the authorities be

\[ r = \frac{RR}{D} \]  \hspace{1cm} (5)
and the banks' excess reserve ratio

\[ e = \frac{ER}{D} \]  \hspace{1cm} (6)

Substituting (3), (5) and (6) into (4) gives

\[ B = (k + e + r) D \]  \hspace{1cm} (7)

or

\[ D = \frac{B}{(k + e + r)} \]  \hspace{1cm} (8)

and then (8) into (2)

\[ MS = \frac{(1 + k)}{(k + e + r)} \cdot B \]  \hspace{1cm} (9)

\[ = mB \]  \hspace{1cm} (10)

where \( m = \frac{(1 + k)}{(k + e + r)} \) is called the money creation multiplier. Thus the money supply, by definition, is related in a non-linear manner to four factors: \( B, k, e \) and \( r \).

It is argued below that, in this form, the textbook theory is only a marginal improvement over the formations table. The inclusion of the policy variable \( r \), the statutory reserve deposit requirement, in identity (9) is certainly a step in the right direction. Thus if one makes the (heroic) assumption that values of \( k, e \), and \( B \) remain unaltered then it is possible to ascertain the impact of policy alterations in reserve requirements on the money supply.

By applying differential calculus, the simple multiplier/base description of the money supply process may be extended to obtain
estimates of the contribution of each of the factors \((B, k, e \text{ and } r)\) to changes in the money supply. Thus taking logs of equation (10)

\[
\log MS = \log m + \log B \quad (11)
\]

and then deriving the total differential of this expression

\[
\frac{dMS}{MS} = \frac{dm}{m} + \frac{dB}{B} \quad (12)
\]

and finally converting (12) to discrete time we obtain:

\[
\frac{\Delta MS}{MS} \approx \frac{\Delta m}{m} + \frac{\Delta B}{B} \quad (13)
\]

That is, the rate of change of the money supply is approximately equal to the sum of the rates of change of the money multiplier and the monetary base. Alternatively, if this logarithmic differentiation process were applied to equation (9) we would obtain:

\[
\frac{\Delta MS}{MS} = \frac{(e + r - 1)}{(1 + k)(k + e + r)} \cdot \Delta k - \frac{(1 + k)}{(k + e + r)} \cdot \Delta e - \frac{(1 + k)}{(k + e + r)} \cdot \Delta r + \frac{\Delta B}{B} \quad (14)
\]

From (14) it is evident that increases in \(e, r\) and \(k\) will, ceteris paribus, result in reductions in the money supply, and increases in \(B\) will increase the money supply.

The final problem is that of ascertaining the components of the monetary base. As the monetary base is defined as the net monetary liabilities of the monetary authorities it is possible, by utilising the balance sheet identity, to define base money in terms of the assets and
any non-monetary liabilities of the monetary authorities. In Australia, the primary assets of the Reserve Bank may be classified into four groups: gold and foreign exchange (GFE), government securities (GSRB), rural credit loans (RCLO), and other net loans (RBOLO). Thus

\[ \Delta B = \Delta \text{GFE} + \Delta \text{GSRB} + \Delta \text{RCLO} + \Delta \text{RBOLO} \]  

(15)

or \[ \frac{\Delta B}{B} = \frac{\Delta \text{GFE}}{B} + \frac{\Delta \text{GSRB}}{B} + \frac{\Delta \text{RCLO}}{B} + \frac{\Delta \text{RBOLO}}{B} \]  

(16)

Substituting (16) into (14) then gives

\[ \frac{\Delta MS}{MS} \approx \frac{(e + r - 1)}{(1 + k)(k + e + r)} \cdot \Delta k - \frac{(1 + k)}{(k + e + r)} \cdot \Delta e - \frac{(1 + k)}{(k + e + r)} \cdot \Delta r \]

+ \[ \frac{\Delta \text{GFE}}{B} + \frac{\Delta \text{GSRB}}{B} + \frac{\Delta \text{RCLO}}{B} + \frac{\Delta \text{RBOLO}}{B} \]  

(17)

This indicates that, ceteris paribus, the money supply increases as foreign exchange reserves are acquired and as the monetary authorities acquire government securities or extend rural credit and other loans.

(c) Sources of Growth of the Australian Money Supply

Equations (13), (14) or (17) may be used to examine past fluctuations in the Australian money supply. By altering the definitions of the money supply, monetary base, and other definitional parameters one may derive formulae differing somewhat from those developed in the previous section and in the Appendix to Part II. The particular definition of the money supply used in this section is the broad definition which includes currency, current, fixed and savings deposits. It should not be inferred that the writer regards this definition as being the most relevant or useful definition. Rather, it was selected on the basis
that it is the definition used by the Reserve Bank and would therefore be the most familiar definition to most readers.

(i) Some Caveats

Because of the huge fluctuations in liquidity in the Australian economy there are very large seasonal changes in both the money supply and its many determinants. However, to simplify the analysis in this section we report in Figures 1 to 3 only the seasonally adjusted results which involve taking a twelve month centred moving average for each of the relevant series. Needless to say, a particular factor may be highly significant in contributing to seasonal variations in the money supply but not to cyclical or secular changes in the growth rate or vice versa.

It must also be emphasised that the contributions of the respective components are not necessarily independent. For example, large purchases of government securities by the Reserve Bank increase the monetary base but could also have the effect of reducing interest rates and thereby encouraging banks to hold greater excess reserves and/or induce the public to hold more or less cash relative to current deposits. As emphasised earlier, the present section of the paper is purely descriptive as it indicates the contribution made to the growth of the money supply by each element under the (unrealistic) assumption that all others remain unchanged. Thus, while the use of the decomposition procedure is valid in analysing ex post changes in the money supply, if the interdependencies are empirically significant, it would be inappropriate to use this approach for forecasting purposes. In this
case, the interdependencies must be explicitly recognised and taken into account.

This interdependency also creates problems if one wishes to use the textbook approach to ascertain the controllability of the money supply. Studies generally classify the parameters of the model according to the degree of influence exerted by the monetary authorities over them. In this respect it is generally asserted that changes in the 'k' and 'e' ratios are beyond Central Bank control, depending primarily upon the portfolio behaviour of the non-bank private sector and the banks respectively. On the other hand, changes in 'r' and 'B' are associated with Central Bank actions. If it can then be shown that changes in the money supply are dominated by changes in 'r' and 'B', it is asserted that the money supply is potentially controllable by the authorities. Alternatively if the major variations in 'k' and/or 'e' are primarily due to policy actions then one may also maintain that the money supply is controllable for in this situation 'k' and 'e' should be regarded as policy determined elements of the money supply process. However, the textbook theory throws no light whatsoever on the economic determinants of the various definitional factors - for this purpose one requires an economic, rather than a descriptive model, of the money supply process.

Another caveat relates to the question of the exogeneity of the monetary base. Equation (15) indicates that the primary factors influencing the monetary base are changes in foreign reserves, open market operations in government securities, and loans of various
types extended by the monetary authorities. Of these three factors, only the second is directly controllable by the monetary authorities while they have an element of control over the third factor by being able to determine costs or availability of Central Bank credit. In a large relatively closed economy external influences on the money supply are insignificant and easily offset by domestic open market operations. Thus for such an economy, while it is acknowledged that the Central Bank does not have exclusive control over the monetary base, by employing defensive open market operations it can offset changes in base money induced by other factors. Thus for all practical purposes the Central Bank of a large relatively closed economy can control the monetary base.

