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MODELS OF THE AUSTRALIAN MONEY SUPPLY PROCESS

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This thesis is submitted in fulfilment of the requirements for the Degree of Master of Commerce (Economics) at the University of New South Wales.

I hereby certify that the work contained in this thesis has not been submitted for a higher degree to any other universitv or institution.

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Date..10/5/77......

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ABSTRACT

In Australia the money supply process has been traditionally analysed and incorporated into economic models by using the "formation table" approach. An alternative structure for analysis is the money multiplier-monetary base framework. This latter approach has been treated with scepticism in the Australian situation largely because the Australian Monetary Authorities have operated by and large an interest rate policy as distinct from a quantities policy. In standard textbook accounts this latter approach is also associated with firstly an exogenous monetary base, and secondly a constant multiplier. The former feature is highly inappropriate for a small open economy with a fixed exchange rate and where an interest rate policy is followed. The second feature implies that there is little behavioural content to this framework. In particular the framework has none of the richness of portfolio balance models with their implied balance sheet restrictions similar to those developed by Tobin.

This thesis examines both frameworks with particular emphasis on evaluating in the light of the features mentioned above, the money multiplier-monetary base framework in the Australian situation. Chapter I sets out the relevance of portfolio balance theory to the money supply process. This chapter also sets out a simplified textbook account of the money multiplier-monetary base framework and the standard criticisms

of this approach. In Chapters II and III the structural identities of this framework are expanded to include the details of the Australian situation.

Chapter IV examines the endogenous aspects of the money multiplier-monetary base framework. Endogeneity in the base results from firstly an exchange rate regime that implies that the net foreign assets component of the base is endogenous. Secondly an interest rate policy that means that the net domestic asset component of the base is linked closely with the deficit and how that deficit is financed. This chapter also derives the portfolio constraints which should be captured in the money multiplier. These chapters show that the standard criticisms of the money multiplier-monetary base to be rather myopic as the framework can be developed to overcome the problems of the standard textbook accounts.

Chapter V derives the formation table approach to the money supply process. It shows the formal equivalence of the two approaches to modelling the money supply process under certain circumstances. It also examines the specific criticisms of the money multiplier-monetary base framework to the Australian situation and finds them unfounded.

Chapter VI estimates a model of the money supply process. Whilst superficially in the formation table approach it is shown to be equivalent to a money multiplier-monetary base framework.

CHAPTER 1

INTRODUCTION

(1.1) The Money Supply Process and Portfolio Balance Theory - The Tobin Tradition

Friedman has actively questioned the efficacy of monetary policy, and has on many occasions advocated the implementation of a money supply rule because -

> "... The actual behaviour of the money stock [under a discretionary approach] has clearly been decidedly worse than the behaviour that would have been produced by the simple rule ..."
>
> (Friedman [39 , p.93]).[1]

Friedman's reasons for preferring a simple rule to discretionary policy results from the lags in the influence of monetary policy which he considers are long and unpredictable and hence makes discretionary countercyclical monetary policy destabilizing.

Implicit in this belief is the assumption that the effects of changes in the money stock are related in a complicated fashion to the myrid of portfolio decision of economic units in reactings to changes in relative prices and the level and composition of wealth caused by the changes in the money stock.

A question closely related to this which is of extreme interest to economists is the reason for the observed similarities

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1. Words in square brackets in this and later quotes have been added.

in behaviour between national income and the money stock. A study of the determination of the money stock can provide valuable information relating to this question of causality:

> "A systematic money supply analysis can be used to examine the possible channels, linking money supply with economic activity. The nature and role of these channels can be assessed and the magnitude and conditions of 'reverse causation' be explored in detail"
> (Brunner [16, p.100]).

The majority of models developed to explain the money supply process, especially those developed for inclusion is the larger policy-forecasting oriented models, have taken an approach similar to the Brainard-Tobin [13] portfolio framework which allows for detailed modelling within each sector.

Whilst this approach is applicable to any sector and at any level of aggregation, it has usually been applied in highly disaggregated studies, particularly of the private non-bank sector. This suggests an important question: what variables need to be explained in the financial sector? Is there a need to explain in detail the links between changes in central bank instruments and the composition of liquid assets? Or is the need to explain the relation between changes in monetary variables and associated changes in the real economy?

A survey of nine econometric models by Christ [25] shows that most model builders have sought to explain the financial sector in detail, that is, a "financial model" rather than a "monetary model". The nine models surveyed had an average of one fifth of their endogenous variables in the financial sector. The models also had an average of six exogenous monetary policy variables.

Why is the link between the money supply process and portfolio theory so important? Portfolio theory was introduced (compared with "Classical Economics" - see Patinkin [73]) in Keynes' liquidity preference theory in the 'General Theory' [54]. The works of Tobin [83], [85] extended early portfolio balance theory into an accounting framework that required the incorporation of constraints on the parameters of models of behaviour. This intersectoral balance sheet approach showed explicitly that the behaviour of one sector (in acquiring assets and issuing liquidities) may strongly influence other sectors. The framework also showed the constraints which must be satisfied within a given sector to a change in some exogenous or predetermined endogenous variables. Like a lot of theory, Tobin's work was based on a set of macro accounting identities.

Another approach which incorporates similar ideas but which also incorporates the accumulation of wealth which Tobin did not explicitly model, is that exemplified by the works of

Parkin et al [72], Cooper [28,29], Purvis [78] and others. The first two works also reflect a disenchantment with ad hoc specification of lag structures[2] in that too much work is characterised by the specification of a static model which is made dynamic by grafting some lags upon it in a casual fashion.[3] It is argued that a well-specified model results from the maximization of the appropriate inter-temporal objective function and the dynamic behaviour should emerge from the necessary conditions of the optimization problem.[4]

It is probably true to say that these approaches have as a basis the desire to incorporate and model the interactions between the real and financial sectors. This again probably stems from the rejuvenated interest in monetary relationships following on from Friedman's theoretical and empirical studies.

Traditional real sector models have been Keynesian in nature and so could be summarised by the Hicksian IS-LM model. The basic characteristic of this model is that the channels of monetary influence are restricted to interest rates and wealth. Keynes in '<u>General Theory</u>' assumed that capital bonds, and private debts are perfect substitutes in investors' portfolios. The marginal efficiency of capital must equal the rate of interest. Keynes, of course, did

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2. See Nerlove, M. [66].

3. An example of this is the stock adjustment model or its multivariate extension, the generalized stock adjustment model as set out by Tobin in "Pitfalls in Financial Model Building" op. cit.

4. However, this approach is not without its critics. It is suggested by some that this approach is arbitrariness one step further removed to the ad hoc approach. See, for example, R.W. Kopcke [56].

not envisage these as identical (as is sometimes suggested), but in given circumstances these differentials are constants independent of the relative supplies of these assets and therefore not essential to the analysis. Once one of the rates is set, the others must differ from it by appropriate allowance for risk and for expectations of price changes.

Thus Keynes had only one yield differential to explain, the difference between the zero yield of money and the interest rate.[5]

An alternative view on the appropriate aggregation of assets is expressed in the Cambridge-Radcliffe Money-Capital Model. This theory either ignored money substitutes and thus gave a money-capital two asset model, or, when other substitutes existed (and given certain constant rate differentials) they were perfect substitutes for money.

What was required was a synthesis of the above approaches which avoided the assumption that all assets but one are perfect substitutes. This required the determination of more than one market determined rate of return. Among assets that are not perfect substitutes, the structure of rates will depend upon relative demands and supplies. Such a synthesis was provided by Tobin in "Pitfalls in Financial Model Building" and

5. That is, Keynes in effect had only two aggregates: money and bonds. With the money-bonds substitution of the traditional IS-LM analysis, the implication is that the transmission mechanism from money to economic activity is limited to interest rates. This therefore places emphasis on the borrowing cost mechanism for transmitting monetary influences.

"General Equilibrium Approach to Monetary Theory". This enabled monetary policy to fall into better perspective. In other words, assets other than money (especially other financial assets) can affect the terms on which the stock of capital is held. Tobin's analysis still has the major limitation, however, of treating increments to wealth as exogenous. This in effect leads to a dichotomised decision making model. That is, the decisionmakers first make the decision of how much to save out of exogenously given income, then the remainder which is the net increment to wealth is allocated amongst the various assets. This model has limitations, for example, Purvis [78] believes that various monetarists' contentions cannot be tested, for example that the composition as well as the level of wealth are important for decision making.

Tobin's framework provided behavioural equations in which relative prices played a major role and a dynamic process of adjustment to disturbances in the form of a generalised stock-adjustment model was incorporated. The balance sheet identities on which the theory was based implied a number of restrictions on the coefficients of the variables in the behavioural equations. The intuitive appeal of these ideas has led to the wide acceptance of Tobin's approach.

In "Pitfalls in Financial Model Building", Brainard and Tobin presented a general equilibrium model of the financial sector and a general disequilibrium model of the dynamic process by which the endogenous variables in the model adjust from one set of equilibrium values to another in response to a change elsewhere. The variables in their models are linked by behavioural equations. However, no formal derivation of the restrictions that:

(i) the impact effect of changes in interest rates and income summed over all assets must be zero, and

(ii) the effect of a change in wealth must be exhausted over all assets,

is given by Brainard and Tobin. The derivation of these restrictions is, however, important. To derive these restrictions it can be assumed that a sector holds its net wealth in the form of n different types of real and financial assets and liabilities: where liabilities are considered as negative assets. The demand for each of these can be considered as a linear function; homogenous in net worth, of interest rates and national income:

$$\hat{y}_t = (b_1 + BX_t)\, W_t \qquad \ldots(1.1)$$

where b_1 is an n x 1 vector of constant terms, X_t is a (n+1) x 1 vector of interest rates and national income, B is the n x (n+1) matrix of structural coefficients, W_t is net worth, a scalar, and $\hat{y}_t$ is the n x 1 vector of the desired values of the financial assets and liabilities given by current values of X_t and W_t.