However, when we turn to the case of a small open economy with fixed exchange rates, such as Australia in the 1960's, there is considerable doubt as to whether the monetary base is controllable. In fact there is a body of international monetary theory, developed by Professors Mundell and Johnson, which indicates that the monetary base or money supply for such an economy in the medium to long-run is essentially determined by the demand for it by the non-bank private sector. Domestic monetary policy merely determines the proportion of the total monetary base which is created domestically. For example, suppose the Central Bank of a small open economy with fixed exchange rates creates an excess demand for money by reducing the supply through open market sales of government securities. This situation of excess monetary demand may be eliminated in the medium to long-run by external borrowing of the non-bank private sector as capital inflow increases.
the supply of (base) money. Alternatively, if the excess demand for money is accompanied by an excess supply of domestic goods, exports may increase and/or imports decrease creating a surplus in the balance of payments and a consequent increase in domestic base money. In both cases, the Central Bank cannot control the money supply in the medium to long-term. Its actions merely determine the mix of externally generated base money to domestically created base money. This theory is summarised in somewhat greater detail by Boxall and Steamer while a reduced form study by Porter has found a significant negative relationship between capital inflow to Australia and changes in the net domestic assets of the Reserve Bank of Australia. While such a finding may be consistent with several alternative views of the money supply process, it is certainly consistent with the monetarist theory presented above which argues that the monetary base for a small open economy is endogenous.

The final caveat is also concerned with the assumed exogeneity of the monetary base. Until recently the Australian monetary authorities have not regarded base money or the money supply as a target variable but have instead set interest rates thereby allowing base money and the money supply to vary substantially on a short-run basis. Thus the application of the traditional textbook approach in these circumstances may be criticised "on the grounds that it involves implicit assumptions about the actions of the authorities which are invalid". Such a mis-specification could lead to an erroneous appreciation of how the money supply has been determined in Australia.
(ii) The Evidence

Having established several theoretical qualifications of the traditional textbook approach let us now turn to the empirical evidence to ascertain whether the suggested interdependencies are in fact a reality in the Australian context. Using equation (13) we may decompose the growth of the money supply into the portions attributable to growth of the adjusted monetary base and to changes in the value of the money multiplier. These results are summarised in Figure 1. Perhaps the most interesting feature of Figure 1 is the fact that each major fluctuation in the rate of growth of the money supply has been associated with a much more volatile fluctuation in the rate of growth of the adjusted monetary base. However, much of this effect of the adjusted monetary base is offset by changes in the multiplier so that the ultimate effect on the money supply is modified. This inverse relationship between the effects of changes in the multiplier and the effects of changes in the adjusted monetary base is so consistent over the sample period that one is forced to conclude that either the various definitional parameters are not independent and/or that they are influenced by similar economic variables.

As emphasised earlier, sources of growth of the money supply may be attributed to the behaviour of the authorities, banks, and the non-bank private sector. Thus it seemed a useful exercise to decompose the changes in the money supply using the traditional assumption that the authorities control the SRD ratio and the monetary base. On the other hand, it is assumed that banks make a basic decision as to the level of their excess reserves while the non-bank private sector plays
a dominant role in determining the ratios of cash, fixed deposits and savings deposits to current deposits. Results based on this decompos-
itron classification are depicted in Figure 2.

Comparing Figures 1 and 2 it is evident that there is a very close relationship between the growth of the money supply and of possible Reserve Bank actions through changes in the SRD requirement and growth of the adjusted monetary base. Also from Figure 2, it is apparent that during the 1960's there was a very strong negative correlation between the possible contributions of the Reserve Bank and the factors under the influence of the banks. Thus the traditional assumption that the actions of the monetary authorities and banks are independent does not seem appropriate in the Australian context. In order to examine the question of the controlability of the Australian money supply it would appear that a behavioural model, which explicitly incorporates the linkages between the supply of base money and excess reserve behaviour of the banking sector, is required in order to distinguish cause from effect.

A third factor which emerges from the study of Figure 2 is that, with two exceptions (1966 and 1972), the parameters under the influence of the non-bank private sector have not played a particularly important role in the fluctuations of the rate of growth of the money supply. The 1966 behaviour could be associated with the switch to decimal currency which substantially altered the amount of cash in circulation.
The adjusted monetary base, on a seasonally adjusted basis, has been decomposed into five components in Figure 3. It is evident that changes in coin outstanding have virtually no influence whatsoever on the adjusted monetary base and consequently on the money supply. A good deal of the fluctuation in the adjusted monetary base appears to be associated with fluctuations in the gold and foreign exchange holdings of the Reserve Bank. However, these fluctuations seem to be somewhat offset by changes in the Reserve Bank's portfolio of government securities [open market operations] and in other loans, capital and reserves, and other liabilities of the Reserve Bank. This significant correlation between the various determinants of the adjusted monetary base suggests the need for an economic model which would incorporate any possible interdependencies between the factors.

It is evident then that the theoretical and empirical evidence presented in this section casts serious doubts on the validity of the traditional textbook approach to analysing the money supply process in the Australian context. Consequently in Section III of this paper an attempt is made to specify an economic, rather than an accounting, model of the money supply process which incorporates both the economic determinants of the various parameters and any interdependencies which link the parameters. In this latter respect the approach adopted differs markedly from that adopted by Albert E. Burger in a similar American study. Burger completely ignores the possibility of any interdependence of the basic parameters and does not impose certain
FIG. 3
DECOMPOSITION OF
ADJUSTED MONETARY BASE
(Seasonally Adjusted Annual Rates Computed Monthly)

\[ \begin{align*}
\Delta B^a/B^a & \\
\Delta GFE/B^a & \\
\Delta RCL/B^a & \\
\Delta COIN/B^a & \\
\Delta GSRB/B^a & \\
\Delta RB/CO/B^a & \\
\end{align*} \]
consistency requirements which are suggested by economic theory. In particular, he has not imposed the constraints imposed by balance sheet identities nor the government's budget constraint (financing identity).

**APPENDIX TO PART II**

In this appendix we provide a somewhat more detailed development of the textbook approach incorporating many of the institutional features of the Australian monetary sector. We begin by defining two important monetary aggregates, the money supply and the monetary base:

\[
MS = NCP + DEPC + DEPF + DEPS - GOVD - INBD + RESID \quad (A-1)
\]

\[
B = NCP + NCTB + NCSB + SRD + TLF + FDLF + ODTBRB + DSBRB \quad (A-2)
\]

where \( MS \) = Volume of Money.

\( NCP \) = Notes and coin in hands of public

\( DEPC \) = Total current deposits within Australia of All Trading Banks

\( DEPF \) = Total fixed deposits within Australia of All Trading Banks (includes certificates of deposit since March 1969)

\( DEPS \) = Depositors' balances at Savings Banks (at end of month) within Australia and external territories.

\( GOVD \) = Commonwealth and State Government accounts at All Trading Banks. These are excluded from the definition of the money supply.

\( INBD \) = Deposits of Other Banks with All Trading Banks, also excluded from the definition of the volume of money.
RESID = A residual item which includes deposits of the public with the Reserve Bank which are included in the money supply plus an error term to take account of the fact that DEPS is defined at the end of the month whereas the figure for savings deposits included in the volume of money is an interpolated weekly average based on end of month figures.

NCTB = Notes and Coin held by All Trading Banks.
NCSB = Notes and Coin held by Savings Banks.
SRD = Trading Banks' statutory reserve deposits with Reserve Bank.
TLF = Term loan fund of All Trading Banks with Reserve Bank.
FDLF = Farm development loan fund of All Trading Banks with Reserve Bank.
ODTBRB = Other deposits of All Trading Banks with Reserve Bank.
DSBRB = Deposits of Savings Banks with Reserve Bank.