An ex post identity requirement is:

$$r' y_t = W_t \qquad \ldots(1.2)$$

where r' is a 1 x n vector in which each element is equal to one, and y_t is the vector of actual values.

The ex ante identity which must be satisfied is:

$$r'\hat{y}_t = W_t \qquad \ldots(1.3)$$

The disequilibrium system by which the system is made dynamic is given by (1.4):

$$\begin{array}{l} y_{1t} - y_{1,t-1} = \alpha_{11}(\hat{y}_{1t} - y_{1,t-1}) + \ldots + \alpha_{1n}(\hat{y}_{nt} - y_{mt-1}) + \partial_{1\Delta w}W_t \\ \quad \vdots \\ y_{nt} - y_{n,t-1} = \alpha_{n1}(\hat{y}_{nt} - y_{n,t-1}) + \ldots + \alpha_{nn}(\hat{y}_{nt} - y_{n,t-1}) + \partial_{n\Delta w}W_t \end{array} \qquad \ldots(1.4)$$

which can be written in matrix form as

$$y_t - y_{t-1} = A(\hat{y}_t - y_{t-1}) + \partial_{\Delta w}\Delta W_t \qquad \ldots(1.5)$$

Adding y_{t-1} to both sides

$$y_t = A\hat{y}_t + Z\, y_{t-1} + \partial_{\Delta w}\Delta W_t \qquad \ldots(1.6)$$

where $Z = I_n - A$. There are more equations ((1.1), (1.2), (1.3), (1.6)) than unknowns $(\hat{y}, y)$ and the question arises as to whether the system is consistent. A sufficient condition for the existence of a solution is given by the following theorem: a system $CX + b = 0$ of m linear equations in n unknowns is consistent if and only if, the coefficient matrix C and the augmented matrix (Cb) have the same rank.

Consider the model comprising of equations (1.1), (1.2), (1.3) and (1.6). This system can be rewritten as:

$$\begin{bmatrix} I_n & -A \\ 0 & I_n \\ r' & 0 \\ 0 & r' \end{bmatrix} \begin{bmatrix} y \\ \hat{y} \end{bmatrix} + \begin{bmatrix} -(Zy_{t-1} + \alpha_{\Delta w} \cdot \Delta W_t) \\ -(b_1 + BX_t) \cdot W_t \\ -W_t \\ -W_t \end{bmatrix} = 0$$

$$\text{i.e. } \underline{C} \begin{bmatrix} y \\ \hat{y} \end{bmatrix} + b = 0 \qquad \ldots(1.7)$$

The resultant condition for at least one solution to exist is:

$$W_t = r'\,(Zy_{t-1} + \partial_{\Delta w}\Delta W_t) + r'A(b_1 + BX_t)\;W_t \qquad \ldots(1.8)$$

and

$$W_t = r'(b_1 + BX_t)\;W_t \qquad \ldots(1.9)$$

A sufficient condition for (1.9) to be satisfied is:

$$r'b_1 = 1 \qquad \ldots(1.9a)$$

$$r'B = 0 \qquad \ldots(1.9b)$$

Conditions (1.9a) and (1.9b) embody the restrictions discussed by Brainard and Tobin [pp.103, 107] on the structural coefficients of the static equilibrium model. These conditions require constant terms summed over equations (1.1) to equal unity and coefficients of any interest rate or income so summed to add to zero. This is the basic concept that the complete vector of interest rates and income should be entered in the equations of each asset and liability.

Turning next to sufficient conditions for (1.8) to be satisfied, we first substitute for Z to obtain:

$$W_t = r'A(b_1 + BX_t)\ W_t + r'(I_n - A)y_{t-1} + r'\partial_{\Delta w}\Delta W_t$$

Subtracting $r'y_{t-1}$ from both sides gives:

$$W_t - r'y_{t-1} = r'A[(b_1 + BX_t)\ W_t - y_{t-1}] + r'\partial_{\Delta w}\Delta W_t$$

Using (1.2) we get:

$$\Delta W_t = r'A[(b_1 + BX_t)\ W_t - y_{t-1}] + r'\partial_{\Delta w}\Delta W_t \qquad \ldots(1.8')$$

Since equation (1.2), ($r'y_t = W_t$) holds identically in all time periods, and since $W_t = W_{t-1} + \Delta W_t$, it follows that:

$$W_t = r'y_{t-1} + \Delta W_t$$

Substituting this into the first term $r'Ab_1W_t$ on the right hand side of (1.8') gives

$$(I - r'\partial_{\Delta w} - r'Ab_1)\Delta W_t - (r'AB)\ X_tW_t - (r'Ab_1r' - r'A)y_{t-1} = 0$$

This last relation will be satisfied if and only if

$$(I - r'\partial_{\Delta w} - r'Ab_1) = 0 \qquad \ldots(1.8a)$$

$$r'AB = 0 \qquad \ldots(1.8b)$$

$$r'A(I_n - b_1r') = 0 \qquad \ldots(1.8c)$$

These are both the necessary and sufficient conditions for consistency of the Brainard-Tobin system.

What do these restrictions imply? Firstly, (1.8c) implies that all columns of the adjustment matrix must have the same sum and that the sum of the elements of b_1 (the constant term) <u>must</u> be unity unless the columns of A sum to zero (the latter being the trivial case).

Secondly, the elements of the matrix AB in (1.8b) are impact multipliers. They give the impact effect on the assets (ceteris paribus) of changes in the independent variables other than wealth (interest rates, income, etc.). Equation (1.8b) asserts that for the non-trivial case each column sum of this matrix must be equal to zero. That is, the impact effect of any interest rate or income change summed over all assets must be zero. This will be satisfied if the long-run interest rate effects sum to zero across assets, and if the non-trivial form of (1.8c) holds.

Thirdly, equation (1.8a) deals with the coefficients which give the effect of a change in net worth on the assets. These are the elements of the vector $\partial_{\Delta W}$ and of the vector AB_1 (as equations assumed homogenous in wealth). The elements of the former vector are the coefficients of the variable ΔW, and the elements of the latter vector are the coefficients of the variable W. Equation (1.8a) states that the sum of these influences must be unity. A more extensive analysis of these derivations is given by Ladenson [59], [60] and Purvis [78].

The procedure developed is actually independent of the structure of the matrix of adjustment coefficients, A. That is the results should be the same if A is not say a general n x n but a diagonal n x n matrix, that is, a simple or univariate stock adjustment model.

Thus the conditions developed for a solution for a general matrix A should also apply to a diagonal matrix. Condition (1.8a) remains satisfied. As with (1.8a), (1.8b) is just a special case of the more general situation and so is also satisfied. For the non-trivial condition (11"c) to hold, which it must by definition for the simple stock adjustment model, the sum of the elements of b_1 must be unity and now the speed of adjustment for each asset is the same; that is, the diagonal elements of A are the same due to the condition that the sum of the columns of A must be the same:

that is, $\Sigma\alpha_{i1} = \Sigma\alpha_{i2} = \ldots\ldots = \Sigma\alpha_{in}$

that is, $\alpha_{11} = \alpha_{22} = \ldots\ldots = \alpha_{nn}$

as $\alpha_{ij} = 0, \quad i \neq j$

(This also shows importance of the sum of the columns of A not necessarily being zero.)

This condition may appear somewhat surprising at first as it implies that an economic unit adjusts to the desired level of each asset, for example demand deposits, equities and real assets at the same rate. This result does not appear to have been found by empirical studies using the simple stock adjustment model possibly because the other restrictions have not been enforced. However, this condition appears to have been derived by R.J. Cooper [28], quoting him "Only one lagged endogenous variable appears in each equation. The coefficient on the lagged dependent variable, $e^{X(t)}$, is the same in each equation, implying a common speed of adjustment for all variables" (Cooper [28, p.24]).

The model of the Australian economy developed by the Reserve Bank (RBA1) [69] has a financial sector which is based on the philosophical framework provided by Tobin.[6] The model is not a strict application of the Tobin framework as within and across equation restrictions are not imposed for the bank, and non-bank private sectors.

(1.2) The Money Multiplier - Monetary Base Framework

There is an alternative to Tobin's framework, albeit historically quite an unpopular framework in Australia. Friedman has advocated the use of a money supply rule, and such a rule would be based on an equation of the form

$$M = m.B \qquad \ldots(1.9)$$

where M is the money stock;

m is the money multiplier;[7] and

B is the monetary base[8]

The interest in money supply rules has led to a rekindling of interest in the money multiplier - money base (MM-MB) framework.[9]

6. Financial sector models currently being developed for the Forecasting Model within the Reserve Bank and by the Treasury and A.B.S. for inclusion in their N.I.F.C. model are also in this tradition.

7. This money multiplier should not be confused with the money multiplier referred to in various St. Louis studies which use the term in connection with the impact of money on income. See, for example, Anderson and Carlson [2].

8. The monetary base is defined as the net monetary liabilities of the Treasury and the Reserve Bank. This concept is discussed in detail in Chapter II.

9. This subject was of growing interest in the 1920's and 1930's but unfortunately was eclipsed by the Keynesian Revolution. See, for example, L. Currie [32]. As noted by H.G. Johnson, this has been one of the neglected areas of monetary theory.

But what is the money-multiplier-monetary base framework? The rest of this section sets out a simplified version of the behavioural equations and identities that underly this framework.

The basic identity underlying the MM-MB framework was given above in equation (1.9). A principal aim of this study is to show that both the monetary base and money multiplier are determined by the portfolio behaviour of several economic units, specifically, the non-bank private sector, the banks, the central bank and the government. The response patterns of these economic units to various changes leads to alterations in the prices and supplies of real and financial assets which gives rise to portfolio balance adjustments.

It is useful that a simplified exposition of the process be given which will allow for easier understanding when the more complete and complex model is given in Chapters II, III and IV. In this simplified version, the government sector is excluded and the balance sheets are greatly simplified. These simplified balance sheets are given in Table 1.

The definition of the monetary base can be simplified to the net monetary liabilities of the Reserve Bank,[10]

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10. The full definition of the monetary base also includes the net monetary liabilities of the Australian Treasury, that is, coin on issue. In this simplified explanation it is assumed that coin is also issued by the Reserve Bank as shown in Table 1.

TABLE 1

SIMPLIFIED BALANCE SHEETS FOR MM-MB FRAMEWORK

Balance Sheet - Non-Bank Private Sector

LIABILITIES		ASSETS	
A_s	Advances - Savings Banks	D_s	Deposits - Savings Banks
A_T	Advances - Trading Banks	D_T	Deposits - Trading Banks
OL_p	Other Liabilities	G_p	Government Securities
		NC_p	Notes and Coin
		OA_p	Other Assets

Balance Sheet - Trading Banks

LIABILITIES		ASSETS	
D_T	Deposits	SRD	Reserves
OL_T	Other Liabilities	G_T	Government Securities
		A_T	Advances
		OA_T	Other Assets

Balance Sheet - Savings Banks

LIABILITIES		ASSETS	
D_s	Deposits	G_s	Government Securities
OL_s	Other Liabilities	A_s	Advances
		OA_s	Other Assets

TABLE 1 (cont.)

Balance Sheet - Reserve Bank of Australia

LIABILITIES		ASSETS	
MB	Monetary Base	FR	Foreign Reserves
- NC	Notes and Coin	G_{RBA}	Government Securities
- SRD	Reserves of Trading Banks	OA_{RBA}	Other Assets
OL	Other Liabilities		

that is

$$B = NC + SRD \qquad \ldots(1.10)$$

the sum of notes and coin and trading bank reserves.

The next concept which has to be defined is the money supply. This opens a highly contentious issue. The framework for analysis is consistent with any definition of the money supply, but which definition is the most useful. This issue is considered in Section (3.1) of Chapter III, but for this illustration the narrow definition of money (M_1) is used, that is

$$M_1 = NC + D_T \qquad \ldots(1.11)$$

the sum of notes and coin (NC) and current deposits at trading banks (D_T).

It is postulated that the non-bank public holds currency in some proportion to their current deposits, that is

$$k = \frac{NC}{D_T} \qquad \ldots(1.12)$$

Therefore

$$NC = k\,D_T \qquad \ldots(1.13)$$

In addition, the trading banks' reserves, SRD's, are given as a proportion of their main liability, demand deposits, D_T.

Thus

$$s = \frac{SRD}{D_T} \qquad \ldots(1.14)$$

that is

$$SRD = sD_T \qquad \ldots(1.15)$$

Now equation (1.12) can be substituted into equation (1.11) giving

$$\begin{aligned} M_1 &= k\,D_T + D_T \\ &= (1 + k)\,D_T \qquad \ldots(1.16) \end{aligned}$$

Similarly, equations (1.13) and (1.15) can be substituted into equation (1.10) to give

$$\begin{aligned} B &= k\,D_T + s\,D_T \\ &= (k + s)\,D_T \qquad \ldots(1.17) \end{aligned}$$

Therefore

$$D_T = \frac{1}{(k + s)}B \qquad \ldots(1.18)$$

Equation (1.18) can now be substituted into equation (1.11) giving

$$\begin{aligned} M_1 &= \frac{(1 + k)}{(k + s)}B \qquad \ldots(1.19) \\ &= m_1 B \end{aligned}$$

where $m_1 = \dfrac{(1 + k)}{(k + s)}$

and m is called the money multiplier. The concept of the multiplier and hence multiple expansion can be seen most clearly if the monetary base is held solely by the trading banks, that is, as reserves (SRD's).

Therefore

$$M_1 = \frac{1}{s} B \qquad \ldots(1.20)$$

$$= \frac{1}{s} SRD \qquad \ldots(1.21)$$

which suggests that money in the form of deposits with the trading banks is equal to a multiple $\frac{1}{s}$ of the base money that can be held.

Pedagological texts often take k, the non-bank public's currency ratio as a constant. This constancy depends on the assumptions of given interest rates and the level of activity. The first step to improve this situation was to make k a function of "the" interest rate (r) and income (y), that is,

$$k = k(r, Y) \qquad \ldots(1.22)$$

In the money supply process the behavioural equations such as k, have ratios as the dependent variable. The dominator of these ratios is usually demand deposits, that is, portfolio decisions are initially made homogenous in demand deposits. Whilst Tobin's original work was on explaining a set of variables at a higher level of aggregation, his method is applicable to any level of disaggregation. It is often overlooked that in the two main works of Tobin mentioned above, the equations developed have effectively ratios as the dependent variable, see, for example equation (1.1).

The variable that has been used as the numerator of the above ratios that make up the money multiplier and the variables that enter the base are determined in the MM-MB framework by the same portfolio decision processes as those which Tobin tries to model, mainly as functions of relative prices. The concept of portfolio allocation is as essential to the MM-MB framework as it is to Tobin's model of behaviour. The difference (except for two others mentioned below) between Tobin's analysis and the money supply process thus reduces to a difference in the variables that the equations are made homogeneous. In Tobin's papers wealth is chosen. In the MM-MB framework, demand deposits is chosen. The same balance sheet restrictions specified by Tobin also apply in the MM-MB framework - the analysis is not dependent on the variable in which the functions are made homogeneous.

The other differences between the two procedures referred to above, are firstly that the MM-MB framework also incorporates an additional set of identities, that is, those traditionally associated with the MM-MB framework mentioned above, the third being that M = mB. The choice of deposits as the variable in which the equations are homogeneous means that the system can be readily absorbed into this third set of identities. If anything, the money supply process is a step further developed than that of Tobin's model.

Secondly, because the MM-MB framework has had a strong pedological heritage it has remained very simple with uncomplicated portfolio behaviour. A stark difference between the Tobin portfolio model and the MM-MB framework relates to this point and in particular the exclusion of any within or across equation constraints.

(1.3) Some Criticisms of the Money Multiplier-Monetary Base Framework

The MM-MB framework has for some reason suffered from a traditional dislike especially in Australia. But many criticisms have been made of this framework in general. Goodhart for example states

> "... one touchstone of areas in macro-economics where analysis has failed to advance has been those that rely on mechanical multiplier relationships between aggregates ..." (Goodhart [46, p.2]).

The money supply process has thus suffered with respect to the portfolio balance approach of Tobin because of the former's apparent ad hoc nature.

There have been studies, and especially in pedagological texts, where the multiplier has been a constant.

> "At the most simplified level, this approach often leads pedagogues to explain changes in the quantity of money in terms of a mechanical multiplier, in which high powered money gets passed from hand to hand like a hot potato. The portfolio adjustments of the banks in this description

apparently play no role in the process ... [and] ... The public's asset preferences are seemingly irrelevant to the determination of the stock of money ..." (Goodhart [45, p.248]).

What then are the features of the MM-MB framework worthy of extending this mechanical relationship? Firstly, it is appropriate to elaborate on what is meant by a money supply process. To start with, it is useful to consider a definition given by Fand [36].

"A money supply function relates the nominal money supply to a number of policy controlled variables and instruments, to other financial variables, to non-financial variables and to exogenous variables."

Fand then makes the following important observation: "We may not be able to estimate a supply function if the parameters affecting supply also affect demand. In this case the observed data points reflect the joint influence of both and it may not be possible to estimate a supply function" (Fand [36])

The point worth stressing is that the MM-MB framework developed here is that of a <u>money supply process</u>, not a money supply function as we have to operate with actual data. That is, a process which determines not only the money stock but how and by whom the money stock is held. No attempt is made to suggest that this is a money supply function as Dewald [35] has strictly interpreted some of the earlier work of Brunner and Meltzer and others.

The features that enhance the MM-MB framework as a model for use by policymakers and forecasters are:

(i) the explicit inclusion of policy variables under the direct control of the monetary authorities;

(ii) the establishment of a definite link between these control variables and the monetary aggregates; and

(iii) the recognition of the existing institutional framework within which the policy and the decision makers must operate.

The MM-MB framework is also an extremely useful analytical tool when flexible exchange rates exist. When flexible exchange rates operate, this allows the use of a money supply rule. Such monetary rules are easily incorporated into the framework of the money supply process.[11]

How then, can the MM-MB framework be developed to take advantage of these useful features of the approach and advance past the mechanistic tag? The areas of development are twofold. Firstly portfolio balance theory needs to be introduced and as a consequence the important behaviour of relative prices is introduced.

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11. See, for example, Nowak [71] for an interesting study with application to Australia. A paper which analyses the feasibility of a money rule for Australia is Argy [8].