Savings banks subject to the Banking Act are required to maintain at least 10% of their depositors' funds either on deposit with the Reserve Bank or held in Treasury bills and notes. As the State savings banks and the trustee savings banks are not subject to this legislation, to determine the required reserves of savings banks we must disaggregate DEPS into two components:

\[ \text{DEPS} = \text{DEPSCP} + \text{DEPSST} \]  \hspace{1cm} (A-3)

where DEPSCP = Depositors' funds at Commonwealth and Private Savings Banks DEPSST = Depositors' funds at State and Trustee Savings Banks.
If we ignore the possibility that Savings Banks may keep portion of their required liquid reserves in Treasury bills and notes then we can define excess reserves of savings banks as

\[
\text{SBXRES} = \text{NCSB} + \text{DSBRB} - 0.1 \text{DEPSCP} \quad (A-4)
\]

\[
\text{NCSB} + \text{DSBRB} = \text{SBXRES} + 0.1 \text{DEPSCP} \quad (A-5)
\]

Let us further define

\[
r = \frac{\text{SBXRES}}{\text{DEPS}} \quad (A-6)
\]

and \[m = \frac{\text{DEPSCP}}{\text{DEPS}} \quad (A-7)\]

so that \((A-5)\) may be rewritten

\[
\text{NCSB} + \text{DSBRB} = (r + 0.1 m) \text{DEPS} \quad (A-8)
\]

Turning now to the portion of the monetary base held by All Trading Banks we define

\[
\text{TBXRES} = \text{NCTB} + \text{ODTBRB} \quad (A-9)
\]

and \[\text{SRD} = s(\text{DEPCCP} + \text{DEPFCP}) \quad (A-10)\]

where \(\text{TBXRES} = \text{Excess reserves of All Trading Banks under the assumption that statutory reserve deposits are always at their required levels}\)

\(\text{DEPCCP} = \text{Total current deposits at banks subject to the Banking Act}\)

\(\text{DEPFCP} = \text{Total fixed deposits and certificates of deposits at Banks subject to the Banking Act.}\)

Defining the ratios

\[
e = \frac{\text{TBXRES}}{\text{DEPC} + \text{DEPF}} \quad (A-11)
\]
\[ w = \frac{DEPCCP + DEPFCP}{DEPC + DEPF} \]  

(A-12)

we then have

\[ NCTB + SRD + ODTBRB = (e + sw)(DEPC + DEPF) \]  

(A-13)

If we further define

\[ c = \frac{NCP}{DEPC} \]  

(A-14)

\[ f = \frac{DEPF}{DEPC} \]  

(A-15)

\[ p = \frac{DEPS}{DEPC} \]  

(A-16)

and using (A-8), (A-13) and (A-14), equation (A-2) may be written

\[ B = cDEPC + (r + .1m) DEPS + (e + sw)(DEPC + DEPF) + TLF + FDLF \]  

(A-17)

or using (A-15) and (A-16)

\[ B = [c + (r + .1m)p + (e + sw)(1 + f)]DEPC + TLF + FDLF \]  

(A-18)

As is well known the term and farm development loan funds are revolving funds with two thirds of the funds transferred from SRD accounts while the Trading Banks finance the remainder from their other assets. The actual volume of reserves in these funds does not bear any systematic relationship to the volume of bank deposits but is determined jointly by Reserve Bank policy in calling new transfers to the fund and on the rate of bank lending from the funds. Consequently it was decided to define an adjusted monetary base

\[ B^a = B - TLF - FDLF \]  

(A-19)

\[ = [c + (r + .1m)p + (e + sw)(1 + f)]DEPC \]  

(A-20)
or \( \text{DEPC} = \frac{B^a}{[c + (r + .1m)p + (e + sw)(1 + f)]} \)  

(A-21)

The money supply is given by equation (A-1) so that if we define

\[
g = \frac{\text{GOVD}}{\text{DEPC} + \text{DEPF}} \quad (A-22) \\
b = \frac{\text{INBD}}{\text{DEPC} + \text{DEPF}} \quad (A-23) \\
u = \frac{\text{RESID}}{\text{DEPC}} \quad (A-24)
\]

then \( MS = c\text{DEPC} + \text{DEPC} + f\text{DEPC} + p\text{DEPC} - (g+b)(\text{DEPC} + \text{DEPF}) + u\text{DEPC} \]

\[
= [1 + c + f + p - (g+b)(1 + f) + u]\text{DEPC} \quad (A-25)
\]

which using (A-21) becomes

\[
MS = \frac{[1 + c + f + p - (g+b)(1 + f) + u]}{[c + (r + .1m)p + (e + sw)(1 + f)]} \cdot B^a \quad (A-26)
\]

or \( MS = \frac{X}{Y} \cdot B^a \quad (A-27) \)

where \( X \) and \( Y \) are the terms in the numerator and denominator respectively of (A-26). Thus the volume of money is equal by definition to a complicated multiplier expression, \( \frac{X}{Y} \), times the adjusted monetary base.

In the next step we decompose the change in the money supply into the portions attributable to changes in the multiplier and to the adjusted monetary base respectively. This is achieved by taking the differential of (A-27)

\[
dMS = B^a d\left(\frac{X}{Y}\right) + \frac{X}{Y} dB^a \quad (A-28)
\]

and then dividing both sides by MS to obtain
\[
\frac{dMS}{MS} = B^a \frac{d(\frac{X}{Y})}{Y} + \frac{X}{Y} dB^a \\
= d \frac{X}{Y} + dB^a \\
\]

(A-29)

The differential operator, d, may be approximated by the change in the variable so that, by equation (A-29), the percentage change in the money supply is approximately equal to the sum of the percentage changes in the multiplier and adjusted monetary base. But \( \frac{X}{Y} \) is influenced by eleven factors, \((c, f, p, g, b, u, r, m, e, s, w)\). We may then further decompose the growth of the money supply into that attributable to changes in the adjusted monetary base and to each of the eleven factors:

\[
\frac{dMS}{MS} = (\frac{1}{X} - \frac{1}{Y}) dc + (\frac{1-g-b}{X} - \frac{sw+e}{Y}) df \\
+ (\frac{1}{X} - \frac{1}{Y}) dp - (\frac{1+f}{X}) dg - (\frac{1+f}{X}) db \\
+ (\frac{1}{X}) du - (\frac{1}{Y}) dr - (\frac{1}{Y}) dm - (\frac{1+f}{Y}) de \\
- (\frac{w[1+f]}{Y}) ds - (\frac{w[1+f]}{Y}) dw + \frac{dB^a}{B^a} \\
\]

(A-30)

The final problem is that of ascertaining the determinants of the adjusted monetary base. It is evident from equation (A-2) that, with the exception of the coin portion of NCP, NCTB and NCSB, each of the components of the monetary base is a liability of the Reserve Bank.

Utilising the Reserve Bank's balance sheet identity

\[
GFE + GSBR + RCLO + RBOL = RBBR + RBOLIA + TLF + FDLF + SRD + \\
DSBRB + NCP + NCTB + NCSB + ODTBRB \\
\]

(A-31)
the adjusted monetary base may be defined in terms of the assets and other liabilities of the Reserve Bank:

\[ B^a = \text{GFE} + \text{GSRB} + \text{RCLO} + \text{RBOLO} - \text{RBCR} - \text{RBOLIA} - \text{TLF} - \text{FDLF} + \text{COIN} \quad (A-32) \]

where GFE = Gold and foreign exchange

GSRB = Australian Government securities held by Reserve Bank
RCLO = Rural Credits Department loans, advances and bills discounted
RBOLO = Reserve Bank loans, advances and bills discounted and other assets excluding those of Rural Credits Department
RBCR = Capital and Reserves of Reserve Bank including IMF Special Drawing Rights
RBOLIA = Other liabilities of Reserve Bank
COIN = Treasury coin on issue which is the only component of the adjusted base which is not an asset or liability of the Reserve Bank

Taking the differential of (A-32) and dividing both sides by the adjusted base we obtain

\[ \frac{dB^a}{Ba} = \frac{d\text{GFE}}{Ba} + \frac{d\text{GSRB}}{Ba} + \frac{d\text{RCLO}}{Ba} + \frac{d\text{RBOLO}}{Ba} - \frac{d\text{RBCR}}{Ba} - \frac{d\text{RBOLIA}}{Ba} - \frac{d\text{TLF}}{Ba} - \frac{d\text{FDLF}}{Ba} + \frac{d\text{COIN}}{Ba} \quad (A-33) \]

The positive items on the right hand side of (A-33) are the sources of the adjusted monetary base while the negative items are the uses of the base.