"At a more advanced level, however, the 'money multiplier' can be regarded as a quasi reduced form of a larger system of structural equations describing aspects of the portfolio allocation of the banks and the public in response to changes in some relative prices ... As one probes deeper to examine the determinants of H [high powered money] itself, so the process whereby the stock of money changes as a result of an interplay of portfolio adjustments by banks and the general public in response to relative price (interest rate) changes will come more clearly and more completely into view."
(Goodhart [45 , p.249]).

Secondly, the monetary base needs to be endogenized:

"... [the] potential defect in this approach to the analysis of the determination of the stock of money is made far more serious by a general failure to probe the behavioural factors determining the level of, and changes in, the high powered money base ... there still seems little or no awareness that taking the level of [the monetary base] as exogenously given pushes out of sight the most important parts of the adjustment process"
(Goodhart [45 , p.245]).

Thus the MM-MB framework whose main advantage many people feel is its simplicity, has to become much more complex to capture the features of behavioural analysis which it lacked and for which it is currently criticised. Thus to overcome criticisms of the MM-MB framework, the simplicity that this framework can have has to be lost. To me these criticisms are myopic as the approach was developed and stayed at its mechanistic level because of its simplicity.

Recent studies on the MM-MB framework have attempted to improve the framework in the above two areas. Leaders in this field have been Brunner and Meltzer (see for example [17], [18], [19], [20]).[12] However, one is still left with the uncomfortable feeling that this procedure does not have the elegant refinements and consistency inherent in some of the large Tobin type models. This impression is strengthened by the fact that even though Brunner and Meltzer in the "Monetarists Framework" make the bonds market explicit, it still is conceived at a very aggregative level.[13]

Tobin himself has stressed the similarity in credit creation potential of both the banks and non-bank financial intermediaries. Tobin stresses that this potential is a function of the non-bank private sector's portfolio preference function, that is, their willingness to hold various forms of real and financial assets and liabilities.[14] Thus a reasonable loan market should be

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12. For work in the Australian context see Sharpe [81].
13. This aggregative approach is probably not inconsistent with some monetarists' ideas about the appropriate level of aggregation.
14. Tobin, J., [85]. In this article Tobin states "A more recent development in monetary economics tends to blur the sharp traditional distinctions between money and other assets and between commercial banks and other financial intermediaries; to focus on demands for and supplies of the whole spectrum of assets rather than on the quantity and velocity of 'money'; and to regard the structure of interest rates, asset yields, and credit availabilities rather than the quantity of money or the linkage between monetary and financial institutions and policies on the one hand and the real economy on the other".

described as the summation of the loan markets of the banking sector and the loan market of the non-bank financial intermediaries. The securities market should distribute the stock supply of outstanding domestic securities between the banking sector, the non-bank financial intermediaries, the non-bank private sector, and the foreign public.

Intuitively, the MM-MB framework should incorporate the same portfolio allocation decisions of economic units that are set out in Tobin's "General Equilibrium". However, the MM-MB framework has lacked the incorporation of these portfolio constraints stressed by Tobin. The avenues for the incorporation of these constraints are the various behavioural equations for the proximate determinants of the money supply.

Tobin's work was based on a set of identities, and implied restrictions which are set out above. The MM-MB framework is also based on accounting identities, three in fact:

(i) definition of the money supply;

(ii) definition of the monetary base; and

(iii) the identity that relates the money supply to the monetary base via the so-called money multiplier, i.e. $M = mB$.

But a statement of identities which <u>must</u> be true at all times is not a theory of economic behaviour. The equation $M = mB$ does not tell us anything about how the money supply is determined.[15] For a theory to be built up with these identities forming a skeleton, it is necessary that the parameters be made behavioural functions; Tobin, for example, stressed the importance of relative prices. That is, the mechanistic approach that often characterises pedagological texts and teachings has to be replaced by a system where the money multiplier and monetary base are possibly complex[16] functions of behavioural parameters explaining the portfolio behaviour of the various sectors involved. In particular the monetary base should be considered an endogenous variable, being the sum of variables, many of which are determined by non-monetary authority portfolio decisions in addition to those determined by the authorities.[17]

(1.4) Objectives

In the same way that it is possible for the MM-MB framework to be expanded to include as much detail as possible, the Tobin portfolio framework can also be applied to a very aggregative system and hence simplified. This thesis has three broad objectives. The first is to show that the MM-MB framework can be embellished with refinements that overcome critics'

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15. There have been attempts, however, to use regression analysis on this identity and then to claim that the good results that are found give strong support for the money multiplier theory. See, for example, Crouch, R.L. [30], [31].

16. Relative to mechanistic approaches.

17. Excellent arguments for the endogenity of the base are given by Goodhart, C. [45].

tags of mechanistic and unrealistic. The second objective is to show that under certain assumptions the two alternative money supply frameworks (the two alternatives are defined below) are equivalent. Thirdly, after attempting to fulfil objectives one and two, a simple aggregative model of the Australian money supply process is estimated within the framework of a small aggregative model of the Australian economy. This model is used to show the effects of various portfolio restrictions and the impact of modelling various components of the money supply process in different ways.

The first of the theoretical alternatives for the money supply process will be an approach in the Tobin tradition. In this approach changes in the money stock are derived from the identity

$$\Delta M = \Delta DCE + \Delta FR \qquad \ldots(1.23)$$

that is, the change in the money stock is equal to the sum of changes in foreign reserves and domestic credit expansion. This approach is referred to as the formation table approach.

The second theoretical alternative follows the MM-MB framework and in this model the growth rate in the money stock is equal to the sum of two growth rates

$$\frac{\Delta M}{M} = \frac{1}{m}\,\Delta m + \frac{1}{B}\,\Delta B \qquad \ldots(1.24)$$

that is, changes in the money stock result from changes in the money multiplier and the monetary base.

The structure of this thesis takes the following form. Chapter II is the first of three chapters which considers the MM-MB framework in detail. Firstly, Chapter II considers the monetary base. Chapter III considers the money multiplier while Chapter IV considers the endogenous aspects of this framework. Chapter V sets out the alternative framework which can be termed the 'formation table' approach. This chapter also shows the exact equivalence of the two alternatives under certain assumptions. Three models of the Australian economy are discussed and estimated in Chapter VI to show the effects of various portfolio restrictions. The monetary sector in these models is in the formation table tradition. Conclusions and implications are drawn in Section (6.3) of Chapter VI.

CHAPTER II

THE MONETARY BASE

(2.1) Derivation of the Monetary Base

This section initially sets out in detail the balance sheets needed to derive the monetary base. The sectors involved are the authorities, that is, the Reserve Bank of Australia and the Australian Treasury. The balance sheets for these two sectors are given in Tables 2.1 and 2.2.

The money multiplier-monetary base (MM-MB) framework for analysis of the money supply process is centred around the demand and supply of base money and the reactions and interactions that result from portfolio adjustment between each of the main participating sectors of the economy.[1]

As was mentioned in Chapter I, the MM-MB framework is based on a set of identities. These three identities are:

(i) definition of the money supply;

(ii) definition of the monetary base; and

(iii) the identity that links the money supply and the monetary base via the money multiplier, that is

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1. Studies of the MM-MB framework can be classified into four groups

   (i) the Friedman-Schwartz-Cagan (FSC) approach
   (ii) the Reserves Available approach
   (iii) extensions of the FSC approach
   (iv) the Brunner-Meltzer approach

   It is basically the latter approach that is followed in this study.

TABLE 2.1 BALANCE SHEET OF THE RESERVE BANK OF AUSTRALIA

LIABILITIES			ASSETS		
• Capital and reserves (Net Worth)		RBCR	• Gold and foreign exchange		GFE
• Notes on issue		N	• Australian Government Securities (excluding Treasury Bills)		GSRB
Held by: non-bank private	NNBP		Treasury Notes	TNRB	
trading banks	+NTB		Other government securities	+BRB	
saving banks	+NSB				
reserve bank	+NRB		• Advances to the Government		RBATGLGD
• Statutory Reserve Deposits		SRD	(Treasury Bills)	TB	
• Term Loan Fund		TLF	less Government Deposits	-GDRB	
• Farm Development Loan Fund		FDLF	• Lender of last resort facility		RBLOLRF
• Other deposits of Trading Banks		ODTBRB	• Notes and Coin held by Reserve Bank		NCRB
• Deposits of Saving Banks		DSBRB	Coin	NRB	
• Other liabilities		RBOL	Notes	+CRB	
			• Other loans, advances, bills discounted and other assets		RBOLABDOA
			Rural Credit Advances	RBRCA	
			Commercial Bills	+RBCB	
			Loans to STMM Dealers	+RBLSTMM	
			Financing of State Governments	+RBFSG	
			Other	+RBOA	

TABLE 2.2 BALANCE SHEET OF THE AUSTRALIAN AND STATE GOVERNMENTS' TREASURIES

LIABILITIES		ASSETS	
• Coin on Issue	C	• Australian governments own holdings of GS	GSGOVT
• Securities on Issue, domiciled in Australia (including Treasury Notes, excluding Treasury Bills)	GS	• State government's own holdings of GS	GSSTAT
• Treasury Bills (excluding LIR Bills) (-Borrowing from the Reserve Bank) (N.B. Excludes internal Treasury Bills, which are both assets and liabilities of the Government)	TB	• Australian government deposits with RBA	GDRB
• Lag-In-Revenue Bills, issued to finance states mid-year expenditures	LIR	• State governments' deposits with RBA	SGDRB
• Securities on Issue, domiciled overseas ($GSFOR_1 - GSFOR_0 = \Delta OB$)	GSFOR	• Other Assets	TOA
• Other Liabilities	TOL		

$$M = mB \qquad \ldots(2.1)$$

Also in that chapter a distinction between a set of identities and a theory was made. This chapter relates to the detailed formulation of the identities, their structure and relationships. The analysis of the behaviour that underlies these "proximate" determinants of the monetary base is given in Chapter IV.