A copy of the results of the decomposition procedure utilising equation (A-30) on both seasonally adjusted and unadjusted bases may
be obtained from the author. In Table 2 an attempt is made to summarise some of these results by indicating the maximum and minimum monthly contributions of each factor to changes in the money supply in the period 1960-1972.

**TABLE 2**

**MULTIPLIER DECOMPOSITION**

**MAXIMUM/MINIMUM CONTRIBUTIONS**

<table>
<thead>
<tr>
<th>FACTOR</th>
<th>UNADJUSTED</th>
<th></th>
<th>SEASONALLY ADJUSTED</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MAXIMUM</td>
<td>MINIMUM</td>
<td>MAXIMUM</td>
<td>MINIMUM</td>
</tr>
<tr>
<td>c</td>
<td>+ .2818</td>
<td>- .2825</td>
<td>+ .0469</td>
<td>- .0469</td>
</tr>
<tr>
<td>f</td>
<td>+ .0530</td>
<td>- .0703</td>
<td>+ .0116</td>
<td>- .0006</td>
</tr>
<tr>
<td>p</td>
<td>+ .1771</td>
<td>- .1409</td>
<td>+ .0357</td>
<td>- .0114</td>
</tr>
<tr>
<td>g</td>
<td>+ .0399</td>
<td>- .0567</td>
<td>+ .0069</td>
<td>- .0059</td>
</tr>
<tr>
<td>b</td>
<td>+ .0264</td>
<td>- .0255 *</td>
<td>+ .0036</td>
<td>- .0030</td>
</tr>
<tr>
<td>s</td>
<td>+ .6809</td>
<td>- .5237</td>
<td>+ .1107</td>
<td>- .1064</td>
</tr>
<tr>
<td>w</td>
<td>+ .1309</td>
<td>- .1644</td>
<td>+ .0113</td>
<td>- .0048</td>
</tr>
<tr>
<td>e</td>
<td>+ .2308</td>
<td>- .5192</td>
<td>+ .0437</td>
<td>- .0356</td>
</tr>
<tr>
<td>m</td>
<td>+ .0251</td>
<td>- .0268</td>
<td>+ .0009</td>
<td>- .0031</td>
</tr>
<tr>
<td>r</td>
<td>+ .2940</td>
<td>- .4691</td>
<td>+ .0720</td>
<td>- .1214</td>
</tr>
<tr>
<td>ba</td>
<td>+ .6125</td>
<td>- .9587</td>
<td>+ .2520</td>
<td>- .0920</td>
</tr>
</tbody>
</table>
III. AN ALTERNATIVE APPROACH TO MODELLING
THE AUSTRALIAN MONETARY SECTOR

In Australia the regulatory authorities have used the interest rate on government securities, and maximum interest rates on deposits and advances of banks, as policy instruments. It would therefore seem appropriate to treat these interest rates as exogenous in the model and to develop demand equations for the claims concerned. This procedure has indeed been adopted by the two major econometric model building groups in Australia, and by others, in developing demand equations for the volume of money or the various components of the volume of money. In defense of these studies it may be argued that the implicit assumption that the banks play an insignificant role in the determination of the money supply is a reasonable approximation when one considers the constraints on banking behaviour imposed by the Australian regulatory authorities. Alternatively, these demand for money functions may be regarded as reduced form equations representing approximations to the solution of a complete model of the money supply process. However because of an identification problem, it is generally not possible to identify the basic parameters of the structural model of the money supply process. Nor it is possible to distinguish cause from effect in the reduced form. For example, a significant coefficient on an income variable in such a reduced form equation is compatible with channels of influence from money to income or vice versa. Thus, reduced form studies provide virtually no information whatsoever as to the mechanism or process underlying the determination of the money
supply. Consequently in the remainder of this section we endeavour to develop a model of the determination of the money supply which does not depart from the assumption that the volume of money is essentially demand determined but yet includes both policy and behavioural parameters of the authorities and banks, together with the numerous interdependencies in the monetary sector suggested by economic theory.

Rather than assume that the components of the volume of money are demand determined we make the alternative assumption that it is volume of base money and its distribution between notes and coin, trading bank reserves and savings banks reserves which is demand determined. It is then the behaviour of the authorities (through control of the statutory reserve requirement and interest rates) together with bank investment behaviour (primarily with respect to the decision as to the appropriate level of excess reserves) which determines the volume of money that is supported by (or created from) the demand determined monetary base.

(a) Government's Financing identity

To ensure the consistency of our model of the monetary sector we begin by imposing the government's financing or budget identity. This merely states that the government's domestic borrowing requirement, \( \Delta GDB \), must be met either by the new issue of coins, \( \Delta COIN \), the sale of government securities to the private sector, \( \Delta GSP \), trading banks, \( \Delta GSTB \), savings banks, \( \Delta GSBB \), authorised money market dealers, \( \Delta GSMM \) and the Reserve Bank, \( \Delta GSRB \), or by drawing down the government's cash balance in its working account at the Reserve Bank \( -\Delta CASHB \). We
follow the RBAI model by assuming that GDB is essentially determined in the real or fiscal sector (though it is subject to monetary influences) but differ in the choice of the residual in this identity. Thus the RBAI model selects \( \Delta \text{GSSB} + \Delta \text{GSTB} \), the change in the banks' holdings of government securities, to be determined, "in a simple sense", by the government budget identity\(^{10}\). It has been shown elsewhere\(^{11}\) that this specification implies that a change in the SRD requirement is in the first instance, completely offset by Reserve Bank sales or purchases of government securities to the banks. Alternatively, it implies that increases in government spending must, in the first instance, be completely financed by increased holdings of government securities by the banks\(^{12}\). While this may in fact be a reasonable approximation of the end result of banking behaviour and government debt financing, it is unsatisfactory for our purposes because the result is basically imposed on the model by the modelbuilder's specification and in no way is it an empirical finding.

The alternative suggested here is to develop a somewhat more detailed and flexible model of the adjustment process so that we can empirically ascertain the reasonableness of Henderson and Norton's approximation. Also it will permit us to examine the effect of SRD policy free of the imposed constraint (though cognizant of the possibility of such interdependence) that SRD policy is completely offset by open market operations of the authorities. Such an approach appears necessary recognising that one of our objectives is to examine the question of the controllability of the money supply for in such a situation interest rates
would no longer be pegged and SRD policy less constrained by offsetting open market operations. Thus we allow banks some discretion as to the size of their government securities portfolio and assume that \( \Delta \text{GSRB} - \Delta \text{CASHB} \) is the residual in the government's borrowing identity:

\[
\Delta \text{GSRB} - \Delta \text{CASHB} = \Delta \text{CDB} - \Delta \text{COIN} - \Delta \text{GSP} - \Delta \text{GSTB} - \Delta \text{GSSB} - \Delta \text{GSMM} \tag{18}
\]

That is, the portion of the government's domestic borrowing requirement which is not satisfied by the issue of coin and government securities to the private sector, banks and money market dealers must be met by the drawing down of the government's cash balance at the Reserve Bank or by borrowing from, or issuing securities to, the Reserve Bank. Thus (18) implies that an increase in the demand for government securities by the private sector will, in the first instance, result in a reduction in the Reserve Bank's government securities portfolio if the securities are purchased from the Reserve Bank. Alternatively, if the securities are part of a new issue, then the purchase may increase the Treasury's cash balance at the Reserve Bank. In contrast, the RBA1 specification implies that, in the first instance, the increase in the private sectors holdings will be accompanied by a similar reduction in the banking sector's portfolio of government securities and statutory reserve deposits. Needless to say, the long-run impact would depend upon the portfolio adjustment behaviour of the banks and the non-bank private sector.

(b) **Demand for Base Money**

Using equations (A-19) and (A-32) an expression may be obtained for the monetary base
\[ B = GFE + GSRB + RCLO + RBOLO - RBCR - RBOLIA + COIN (19) \]

where RBOLIA includes the Treasury's cash balance at the Reserve Bank

\[ RBOLIA = CASHB + RBONL. \] (20)

and RBONL is merely the other liabilities of the Reserve Bank less the Treasury's cash balance at the Reserve Bank. Also, foreign reserves of the Reserve Bank are given by

\[ GFE = GFE_{-1} + CAB + TC \] (21)

where CAB is the balance on current account and TC is the net capital inflow. By substituting (20) and (21) into (19) we then obtain:

\[ B = GFE_{-1} + CAB + TC + GSRB - CASHB + RCLO + RBOLO - RBCR - RBONL + COIN \] (22)

There are then two alternative approaches open to the model builder to determine the monetary base 'B'. One approach is to develop, at an aggregative level, a demand equation for base money B and to permit (CAB + TC + RCLO + RBOLO - RBONL + COIN), or any component thereof\textsuperscript{13}, to be determined as the residual in equation (22). Implicit in this approach is the viewpoint that the monetary base is a useful and meaningful macroeconomic concept.\textsuperscript{14} If by chance CAB, TC or (CAB + TC) is selected as the residual in (22) then this approach reflects the monetarist view of the balance of payments which was described in part IIc(i) of this paper.

The alternative procedure involves the development of behavioural equations to explain the items on the right hand side of (22), the sum of the items then determining the monetary base B. Implicit in this
approach is the view that it is the individual components of the monetary base which are demand determined and that the monetary base is the sum of these possibly independent demands. The choice between the aggregative (monetarist) approach and the alternative approach is a difficult one as the implications of the two approaches are by no means identical. For example, in the alternative approach the monetary base and other determinants of the money supply, such as excess reserve ratios, are not independent. Shortly we will see that the banks' demand for government securities depends upon their excess reserve ratio. Thus an increase in the excess reserve ratio would reduce banks' demands for government securities but, by the government's budget identity, (18), if \textit{ceteris paribus} conditions hold, then there must be an increase in \((\Delta GSRB - \Delta CASHB)\). This then feeds into equation (22) so that the monetary base, \(B\), would be increased accordingly. On the other hand, this particular channel of interdependence between trading bank excess reserves and the monetary base is not incorporated in the aggregative (monetarist) approach. Thus, if the banks decide to increase the volume of excess reserves held then, \textit{ceteris paribus}, this will result in a reduction in their portfolio of government securities, an increase in the Reserve Bank's holdings of government securities, a reduction in the residual item in equation (22), and no change in the monetary base.

Because of the differing implications of the monetarist and alternative approaches, at this time it is intended to develop both forms of the model. For the monetarist approach, following Kouri and
Porter we will assume that the demand for base money is given by

\[ B = B(Y, W, R, R^*, E) \]  \hspace{1cm} (23)

\[ \frac{\partial B}{\partial Y} > 0 \quad \frac{\partial B}{\partial W} > 0 \quad \frac{\partial B}{\partial R} < 0 \quad \frac{\partial B}{\partial R^*} < 0 \]

where \( Y = \) Nominal income

\( W = \) Nominal wealth

\( R = \) Domestic interest rate

\( R^* = \) Foreign interest rate

\( E = \) Vector of risk factors

In the alternative approach the base is defined by equation (22).

(c) **Distribution of Base Money**

Base money may be held in three forms: (i) notes and coin held by the non-bank private sector, \( X_1 \); (ii) reserves, both required and excess, held by trading banks, \( X_2 \); and (iii) required and excess reserves held by savings banks, \( X_3 \). The problem is that of determining how a given volume of base money is distributed between \( X_1, X_2, \) and \( X_3 \) so that

\[ B = X_1 + X_2 + X_3. \]  \hspace{1cm} (24)

The quantity of notes and coin held by the non-bank private sector is assumed to be demand determined so that its determination is described in section (h) below. On the other hand the volume of savings bank reserves is assumed to be determined jointly by the portfolio behaviour of the non-bank private sector and the savings banks as described below in sections (h) and (e) respectively. As the volume of base money is given by either (22) or (23), trading bank reserves are then determined
as the residual in identity (24) so that:

$$X_2 = B - X_1 - X_3$$  \hspace{1cm} (25) 

(d) **Trading Bank Portfolio Behaviour**

The balance sheet identity of the trading banks is given by equation (26):

$$DEPC + DEPF = DEPCCP + DEPFCP + (DEPC - DEPCCP) + (DEPF - DEPFCP)$$

$$= SRD + TBRXES + TLF + FDLF + ADVTB + GSTB + MMLOTB + ONATB$$

$$= X_2 + ADVTB + GSTB + MMLOTB + ONATB$$  \hspace{1cm} (26) 

where ADVTB = Advances of trading banks

MMLOTB = Trading bank deposits with authorised money market dealers

ONATB = Other net assets of trading banks.

Trading Banks are unique among financial intermediaries in that while each individual trading bank can lend or purchase securities only to the extent of its excess reserves, the system of trading banks as a whole may purchase earning assets in excess of the volume of cash reserves held. That is, the trading banks as a whole create money.

This unique property of trading banks does create problems for the model-builder as it is obviously not legitimate to assume that the macro behaviour of the banking system is the sum of the behaviour of individual banking units. As this is a macro study it emphasises the behaviour of the banking system as a whole and it is therefore acknowledged that the portfolio behaviour implied does not necessarily apply to individual banks.
To illustrate our approach it is useful to examine banking behaviour in terms of some simple T accounts so let us begin by assuming that the Reserve Bank creates reserves of $100 by lending this amount to the trading banks. The balance sheet situation of the trading banks is then:

<table>
<thead>
<tr>
<th>All Trading Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
</tr>
<tr>
<td>Reserves</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

Assume for the moment that there are no currency withdrawals nor transfers to savings deposits and that the required (statutory) reserve deposit against deposits is 20%. In this simplistic economy, when the banks make loans or purchase securities from the private sector there is no loss of reserves from the banking system. However, part of the total reserves will be transferred from excess reserves to required reserves.

To illustrate, assume the banks extend loans of $100 and purchase securities of $100 from the private sector by issuing $200 of current deposits. Then the balance sheet position becomes:

<table>
<thead>
<tr>
<th>All Trading Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
</tr>
<tr>
<td>Required reserves</td>
</tr>
<tr>
<td>40</td>
</tr>
<tr>
<td>Excess reserves</td>
</tr>
<tr>
<td>60</td>
</tr>
<tr>
<td>Advances</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>Securities</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>300</td>
</tr>
</tbody>
</table>
This process of increasing earning assets and simultaneously creating money would continue until the banks' excess reserves ratio, 
\[ e = \frac{\text{Excess Reserves}}{\text{Deposits}}, \] falls to some desired level, \( e^* \). If \( e^* = 0.05 \) the balance sheet position would become:

<table>
<thead>
<tr>
<th>All Trading Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
</tr>
<tr>
<td>Required reserves</td>
</tr>
<tr>
<td>Excess reserves</td>
</tr>
<tr>
<td>Advances</td>
</tr>
<tr>
<td>Securities</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The final result is obtained by simple algebra as follows:

\[ RR + ER = 100 \]

But \[ RR = (0.2) \text{ DEP}, \]

and \[ \frac{ER}{DEP} = 0.05. \]

\[ RR + ER = 0.2 \text{ DEP} + 0.05 \text{ DEP} \]
\[ = 0.25 \text{ DEP} \]

\[ \therefore \text{ DEP} = \frac{RR + ER}{0.25} \]

or \[ \text{ DEP} = \frac{100}{0.25} \]
\[ = 400 \]

Our approach then to modelling trading bank portfolio involves a three step procedure. Firstly we estimate an equation for trading bank excess reserves, \( \text{TBXRES} \). Given that total trading bank reserves,
$X_2$, are determined by equation (25) and, assuming for the present time that TLF and FDLF are exogenous to the model, then the volume of SRD and (DEPCCP + DEPFCP) are found by the procedure illustrated above. Secondly, the $w$ ratio, which is the proportion of current and fixed deposits subject to the SRD requirement defined in (A-12), may either be determined exogenously or by means of a behavioural relationship. This then enables us to determine the total volume of current and fixed deposits, (DEPC + DEPF). The portfolio of earning assets is then given by the identity:

$$DEPC + DEPF - X_2 = ADVTB + GSTB + MMLOTB + ONATB$$  \hspace{1cm} (27)

With Australia's overdraft system of trading bank lending it is convenient and quite plausible to assume that the volume of trading bank advances, ADVTB, is determined by the private sector's demand for such loans. This assumption may be modified later by estimating a supply equation for overdraft limits outstanding with the rate of drawing of these limits demand determined\textsuperscript{16}. Thus in the final step we determine how trading banks allocate earning assets less advances between the three components, GSTB, MMLOTB and ONATB. If it were not for the complications of the LGS requirement (discussed below) the first and third steps could be integrated thereby substantially simplifying the model of the portfolio selection of trading banks. Let us now develop each of these three steps in greater detail.