The monetary base is a useful concept for monetary analysis (the value of this concept is also discussed later - see Section (5.3) of Chapter V) and is defined as the net monetary liabilities of the Australian Treasury and the Reserve Bank held by the banks and the non-bank public. Special attention is given to this collection of assets as each component is a potential source for a multiple expansion of the money supply. The usefulness of this concept especially in overseas studies is based on two beliefs:

(i) a belief that the monetary base is an important link between the Central Bank's monetary policy and the Central Bank's ability to influence income, output and prices;[2] and

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2. See for example Meltzer, A., [63] in which Meltzer states "Evidence from past periods suggest that the monetary base is the most important determinant of the money supply, and that there is a high degree of association between the base and the money stock." Examples of studies that have linked the money stock with economic activity are Anderson, L. and Jordan, J. [4], De Prano, M., and T. Mayer [34], Ando, A., and F. Modigliani, [6] and Friedman, M. & D. Meiselman, [43]. Also see Fisher, G., and D. Sheppard, [37].

(ii) a belief that the Central Bank can control the monetary base with considerable accuracy.[3]

However, these contentions are not universally held especially the latter argument for small open economies with fixed exchange rates. Even though there is considerable disagreement about the degree of control that the Central Bank has of the monetary base, Friedman for example has not been alone in suggesting that destabilization can be generated by monetary policy because of the variable lags associated with changes in the money supply. Others would argue however that possibly necessary eradic movements of the monetary base to achieve a given money supply growth rate may also be destabilizing.

The balance sheets for the Reserve Bank and the Treasury were given in Tables 2.1 and 2.2. Net monetary liabilities of the authorities are defined as (total liabilities - non-monetary liabilities - Capital and Reserves) = net monetary liabilities. Using this definition and the balance sheets the following identity can be derived:

$$\begin{aligned} B = {} & (RBCR + N + SRD + TLF + FDLF + ODTBRB + DSBRB + RBOL) \\ & + (C + GS + TB + LIR + GSFOR + TOL) \\ & - ((RBCR + RBOL) + GS + TB + LIR + GSFOR + TOL) \end{aligned} \quad \ldots(2.2)$$

3. "The monetary base, according to some economists, is an asset which monetary authorities supply to the economy ... the supply of this asset can be controlled by the Federal Reserve System." Anderson and Jordan [3], pp.11

$$= NC + DSBRB + SRD + ODTBRB + TLF + FDLF \qquad \ldots(2.3)$$

where NC = N + C.

Total liabilities of the Reserve Bank (RBTL) are equal to

$$RBTL = B + RBCR + RBOL - C \qquad \ldots(2.4)$$

Therefore because of the balance sheet restrictions total assets of the Reserve Bank (RBTA) must equal

$$RBTA = B + RBCR + RBOL - C \qquad \ldots(2.5)$$

Therefore the base can alternatively be defined as

$$B = RBTA - (RBCR + RBOL) + C \qquad \ldots(2.6)$$

$$= GFE + [GSRB + RBATGLGD] + RBOLABDOA + RBLOLRF + NCRB - [RBCR + RBOL] + C \qquad \ldots(2.7)$$

These two alternative means of defining the base have been referred to as the "uses" (the former) and the "sources" (the latter) definitions of the base respectively. The sources definition allows a study of the base to start with the division, of the base into a foreign component and a domestic component. The foreign component is that part of the base that is derived from the balance of payments constraint. The domestic component is that part that is derived from the domestic budget constraint.

As a result of this analysis, an equation describing the domestic component (NDA) of the monetary base can be given as

$$RBOLABDOA + RBLOLRF + GSRB + RBATLGD + NCRB - [RBCR + RBOL] + C = NDA \qquad \ldots(2.8)$$

The foreign component (NFA) is given by

$$GFE = NFA \qquad \ldots(2.9)$$

Therefore

$$B = NFA + NDA \qquad \ldots(2.10)$$

That is, the sources of the monetary base comprise the sum of net foreign assets (NFA) and net domestic assets (NDA).

In addition to this equation describing the sources (sometimes inappropriately referred to as the supply) of base money the equation which gives the uses (or what is sometimes referred to as the demand) of this "high-powered" money can be disaggregated to give more detail on what the monetary base is used for. From equation (2.3) the base was defined as

$$B = NC + SRD + TLF + FDLF + ODTBRB + DSBRB \qquad \ldots(2.11)$$

$$= [NCNBP] + [NCSB + DSBRB] + [NCTB + SRD + ODTBRB] + [TLF + FDLF] \qquad \ldots(2.12)$$

= Base money held by the non-bank public (A)

\+ Base money held by the savings banks (B)

\+ Base money held by the trading banks (C)

\+ Other base components (D)

That is, base money is used as currency by the public (A), as reserves (both required and excess) by the banking sector (B, C) and as other components (D).

This distinction between the sources and uses of the base provides the opportunity of showing the importance of the monetary base to the economy by its influence on portfolio balance theory. The recent work of Tobin and others in relation to the determination of economic activity "stresses the role of assets, both financial and real, and the market adjustment of asset holdings through the relative price mechanism. The monetary base ... is an asset which monetary authorities supply to the economy. Since the supply of this asset can be controlled by the Federal Reserve System, banks and the non-public must adjust their holdings of real and other financial assets so as to bring the amount of monetary base demanded equal to the amount supplied. In the process of adjustment, economic activity, prices of real assets, and interest rates are changed."[4]

(2.2) Adjustment of the Monetary Base

Whilst equation (2.1) is the basic equation for the MM-MB framework, most theoretical and empirical analyses of the framework centre on a variation of that equation. This variation is given in equation (2.1')

$$M = m.B^a \qquad \text{...(2.1')}$$

Equation (2.1') states that the money stock is the product of the money multiplier and the adjusted monetary base. The base is adjusted in a belief that the resulting series corresponds closer to the way the system operates and hence is more useful for analysis.

It was suggested above that the monetary base if it is able to be controlled can possibly be used as an indicator of the independent behaviour of the authorities and of the Reserve Bank in particular. However, it is probably obvious that there are various

4. Anderson and Jordon [3], p.11. The extent of controllability of the base is considered later. This quote is meant only for illustrating a particular point.

components of the base that are not under direct control of the Reserve Bank. Some commentators on the money supply process have suggested that changes in these uncontrollable items account for such a significant proportion of changes in the base that the authorities have in effect no accurate control of the base.[5] However adjusting the base to make it a more useful variable in analysing the money supply process is a different question to adjusting the base to make it a better indicator of discretionary monetary policy. The items for which the base is adjusted for the former reason are usually a subset of those items that are used to adjust the base for the indicator reason. This section is concerned with the adjustment of the base for the first reason. In a latter section some further adjustments are suggested for the indicator question. The criterion used by most commentators for selecting the items to adjust the base for are similar for both reasons however. That is, to make the base an item over which the Reserve Bank has greater control.

For what items do commentators suggest the base should be adjusted? The first item that is usually suggested to necessitate adjustment is the central bank's lender of last resort facility (RBLOLRF). The reason for this is that the central bank sets the price (the penalty interest rate charged) and then allows the banks

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5. The important point made by these commentators is that whilst some of these items are only a small percentage of the monetary base, the change in these items can represent a significant proportion of the total change in the base.

to determine the level of RBLOLRF. Thus at the going price part of the monetary base is determined by the banking system's behaviour with respect to borrowings, that is, RBLOLRF is endogenous to the banks and outside the control of the Reserve Bank once the penalty interest rate has been set. A similar argument could but has not usually been put forward for Reserve Bank discounting of bills.

However, in an open economy with high capital market integration the banks have an alternative to obtaining lender of last resort facilities when they are short of cash. The banks have the alternative of borrowing from foreign credit markets. In a fixed exchange rate regime changes in net bank borrowings from foreign sources (- (TBNFA + SBNFA)) results in changes in the stock of gold and foreign exchange and hence changes in the monetary base.[6] This adjustment occurs because the Reserve Bank is usually obliged to buy and sell whatever amount of foreign currency

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6. Changes in foreign reserves result from four possible sources registered on the balance of payments:

   (i) Surplus (+)/deficit (-) on current account (CAB):

   (ii) Net capital inflow (+)/outflow (-) by the non-bank private sector (NBPNI) and the government sector (GDNI);

   (iii) Increases/decreases in the Australian International Monetary Fund (IMFGT) gold tranche position; or increases/decreases in Special Drawing Rights (SDR's);

   (iv) Increases (-)/decreases (+) in the banking sector's net foreign assets (TBNFA + SBNFA) because of its net capital movements.

is supplied or asked for by the banking system. However, in Australia during part of the early 1970's various forms of capital controls were introduced and are still in various stages of operation at the present time. This in effect increases the cost of borrowing from foreign credit markets and could possibly make the cost prohibitive especially when there is only a small interest differential.[7] The extent to which this goes on in Australia is an empirical question but sufficient data on these items is not readily available in Australia.

The monetary base can be adjusted for a third set of items. These items are the Term Loan Fund (TLF) and the Farm Development Loan Fund (FDLF). "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 the rate of bank lending from the funds".[8] These items thus differ from the earlier two in that they are in fact, under the control of the Reserve Bank. But as pointed out above they bear no systematic relationship with deposit or in most cases with current economic conditions. Hence, movements in

7. This appears to have occurred in the most recent major credit squeeze.

8. Sharpe, I., [81], pp.6

these items do not reflect the policy behaviour of the Reserve Bank in relation to current economic conditions.