In a recently published paper\textsuperscript{17} the author has derived asset demand equations on the assumption that investors are expected utility maximizers and that they are constrained in their portfolio selection by a fundamental balance sheet identity. This utility is assumed to
be positively related to the expected return and negatively related to the risk of the portfolio. In the short-run, however, instantaneous adjustment to this long-run solution may not be optimal because of differing transactions costs and liquidity properties of the various assets. Thus it is assumed that short-run portfolio behaviour is motivated by a desire to minimize the costs of attaining the long-run solution. Under specific assumptions as to the nature of the utility and cost functions, demand equations of the following form were derived:

$$\Delta A_i(t) = \beta_{i0} + \beta_{i1} f(t) + \beta_{i2} R(t) - \sum_j \theta_{ij} A_j(t-1) \quad (28)$$

where $A_i$ is the stock of asset or liability $i$:

- $R$ is a vector of expected yield and asset risk attributes:
- $f$ is the total funds to be invested in the alternative assets: and

$$\Sigma_{i=1}^{n} \beta_{i0} = \Sigma_{i=1}^{n} \beta_{i2} = 0; \quad \Sigma_{i=1}^{n} \theta_{ij} = 1, \quad \Sigma_{i=1}^{n} \theta_{ij} = 1$$

Applying (28) to the trading bank portfolio choice between excess reserves and earning assets less advances we have:

$$TBXRES = g[RGS, RAMM, \frac{DEPF}{DEPC}, (TBXRES + GSTB + MMLOTB + ONATB),$$

$$TBXRES_{-1}, (GSTB + MMLOTB + ONATB)_{-1}] \quad (29)$$

We have included the expected yields on government securities, RGS, and on loans to authorised money market dealers, RAMM, and an implicit zero yield on cash reserves in the vector of expected yields. It would have been more correct to utilize the discount rate of the Reserve Bank for the yield on excess reserves as the holding of excess reserves reduces the
probability of a bank having to borrow at the discount window at this
cost. However, in Australia, the discount rate is not published. The
ratio, \( \frac{\text{DEPF}}{\text{DEPC}} \), is included as a proxy for portfolio risk. In this respect,
cash reserves serve a very important function as a buffer against
unexpected deposit withdrawals. The greater the variability or
volatility of deposits the greater the portfolio risk and consequently
the greater the need for cash reserves. As it is generally believed
that current deposits are more subject to unexpected withdrawals than
are fixed deposits, the ratio of the two should provide a rough index
of the volatility of trading bank liabilities.

The 'w' ratio, which is the proportion of current and fixed
deposits subject to SRD requirements, is a much more difficult variable to
explain in economic terms. We would expect 'w' to be related to the
competitive position of the State banks relative to that of the banks
subject to the Banking Act. But the competitive position of State banks
is in turn a function of advertising expenditures, the rate of growth of
branches and agencies, the severity of Reserve Bank direct controls, and
the rate of economic growth in the respective State economies. For
example, rapid growth in Western Australia where the Rural and Industries
Bank of Western Australia has a local advantage should, \textit{ceteris paribus},
increase the proportion of deposits held by State Banks. Similarly a
buoyant rural economy would tend to increase the State Banks' share of
banking business because of their role in the rural sector.
Over the decade encompassed by this study the seasonally adjusted 'w' ratio has declined from .96 to .91 with the decline concentrated in 1960-1963 and 1971-1972. In addition, the unadjusted ratio fluctuates substantially on a seasonal basis reflecting the seasonal nature of incomes in the primary industry. However the decomposition analysis of the previous section (see Table 2) indicates that this variation contributes little to changes in the money supply. In the light of the difficulty of obtaining monthly data of the determinants of the 'w' ratio and the ultimate insignificance of changes in 'w' in explaining growth of the money supply it was decided to 'explain' the 'w' ratio, in a statistical sense, by a time trend variable and various seasonal dummy variables. We then have

\[ w = f(t, S_i) \]  

(30)

where \( t \) is time and \( S_i \) a seasonal dummy variable for the 'i'th month.

As indicated earlier, the allocation of total earning assets less advances of trading banks between government securities (GSTB), money market loans (MMLOTB) and other net assets (ONATB) is constrained by the fact that banks subject to the Banking Act must satisfy the LGS requirement. Unfortunately on the basis of published statistics, one cannot disaggregate the assets of trading banks according to whether or not the banks are subject to the Banking Act. Thus equation (31) below is not strictly speaking correct as the excess reserves of banks not subject to the Banking Act are not part of the L.G.S. requirement. By definition:
\[ REQLGS = I(DEPCCP + DEPFCP) \]
\[ = TBXRES + GSTBRQ \]  
(31)

where \( I \) is the L.G.S. requirement of 16\% of depositors' balances from January 1960 to March 1962 and 18\% thereafter. \( REQLGS \) is the required holdings of L.G.S. assets. \( GSTBRQ \) is the portion of the trading banks' portfolio of government securities required to satisfy the L.G.S. requirement given that a prior decision as to the volume of TBXRES has been made.

It is evident then that the second portfolio decision of trading banks relates to the allocation of

\[ (DEPC + DEPF - X_2 - ADVTB - GSTBRQ) \]

between government securities in excess of the legal requirement for L.G.S. purposes, GSTBX, money market loans, MLLOTB, and other net assets, ONATB. The total government security portfolio of trading banks is then given by

\[ GSTB = GSTBRQ + GSTBX \]  
(32)

Utilising (28) we then obtain for \( i = 1 \) to \( 3 \)

\[ \Delta Z_i = f[RGS, RAMM, RADV, (DEPC + DEPF - X_2 - ADVTB - GSTBRQ), \]
\[ GSTBX_{-1}, MLLOTB_{-1}, ONATB_{-1}] \]  
(33)

where \( Z_1 = GSTBX \)

\[ Z_2 = MLLOTB \]

\[ Z_3 = ONATB \]
(e) **Savings Bank Portfolio Behaviour**

Savings banks differ from trading banks both with respect to the type of assets held and in the fact that the former suffer a much larger loss of reserves than the latter, when they acquire earning assets. This suggests that a somewhat different model may be required for savings banks than for the trading banks.

Assume for the moment that the non-bank private sector decides to deposit $100 cash in a savings account. In terms of T accounts the transaction has the following effect if the required reserve ratio of savings banks is 10%:

<table>
<thead>
<tr>
<th>Private</th>
<th>Savings Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td><strong>Liab.</strong></td>
</tr>
<tr>
<td>Cash</td>
<td>-100</td>
</tr>
<tr>
<td>DEPS</td>
<td>+100</td>
</tr>
<tr>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

As the savings banks have excess reserves of $90 they will then acquire earning assets, say of $80, in the form of cash loans to the private sector. The T accounts then become:

<table>
<thead>
<tr>
<th>Private</th>
<th>Savings Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td><strong>Liab.</strong></td>
</tr>
<tr>
<td>Cash</td>
<td>-20 LOAN</td>
</tr>
<tr>
<td>DEPS</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>80</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Two features of this illustration are significant. Firstly, it is clear that total base money has not altered although the distribution of base money between the private sector's cash holdings and savings bank reserves has changed. Secondly, the volume of savings bank reserves increase as deposits are received and decrease when earning assets are acquired. The following model endeavours to incorporate these features.