Brunner[9] has suggested that the base should also be adjusted for changes in reserve requirements, that is, for changes in Statutory Reserve Deposits resulting from changes in the SRD ratio. The adjustment is thus

$$B^r = \sum_{t=1}^{T} - \{ (s - s_{-1}) \frac{(D+F)+(D+F)_{-1}}{2} \}$$

$$= \sum_{t=1}^{T} - \{ \frac{\Delta s}{2} [(D+D_{-1})+(F+F_{-1})] \} \qquad \ldots(2.13)$$

where s is the statutory reserve deposit requirement and D and F are respectively demand deposits and fixed deposits. t refers to the time period and T denotes the current time period.

An alternative which is a little simpler is

$$B^r = \sum_{t} - \{ \Delta s . (D+F)_{-1} \} \qquad \ldots(2.14)$$

Anderson and Jordon[10] state

" Reserve adjustments must be made in the source base in order to maintain comparability over time. 'Reserve Adjustments' allow for the effects of changes in reserve requirements on member bank deposits."

9. Brunner, K., [14], pp.79-108.

10. Anderson, L.C., and J.L. Jordon, [3], p.8.

A change in the statutory reserve deposit rate changes the banks' excess reserves and hence their ability to create money. The evidence of this in the money supply equation should be twofold. Firstly, the money multiplier should change as it is a function of the SRD ratio.[11] Secondly, a change in the SRD ratio changes (for a given amount of demand and fixed deposits) the level of Statutory Reserve Deposits and hence the expectation that the quantitative size of the base will change.[12]

The 'reserve adjustments' were advocated because of the belief that the <u>expected</u> quantitative effect of changes in the reserve ratio were not reflected in changes in the monetary base. Why is this so? The usual definition of the base used in the money supply equation is the source definition, that is,

$$B = GFE + [GSRB + RBATGLGD] + RBLABDOA + RBLOLRF + NCRB - [RBCR + RBOL] + C \qquad \ldots(2.7)$$

The problem arises as to where the change in Statutory Reserve Deposits (reflecting the change in the SRD ratio) show up in the items in equation (2.7).

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11. See the simplified model given in Section (1.2) of Chapter I. In that section the money multiplier was derived as

$$m = \frac{1+k}{k+s}$$

12. There would also be indirect influences on both factors due to portfolio readjustments caused by the change in the statutory reserve deposit ratio. A full account of the portfolio behaviour underlying the multiplier and the base is contained in Chapter IV.

Three alternatives are possible

(i) a change in SRD's, ceterus paribus, must change the use definition of the monetary base, and hence by balance sheet constraints the source definition of the monetary base must change and therefore must reflect the quantitative effect of the change in the SRD ratio;

(ii) a change in SRD's, does not leave all the other items of the use definition unchanged. Hence, the change in SRD's may be exactly offset by movements in the opposite direction in the other components. Therefore the base will not reflect the quantitative movements caused by changes in SRD's;

(iii) some combination of (i) and (ii), so the base would reflect only part of the quantitative influence.

Which alternative is correct? The first case may be correct if the banks have to sell government securities to satisfy the requirements of an increased SRD ratio. (This would also apply if an increased SRD requirement is financed by a reduction of some other asset item which is not in equation (2.12)). If the Reserve Bank is endeavouring to stabilize interest rates this will involve an increase in the Reserve Bank's holdings of government securities (GSRB) and hence both definitions of the base will increase equally. But what if the Reserve Bank is not following an interest rate policy?

Alternatively, the banks may be uncertain about the future and as a short-term measure may increase their other deposits with the Reserve Bank (ODTBRB) when their Statutory Reserve Deposits fall due to a fall in the SRD ratio. This suggests that case (ii) is correct. But the banks should be profit makers, will they increase their other deposits with the Reserve Bank when they could obtain a better return elsewhere?

The alternative which is correct will depend on the time period between when the change in SRD's occurred and when the balance sheets are examined again. The longer the period the greater will be the portfolio adjustments which will occur and therefore change both the source and use definitions of the base.

The most likely case is that the source definition does not fully reflect changes in SRD's but by using reserve adjustments over compensation may be made. The usefulness of this adjustment then is an empirical question but seems more applicable to the indicator question than in analysing the money supply process. It is worth noting that in the long run the source base may not fully adjust by the change in the SRD ratio because portfolio readjustment by banks may involve changes in other items in the use definition of the base to new equilibrium values.

The last item that adjustment can be made for is to gold and foreign exchange holdings of the Reserve Bank. Movements in this item that are relevant for a study of the money supply process are those that relate to balance of payments transactions and not those that arise from changes in the exchange rate. That is,

$$\Delta GFE* = \Delta GFE - \sum_i \Delta E_i . FR_i \qquad ...(2.15)$$

This states that the change in gold and foreign exchange relevant for the money supply process is the total change in foreign reserves less the change in the value of Australia's holdings of foreign currency i(FR_i) due to changes in the exchange rate between Australia and country i, that is ΔE_i. ΔGFE* is therefore changes in gold and foreign exchange due to balance of payments transactions.

These are the usual items recommended for adjusting the monetary base. This does not mean that the Reserve Bank controls all the other items of the base. What it does mean is that the Reserve Bank can if it so desires offset, through open market operations or by changing other policy variables, any endogenous movements in other items, for example sterilizing capital inflows. Thus, the Reserve Bank has the potential to "control" the base or the adjusted base and hence the potential to influence the portfolio decisions of all other sectors, and consequently real equilibrium.

Another concept can be introduced, this is the national stock of monetary reserves (NSMR) and is defined as the sum of

(i) the Reserve Bank's stock of gold and foreign exchange (which includes Australia's SDR Position with the IMF);

(ii) the Australian IMF gold tranche position (IMFGT); and

(iii) the banking system's net foreign assets.

That is,

$$NSMR = GFE + (IMFGT) + (TBNFA + SBNFA) \qquad ...(2.16)$$

which can be re-written as

$$GFE = NSMR - (IMFGT) - (TBNFA + SBNFA) \qquad ...(2.17)$$

The various definitions of the base can now be written as

(i) $$B = [GFE] + [GSRB] + [RBATGLGD] + - [RBCR + RBOL] + [RBLABDOA + RBLOLRF + C + NCRB] \qquad ...(2.18)$$

(ii) $$B' = GFE^* + GSRB + RBATGLGD - [RBCR + RBOL] + [RBLABDOA + RBLOLRF + NCRB + COIN] \qquad ...(2.19)$$

where GFE* is gold and foreign exchange adjusted for changes in exchange rate valuations.

(iii) $$B^a = B - [TLF + FDLF] \qquad ...(2.20)$$

where B is defined as above in (2.19)

(iv) $$B^{a1} = B^a - RBLOLRF \qquad ...(2.21)$$

where B^a is defined in (2.20)

(v) $$B^{a2} = B^{a1} - (- (TBNFA + SBNFA)) \qquad ...(2.22)$$

$$= NSMR + [GSRB + RBATGLGD - IMFGT] - [TBNFA + SBNFA] + C - [RBCR + RBOL] - [TLF + FDLF] - RBLOLRF - (-TBNFA + SBNFA) + RBLABDOA + NCRB \qquad ...(2.23)$$

$$= NSMR + [GSRB + RBATGLGD - IMFGT] + C + RBLABDOA + NCRB - [RBCR + RBOL] - [TLF + FDLF] \qquad ...(2.24)$$

where B^{a1} is defined in (2.21).

(vi) $$B^{a3} = B^{a2} + B^r \qquad ...(2.25)$$

where B^{a2} is defined in (2.24), and B^r is the reserves adjustment discussed on page 40.

The Australian IMF gold tranche position is held by the Australian Government Treasury. Increases in this position are associated with a decrease of the same amount in the Reserve Bank's stock of gold and foreign exchange (and vice versa) but the level of national stock of monetary reserves remains unchanged. The Australian Government finances its increased IMF position by handing over to the Reserve Bank short-term government liabilities and/or by reducing its demand deposits with the Reserve Bank. This arrangement implies that part of the Reserve Bank's net claims on the government automatically increase or decrease with the government's IMF position. The same is true with inverse signs, for the Reserve Bank's stock of gold and foreign exchange. To gain a clear insight into the Reserve Bank's autonomous behaviour it is desirable for the variable representing Reserve Bank operations to be (GSRB + RBATGLGD) - IMFGT rather than just GSRB + RBATGLGD, which is achieved in equation (2.24).

(2.3) The Government Deficit and the Monetary Base

In the above analysis the base was split into two parts: net foreign assets (NFA) and net domestic assets (NDA). The former was derived from the balance of payments constraint. It was said that the latter was a consequence of the domestic budget constraint. However, up until now the government budgetary position and financial policy have not been mentioned; how does it fit into the framework. For consistency and understanding the government budget deficit or surplus should be linked with the means of financing the budget and with its effects on other asset markets and output. That is, the government financing constraint must be introduced to ensure the internal consistency of the system. Expenditures (G) and receipts (T) of the government sector are unlikely to balance at any particular moment of time; that is (G - T) may equal zero over one year, but may be $Xm in the first half of the year, and this has to be financed. When expenditures exceed receipts, the government has to finance the deficit from a number of sources but the most well known and usually the most important is the issue of government bonds. If there is a surplus then the excess funds can be used to repay outstanding government debt. This section focuses attention on the government deficit, the financing of that deficit and the implications of this for the study of the monetary base.

The government's cash flow deficit or the government's financing identity is

$$CFD = G - T \qquad \ldots(2.26)$$

which simply states that the government deficit (surplus) is the difference between expenditure and receipts. It is often assumed that expenditure and receipts are determined in the so called real sector. However, it is not difficult to imagine that the size of the deficit can be a function of such things as the ability to finance that debt, political considerations, stabilization factors, and implications for the national debt. In addition it is possible for the financing of the deficit to exert influence on the real sector, for example, if interest rates on government debt are set with the idea of raising a certain amount of money then this could change the vector of relative prices facing potential investors.

The importance of the government financing constraint was stressed by Christ [25]. This constraint can be written in general as

$$CFD = G - T \qquad ...(2.26)$$

$$= \Delta MS + \Delta GS + \Delta O \qquad ...(2.27)$$

where G, T and CFD are defined above, and ΔMS, ΔGS and ΔO refer to financing of the deficit by issuing money (MS), bonds (GS) or from other sources (ΔO). Letting the right hand side of (2.27) be denoted as Z then the equation can be re-written as

$$CFD = \Delta Z \qquad ...(2.28)$$

that is $Z = CFD + Z_{-1}$ ...(2.29)

Therefore

$$Z = \int_0^t CFD_\gamma d\gamma \qquad ...(2.30)$$

This equation states that the total amount of government debt supplied equals the governments budget deficit accumulated over time.

As set out in Chapter III, the Reserve Bank, trading banks, savings banks, non-bank private and foreign sectors hold as a certain fraction of their portfolios in the form of government securities. This allows equation (2.27) to be disaggregated further, that is, by sectors holding government securities.

$$CFD = \Delta GSTB + \Delta GSSB + \Delta GSNBP + \Delta GSFOR + \Delta O$$
$$+ [\Delta GSRB + \Delta RBATGLGD] + \Delta C \qquad ...(2.31)$$

That is the government deficit is financed by the increase in holdings of domestic government securities by trading banks (ΔGSTB), savings banks (ΔGSSB), non-bank public (ΔGSNBP);[13] government securities domiciled overseas (ΔGSFOR); government securities held by the Reserve Bank (ΔGSRB) and lastly by RBATGLGD which is Reserve Bank Advances to the government (ΔTB) less the use of government deposits at the Reserve Bank (ΔGDRB), that is ΔRBATGLGD = ΔTB + ΔGDRB; the new issue of coin (ΔC); and by other finance transactions (ΔO).

If the assumption that the cash flow deficit is determined in the real sector, is maintained for simplicity, then one of the items on the right hand side of equation (2.31) can be considered as a residual. In countries which have as an intermediate target a money aggregate, the choice of which item is a residual is mainly a matter of personal preference. However in Australia, an interest rate policy implies that the behaviour of the Reserve Bank with regard to government debt Δ(GSRB + RBATGLGD) is somewhat different to that of the other sectors suggesting that this item should be considered as the residual item. The reason for this is that the Reserve Bank does not have control over (GSRB + RBATGLGD), but this variable is governed by what the government decides its deficit will be and on the amount of government securities the non-bank private sector, the banks and the foreign sector decide to hold.

13. Foreigners' holdings of government securities domiciled in Australia are included in GSNBP.

Thus, the Reserve Bank accepts in exchange for short-run stabilisation of interest rate movements the loss of control of (GSRB + RBATGLGD) which then acts as a residual.

In the above discussion the behaviour of the Reserve Bank with regard to government debt was summarised as GSRB + RBATGLGD. For this section it is useful to disaggregate this total further,

$$GSRB + RBATGLGD = BRB + TNRB + TB - GDRB \qquad \ldots(2.32)$$

where BRB is Reserve Bank holdings of Bonds and Debentures,

TNRB is Reserve Bank holdings of Treasury Notes,

TB is Borrowings of the government from the Reserve Bank (Public Treasury Bills, excluding LIR Bills, where LIR Bills are Lag in Revenue Bills)

GDRB is Cash Balances of the government with the Reserve Bank.

Because the deficit must be financed this has monetary implications. Now, in the aggregate

$$CFD = \Delta OB + \Delta LR + \Delta TN + \Delta TB - \Delta GDRB + \Delta OFT \qquad \ldots(2.33)$$

where OB is Net Overseas Borrowings

LR is Net Loan Raisings (excludes change in securities on issue due to Special Loans or LCIR cancellations)

LCIR cancellations are Loan Consolidation and Investment Reserve cancellations

OFT is Other Financing Transactions in Australia

TN is Treasury Notes

The Domestic Borrowing Requirement (DBR) can be defined as

$$DBR = CFD - (\Delta OB + \Delta OFT) = \Delta LR + \Delta TN + \Delta TB - \Delta GDRB \qquad \ldots(2.34)$$

In addition, Government Debt Net (GDN), which is the net change in Australian and State Governments' indebtedness to the non-government sectors, can be defined as

$$GDN = DBR + \Delta RBFSG - \Delta GSGOVT^{a} + \Delta C \qquad \ldots(2.35)$$

where RBFSG is Reserve Bank Financing of State Governments;

$\Delta GSGOVT$ is Australian Government's own holdings of debt;

and

$\Delta GSGOVT^{a}$ is $\Delta GSGOVT$ adjusted by adding LCIR cancellations and subtracting Special Loans.

Equation (2.35) can be re-written as

$$\begin{aligned} GDN = {} & [\Delta BRB + \Delta TNRB + \Delta TB - \Delta GDRB + \Delta RBFSG] \\ & + [\Delta GSTB + \Delta GSSB + \Delta GSNBP + \Delta C] \end{aligned} \qquad \ldots(2.36)$$

Equation (2.35) can also be re-written as

$$DBR = GDN - \Delta RBFSG + \Delta GSGOVT^{a} - \Delta C \qquad \ldots(2.37)$$

Equation (2.37) can then be substituted into equation (2.32) giving

$$\begin{aligned} DBR = {} & [\Delta BRB + \Delta TNRB + \Delta TB - \Delta GDRB + \Delta RBFSG] \\ & + [\Delta GSTB + \Delta GSSB + \Delta GSNBP] + \Delta C \\ & - \Delta RBFSG + \Delta GSGOVT^{a} - \Delta C \end{aligned} \qquad \ldots(2.38)$$

$$\begin{aligned} = {} & [\Delta BRB + \Delta TNRB + \Delta TB - \Delta GDRB] \\ & + [\Delta GSTB + \Delta GSSB + \Delta GSNBP] \\ & + [\Delta GSGOVT^{a}] \end{aligned} \qquad \ldots(2.39)$$

The first bracketed item refers to the behaviour of the Reserve Bank. The second item to the behaviour of the non-Reserve Bank, non-government sector; and the last item to the behaviour of the government.

The adjusted cash flow deficit (CFD^a) can be defined as

$$CFD^a = CFD - \Delta OFT \qquad \ldots(2.40)$$

$$= DBR + \Delta OB \qquad \ldots(2.41)$$

Equation (2.41) allows DBR to be written as

$$DBR = CFD^a - \Delta OB \qquad \ldots(2.42)$$

The total change in government debt can be written as

$$GD = \Delta GSRB + \Delta RBATGLGD + \Delta GSPS + \Delta GSGOVT^a + \Delta OB \qquad \ldots(2.43)$$

where GSPS is government debt held by the non-government private sectors. Therefore as above with equations (2.28) to (2.30)

$$CFD^a = GD \qquad \ldots(2.44)$$

i.e. $GD = CFD^a + GD_{-1}$

Integrating both sides of (2.44) gives

$$GD_T = \int_0^T CFD_t^a \, dt \qquad \ldots(2.45)$$

This equation states that the amount of government debt supplied (including overseas borrowings and the government's own holdings of securities adjusted for LCIR cancellations and Special Loans) is equal to the Cash Flow Deficit accumulated over time.

Up till now, all that has been shown is the relationship between the deficit and the financing of the deficit. How is this related to the monetary base? The budget identity must hold at all times. Equations (2.43) and (2.36) relate the budget identity to the financing of that deficit by the various sectors. These identities allow one of the items in equation (2.43) to be considered as a residual. The question arises as to which item should be considered as the residual.

Ando[14] suggests some points when considering the choice of a variable to be the residual or not

"(i) In formulating behavioural equations for all elements of a balance sheet, one should be careful not to treat some elements as a residual inadvertently.

(ii) However, one should allow for the possibility that <u>some element is a genuine residual</u> in the decision process, or fairly close to it, at least in the short run.

(iii) If there is a reasonable possibility that some particular entry in the balance sheet is a residual so long as one is careful not to specify the remaining equations to make the residual equation outrageous, from the statistical point of view, estimating the system treating one of the items as the residual is likely to be less subject to serious biases."

The item to be proposed as the residual is the Reserve Bank's holdings of government securities plus Reserve Bank's advances to the government less government deposits with the Reserve Bank. It is proposed that the Reserve Bank's behaviour with regard to government debt is different to that of the banks and non-bank private sectors and for these reasons is the most suitable variable to be the residual. Reserve Bank holdings of government

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14. Ando, A., [5], especially pages 3-7.

securities result from two factors:

(i) financing the deficit; and

(ii) open market operations (OMO).