The balance sheet identity of the savings banks is given by:

\[
\text{DEPS} = \text{DEPSCP} + \text{DEPSST}
\]

\[
= \text{SBRQRES} + \text{SBXRES} + \text{INBD} + \text{GSSB} + \text{MMLOSB} + \text{LSGSSB} + \text{MSB} + \ 
\text{ONASB}
\]

\[
= (.1) \text{DEPSCP} + \text{SBXRES} + \text{INBD} + \text{GSSB} + \text{MMLOSB} + \text{LSGSSB} + \ 
\text{MSB} + \text{ONASB} \hspace{1cm} (34)
\]

where \text{SBRQRES} = \text{required reserves of savings banks (10\% of DEPSCP)}

\text{MMLOSB} = \text{savings bank loans to authorised money market dealers}

\text{LSGSSB} = \text{local and semi-government securities held by savings banks}

\text{MSB} = \text{home mortgage loans of savings banks}

\text{ONASB} = \text{other net assets of savings banks.}

We assume that the volume of savings deposits is demand determined within the private sector portfolio behaviour and thus is predetermined to the savings banks. Then it is necessary to explain the ratio 'm', as defined in equation (A-7), to determine the proportion of savings deposits which are subject to the 10\% reserve requirement under the Banking Act.
Application of the 10% reserve requirement then permits us to determine SBRQRES. Finally, the savings banks allocate \((DEPS - SBRQRES)\) between excess reserves, SBXRES, interbank deposits, INBD, government securities, GSSB, money market loans, MMLOSB, local and semi-government securities, LSGSSB, home mortgage loans, MSB, and other net assets, ONASB. Then \(X_3\) is defined

\[
X_3 = SBRQRES + SBXRES
\]  

so that by equation (25), if the monetary base \(B\) is unchanged, then an increase in savings bank reserves must be offset by a reduction in trading bank reserves.

The 'm' ratio increased from .704 to .758 over the sample period indicating that, contrary to trading bank experience, the Commonwealth and Private Savings banks improved their competitive positions relative to the State savings banks. However the increase was quite uniform over the period so that the 'm' ratio contributed insignificantly (see Table 2) to the growth of the money supply. Similar difficulties are involved in explaining the savings bank 'm' ratio as applied to the trading bank 'w' ratio. Thus, for the time being, it is convenient to make the simplifying assumption that:

\[
m = f(t, Si)
\]  

Finally, utilising (28) we obtain for \(i = 1\) to 7

\[
\Delta A_i = f[RFD, RGS, RAMM, RLSGS, RM, (DEPS - SBRQRES), SBXRES_{-1}, INBD_{-1}, GSSB_{-1}, MMLOSB_{-1}, LSGSSB_{-1}, MSB_{-1}, ONASB_{-1}]
\]
where RLSGS is the maximum yield on local and semi-government securities, RM is the maximum yield on home mortgage loans, and Ai for i = 1 to 7 refers to each of the assets in the savings banks' portfolio choice set. In a paper published elsewhere the writer has argued that, with respect to home mortgage loans, the decision variable of the banks is the volume of new lending approvals and not the loans outstanding. However, monthly statistics of loan approvals are not available for the sample period encompassed in this study so that we are forced to introduce this misspecification into the model.

(f) **Interdependence of Savings and Trading Bank Sectors**

The model developed in parts (d) and (e) of this section assumes that, with only one exception, the portfolio behaviour of Australian savings banks is independent of that of the trading banks. The exception is that, for a given amount of base money, if savings banks accumulate increased reserves this will be at the expense of the trading bank reserves. However, in Australia the Commonwealth Banking Corporation and the private banks operate in both the savings and trading bank fields. This raises the possibility of these institutions co-ordinating their savings and trading bank portfolio behaviour as a means of increasing overall profits.

One possibility is that a bank may switch excess reserves from the trading bank division where they would not receive any interest to the savings bank division where they could be deposited with the Reserve Bank. Savings banks receive a yield on such deposits roughly equal to that paid by trading banks on fixed deposits. Thus the trading banks may "purchase"
government securities from their savings bank operations in exchange for cash and thereby "shift" non-interest bearing reserves to the savings banks where they may yield a nominal return. This hypothesis appears quite plausible in view of the seasonally adjusted results of Table 2 which indicate that variations in the savings bank excess reserve ratio 'r' contribute to much greater variations in the money supply than do changes in the trading bank excess reserve ratio 'e'.

The problem however is that of incorporating this reserve adjustment mechanism. It is impossible to identify or distinguish the adjustments in reserves and other assets attributable to the "shifting" of reserves from those associated with more traditional banking operations. For this reason we adopt an ad hoc procedure whereby the savings bank portfolio adjustment process is assumed to be modified by changes in base money held by the banking sector. Consequently equation (37) is modified as follows:

\[ \Delta A_i = f(RFD, RGS, RAMM, RLSGS, RM, (DEPS - SBRQRES), \Delta (B - NCP), SBRQRES_{-1}, INBD_{-1}, GSSB_{-1}, MMLOSB_{-1}, LSGSSB_{-1}, MSB_{-1}, ONASB_{-1}) \]  

(38)

(g) Money Market Dealers' Portfolio Behaviour

The balance sheet identity of money market dealers is given by

\[ MMLOTB + MMLOSB + MMLOP = GSMM + ONAMM \]  

(39)

where MMLOP = the private sector's loans to dealers

ONAMM = other net assets of dealers.
We have already formulated equations for trading and savings bank demands for money market loans and in the following section the private sector's demand equation is developed. The yield on money market loans is a market determined rate which varies both seasonally and cyclically in response to changes in the demand and supply of liquidity. This suggests that both supply and demand equations for money market loans should be developed.

Our approach then will be to try to explain the yield on money market loans in terms of excess supply or demand for such loans together with an adjustment mechanism. Thus we assume that:

\[
R_{\text{MAM}} = aR_{\text{MAM} - 1} + b[M_{\text{MMLO}}^S - M_{\text{MMLO}}^D] \tag{40}
\]

where the $S$ and $D$ subscripts indicate the supply and demand respectively and

\[
M_{\text{MMLO}}^D = M_{\text{MMLOT}} + M_{\text{MMLOS}} + M_{\text{MMLO}} \tag{41}
\]

If we further assume that observations of money market loans lie along the demand curve and apply (28) to obtain the supply equation

\[
M_{\text{MMLO}}^S = c_0 + c_1R_{\text{GS}} - c_2R_{\text{MAM}} - c_3ON_{\text{MAM}} + c_4G_{\text{MMM}} - 1 + c_5M_{\text{MMLO} - 1} \tag{42}
\]

then

\[
R_{\text{MAM}} = aR_{\text{MAM} - 1} - bM_{\text{MMLO}}^D + c_0 + bc_1R_{\text{GS}} - bc_2R_{\text{MAM}} - bc_3ON_{\text{MAM}}
+ bc_4G_{\text{MMM}} - 1 + bc_5M_{\text{MMLO} - 1} \tag{43}
\]

where $0 < a < 1$ and $c_1, c_2, c_3, b > 0$.

Finally, the size of the government securities portfolio of money market dealers is obtained from the balance sheet identity

\[
G_{\text{MM}} = M_{\text{MM}} - ON_{\text{MAM}}. \tag{44}
\]
where ONAMM is exogenous in the model.

The adjustment mechanism involved in the market for money market loans may be depicted graphically in Figure 4. Assume that the market is initially in equilibrium at a market yield of RAMM\(_0\) but that this is disturbed by an increase in liquidity which shifts the demand curve to the right. If the liquidity increase does not affect the supply curve then a new equilibrium will eventually be attained at the lower yield, RAMM\(_1\). However the dynamics of the adjustment could involve an immediate shift from E to F and then a gradual movement along the demand curve to the point G.

(h) **The Private Sector's Portfolio Behaviour**

It is now time to tidy up the "loose ends". The private sector's balance sheet identity, netting out claims which are both assets and liabilities of the sector, is given by

\[
\begin{align*}
    \text{RBONL} + \text{NCP} + (\text{DEPC} + \text{DEPS} - \text{GOVD} - \text{INBD}) + \text{DEPS} + \text{GSP} + \text{MMLOP} + \text{REALAS} \\
    = \text{ADVTB} + \text{MSB} + \text{ONATB} + \text{CNASB} + \text{ONAMM} + \text{NWP} + \text{RCLO} + \text{RBOLO} + \text{LSSS} & \quad (45)
\end{align*}
\]

where REALAS = real assets of private sector.

NWP = net worth of private sector.

The only items not already determined elsewhere in the model are DEPS, GSP, NCP, REALAS, ADVTB, RBONL, RBOLO, RCLO, MMLOP, GOVD and NWP. We simplify the model somewhat by assuming that the last two variables, government deposits at the Trading Banks and net worth of the private
sector, are exogenous in the model. In a complete model of the Australian economy this net worth variable should be treated endogenously thereby providing an additional link between the real and financial sectors.\textsuperscript{19}.

Re-ordering equation (45) we obtain:

\[ \text{NCP + DEPS + GSP + MMLOP + REALAS + RBONL - RBOL0 - RCLO - ADVTB} \]
\[ = \text{MSB + ONATB + ONASB + ONAMM + LSGSSB + NWP} \]
\[ - (\text{DEPC + DEPF - GOVD - INBD}) \]
\[ = \text{SCALAR} \quad (46) \]

Let the items on the left hand side of (46) be represented by \( P_i \) where \( i = 1 \) to 9. Utilising (28) but incorporating income as a short-run constraint or determinant of portfolio behaviour of the non-bank private
sector we have

\[ \Delta P_1 = f[RSD, RGS, RAMM, RSPC, RRCLO, RADV, Y, SCALAR, NCP_{-1}, DEPS_{-1}, GSP_{-1}, MMLOP_{-1}, REALAS_{-1}, RBONL_{-1}, RBOLO_{-1}, RCLO_{-1}, ADVTB_{-1}] \]  

(47)

where RSPC is the supply price of capital and

RRCLO is the yield on rural credit loans of Reserve Bank

As it is not intended at this stage to develop a complete model of the real sector we will not be able to determine the supply of real assets, and consequently the supply price of capital, endogenously within the model. Thus we assume that the supply price of capital is exogenously given to the private sector\(^{20}\). The alternative procedure would be to develop an equation similar to that in RBA1 for the supply price of capital\(^{21}\).

(i) The Foreign Sector

The specification of the foreign sector depends upon the particular approach adopted in section (b) with respect to base money. Thus if the aggregative (monetarist) approach is adopted then, in equation (22), the base \( B \) is determined by equation (23), the government's financing identity (18) determines the government's borrowing from the Reserve Bank, GSRB - CASHB, and the private sector's portfolio behaviour in equation (47) determines the Reserve Bank's assets and liabilities, RCLO, RBOLO and RBONL. If we assume that capital and reserves of the Reserve Bank, RBCR, COIN on issue, and the lagged value of gold and foreign
exchange holdings, GFE_{-1}, are each exogenously given and that the size of the current account balance is determined in the real sector (and thus predetermined to the monetary sector), then total capital inflow, TC, is determined endogenously as the residual in (22). On the other hand in the alternative approach, behavioural equations need to be developed to explain the current account balance and capital inflow\textsuperscript{22} while the base B is determined by equation (22).

The difference in the two approaches is apparent in Figure 5. In the monetarist approach, fiscal policy and Reserve Bank open market operations have no effect on the money supply. However in the alternative approach these policy operations may influence the money supply.

(j) A Reduced Form Equation for the Money Supply

In the introduction to this section of the paper it was suggested that the numerous studies which have estimated aggregate demand for money functions in Australia could be regarded as approximations to a reduced form solution of the model of the monetary sector. Needless to say, the reduced form solution would be a very complicated one because of the non-linear nature of the model, the numerous constraints imposed in the model, and the many exogenous or predetermined variables in the model. Ignoring these complexities, it is possible to specify a general functional form of the solution and, by making a linear approximation and then using ordinary least squares regression techniques, obtain estimates of the reduced form parameters. However this approach has been rejected for two primary reasons:
Figure 5
FLOW CHART OF THE MONETARY SECTOR
(a) THE MONETARIST APPROACH

\[ GDB \]

\[ (GSRB - CASHB) \]

\[ (GFE - RBCR + COIN) \]

\[ CAB \]
\[ TC \]

\[ BASE \]
\[ f(Y, NWP, R, R^k, E) \]

\[ TBXRES \]
\[ TBRES \]
\[ SBRES \]

\[ SBQRES, \]
\[ MMLOTB \]
\[ GSTB \]

\[ ONATB \]
\[ (DEPC + DEPF) \]

\[ ADVTB \]
\[ NCP \]
\[ DEPS \]

\[ [ \bar{V}, NWP ] \]
(b) THE ALTERNATIVE APPROACH

\[ \text{GSTB} \rightarrow (\text{GSRB} - \text{CASHB}) \]

\[ \downarrow \]

\[ \text{BASE} \]

\[ \downarrow \]

\[ \text{X} \quad \text{N} \quad \text{TC} \]

\[ \text{TBRES} \]

\[ \text{GDB} \]

\[ \text{GSP} \quad \text{GSSB} \quad \text{GSM} \]

\[ \text{COIN} \quad \text{RBCR} \]

\[ \text{RBONL} \quad \text{RBOLO} \quad \text{RCLO} \]

REMAINDER AS ABOVE IN (a)
(1) It provides no information as to the mechanism underlying the money supply process, particularly neglecting cause and effect relationships; and

(2) The linear approximation and the unconstrained estimation techniques could involve serious mis-specification errors.
FOOTNOTES

1. A formations table analysis is published monthly by the Reserve Bank of Australia in the Statistical Bulletin "Bank Liquidity and Money - Analysis of Changes".


3. This viewpoint is expressed in most American monetary texts. See for example D. Wrightsman Monetary Theory and Policy (Free Press, New York 1971).


13. That is assuming that RBCR is exogenous and \((\text{GSRB} - \text{CASHB})\)
is determined by (18).

14. A similar choice confronts the modelbuilder in deciding whether
to estimate an aggregate demand equation for GNP or to estimate
demand equations for each of its components. In this case the
choice depends upon the modelbuilder's preference for a
Keynesian relative to a neo-classical theory and upon his views
as to how various policy instruments influence the components
of aggregate demand.

15. P.J.K. Kouri and M.G. Porter, "International Capital Flows and
Portfolio Equilibrium", forthcoming in the Journal of Political
Economy.

16. For justifications of this alternative approach refer to T.J.
Valentine, "Loan Supply Function of Trading Banks", Australian
Economic Papers, (June 1973) or I.G. Sharpe, "A Mortgage Model:
Some Theoretical and Empirical Results as Applied to Australian
Savings Banks", Australian Economic Papers (December 1973)
pp. 208-20.

17. I.G. Sharpe "A Quarterly Econometric Model of Portfolio Choice
Part I: Specification and Estimation Problems" Economic Record
(December 1973).


Integrated Model of Consumption, Investment and Portfolio
Decisions" Paper Presented at A.N.Z.A.A.S. Congress (Perth,
August 1973).

20. Ibid.


22. See equations (10) and (78) in Norton & Henderson Op.cit.