The Reserve Bank, along with many other Central Banks, places a high priority on maintaining an orderly bond market and in particular, stabilizing short-term fluctuations in interest rates on government securities. Many people believe, however, that the Reserve Bank does not always act so as to allow interest rates to adjust to what the market "would have set" but in addition ensuring a stable transition from one rate to the next. The description of the Reserve Bank following an interest rate policy is fairly close to the truth as it is in many countries. The recent large discrete jumps in the official interest rates reflect not only the rapid increase in inflation but also the long delay in adjusting interest rates so as to maintain the traditionally smooth transition path.[15]

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15. The feature of interest rate stability raises two interesting questions - (i) the reason for the non-one-to-one relationship between the money stock and interest rates; and (ii) the question of whether there are trade-offs between the short-term and the long-term if interest rates are kept away from market determined rates.

An interesting introductory discussion of these points can be found in <u>Open Market Policies and Operating Procedures</u> [75]. The paper by W. Poole "Rules-of-Thumb" for Guiding Monetary Policy" discusses the first question, and J.L. Pierce "The Trade-off Between Short and Long-Term Policy Goals" the second question. Pierce endeavours to show that there is a trade-off between (i) short-term control over employment and prices, and (ii) stability of interest rates and the financial sector in general.

He also attempts to show that this has long-term consequences for the size of movements in interest rates that would be necessary for achieving long-term objectives for employment and prices. Also over attention to short-term problems may have important implications for the <u>paths</u> required to hit desired long-term targets. Over zealous attempts to stabilize the financial sector in the short term may distort output and prices to the point that large changes in interest rates are required in the longer term to bring the economy under control.

Given that the Reserve Bank sets (in practice if not in principle) the price of Government Securities then it obviously cannot determine the quantity of government securities held by each of the other sectors. This is not to say that the Reserve Bank cannot influence the holdings of securities by these other sectors. The fact that the Reserve Bank sets the price means that it has the ability to change relative prices and hence influence the portfolio decisions of the other sectors. Thus if the Reserve Bank wishes the other sectors to hold more securities then it can change relative prices so as to encourage the other sectors to hold more securities. But once the Reserve Bank sets the price it cannot make the other sectors hold the quantity of securities that the Reserve Bank desires them to hold. It is a decision which the other sectors must make in evaluating whether there has been a change in relative prices, along with such things as their actual and desired liquidity position, the inflation rate, etc.

If we continue to assume that the cash flow deficit is determined in the real sector (to avoid any feedback influences) and that the Government and Reserve Bank have set a price on new issues of government securities which leads the banks and non-bank private sectors to take up the quantity of new securities desired at that given set of relative prices then any deficiency between the domestic borrowing requirement (and hence implicitly the deficit) and the other sectors' (including $GSGOVT^{a}$) take-up is met by purchases of new securities by the Reserve Bank[16] and by Reserve Bank advances to the government (treasury bills) or by a decrease (an increase if there is a surplus and other debt has been repaid) in the government's cash balances with the Reserve Bank.

When the Reserve Bank engages in open market operations, it is in an endeavour to change the interest rate (usually although not necessarily) in the direction of market forces or in an endeavour to keep interest rates stable against market inertia. In either case, once the Reserve Bank sets the new price or is committed to an existing price, the quantity of government securities bought by or sold by the Reserve Bank depends on the portfolio preferences of the other sectors. The Reserve Bank supplies or demands whatever amount of government securities is required to achieve its price objective. For this reason the Reserve Bank's purchase of new securities mentioned above may still be considered as a residual.

Possibly, the government's own holdings should be incorporated with those of the Reserve Bank being both inter-dependent policy variables. Government bonds and treasury note holdings of the Reserve Bank and the Government are linked to OMO

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16. This item may not be a residual with reference to the deficit as the Reserve Bank may purchase newly issued securities to maintain a balanced portfolio, so that open market operations (OMO) can be carried out in the future. In a period where OMO have resulted in large sales to the private sector, the Reserve Bank can apply to the government to buy further bonds from the stock held by the Government Trust Account (LCIR). Alternatively, switches from the Reserve Bank holdings to the LCIR can occur when it is thought Reserve Bank holdings are excessive for current likely OMO needs.

policy needs (as mentioned above), so may not be purely residual. However, the other items of the Reserve Bank appear to be in accord with Ando's description of a genuine residual. The residual item can then be defined as

$$RESID = \Delta BRB + \Delta TNRB + \Delta TB - \Delta GDRB = [GSRB + RBATGLGD] \qquad ...(2.46)$$

or if the government's own holdings are also added in

$$RESID_2 = \Delta BRB + \Delta TNRB + \Delta TB - \Delta GDRB + \Delta GSGOVT^a \qquad ...(2.47)$$

or if account of the "normal" portfolio behaviour of the Reserve Bank with regard to the issue of new securities is desired to be accounted for the residual can be defined as

$$RESID_3 = \Delta BRB - \Delta NIRB + \Delta TNRB + \Delta TB - \Delta GDRB \qquad ...(2.48)$$

where NIRB is the take-up of new issues of government securities by the Reserve Bank.

If it is assumed that equation (2.46) is to be followed then

$$RESID = DRB - [\Delta GSTB + \Delta GSSB + \Delta GSNBFI + \Delta GSNBP] - [\Delta GSGOVT^a] \qquad ...(2.49)$$

From equation (2.7) of section (2.1) we have the source definition of the base

$$B = GFE + RBLABDOA + RBLOLRF + [GSRB + RBATGLGD] - [RBCR + RBOL] + [COIN] \qquad ...(2.7)$$

which can be re-written by using equation (2.32) and (2.46) as

$$B = GFE + RBLABDOA + RBLOLRF + [\Delta BRB + \Delta TNRB + \Delta TB - \Delta GDRB - [RBCR + RBOL] + [COIN] \qquad ...(2.50)$$

$$= GFE + RBLABDOA + RBLOFRF + RESID - [RBCR + RBOL] + [COIN] \quad ...(2.51)$$

Now making use of equation (2.49)

$$B = GFE + RBLABDOA + RBLOLRF + DBR - [\Delta GSTB + \Delta GSSB + \Delta GSNBP - [\Delta GSGOVT^{a}] - [RBCR + RBOL] + [COIN] \quad ...(2.52)$$

$$= GFE + RBLABDOA + RBLOLRF + [CFD - (\Delta AOB + \Delta OFT) - [\Delta GSTB + \Delta GSSB + \Delta GSNBP - [\Delta GSGOVT^{a}] - [RBCR + RBOL] + [COIN] \quad ...(2.53)$$

$$= GFE + RBLABDOA + RBLOLRF + GDN - [\Delta RBFSG - \Delta GSGOVT^{a} + \Delta COIN] - [\Delta GSTB + \Delta GSSB + \Delta GSNBP] - [\Delta GSGOVT^{a}] - [RBCR + RBOL] + [COIN] \quad ...(2.54)$$

Equations (2.52), (2.53) and (2.54) provide the important link between the domestic borrowing requirement, government debt net and the government deficit and the monetary base.

CHAPTER III

THE MONEY MULTIPLIER

(3.1) The Definition of Money

The variable that obviously needs to be defined for the analysis to develop further to the money multiplier is the money stock itself. The basic analysis is independent of the definition chosen with both the narrow definition of money (M_1) and the wide definition of money (M_3) having been used in various studies.[1]

The choice of what definition of money to use is important. Two issues are at hand, firstly what is money, and as this study is concerned with the money supply process this is important. And secondly, the link between money and economic activity.

"The question of how money should be defined is extremely controversial but cannot be wholly avoided.... Some criteria must be found to determine which set of assets may be described as 'money' and which it is in the interests of the authorities to control."[2]

These above questions imply that there is something unique about the variable that we call money.

"We observe over man's history that social groups without generally accepted media of exchange exhibit poor survival

1. For example M_1 is used by Anderson and Jordon [4], whereas M_3 has been used by Sharpe [81].
2. Gibson, N.I., and D.R. Thorn [44].

characteristics. Most social groups do not use assets or commodities at random in the execution of exchange. One observes that a small subset of assets is dominantly used in transactions. These transactions-dominating assets are usually referred to as money". (Brunner [16], page 5)

Two distinct questions arise from this statement

(i) why does money come into existence; and

(ii) given that money is in existence, why is it held when there is no apparent yield but a definite apparent cost (which can be very high in times of high inflation: "The allocation of wealth to an asset with no apparent yield remained an unsettled problem throughout the 'Keynesian revolution' and recent monetarised re-examination of monetary analysis". (Brunner, [16], page 5))

Clower [27] has shown that "money" must have some distinctive features compared to other commodities if a money economy is to be distinguished from a barter economy. Thus if we are to understand why there is a relationship between the money and economic activity it is necessary to answer the above two questions. Thus the definition of money is a functional definition.

"A natural point of departure for a theory of monetary phenomena is a precise distinction between money and non-money commodities. In this connection it is important to observe that such a distinction is possible only after we assign a special role to certain commodities as a means of payment. For any commodity may serve as a unit of account and standard of deferred payment: and every asset is, by its very nature, a potential store of value. If money is to be distinguished by the functions it performs, therefore, it is to the medium of exchange function that we must address our attention. The only difficulty is to express analytically what is meant when we assert that a certain commodity serves as a medium of exchange". (Clower, [27] , page 4)

Goodhart [46] stresses a narrower functional definition than the medium of exchange. Goodhart uses the "means of payment" function to distinguish money. This distinction relates to the "finality" of the transaction. With the transfer of a means of payment from a buyer to a seller the transaction is complete. With the transfer of a medium of exchange the transaction may not be complete as the receiver of the medium of exchange may feel that he has still a claim on the buyer until the medium of exchange is itself turned into a means of payment. The distinction between cash and cheques illustrates this feature. In general the broader functional definition is used in the following analysis.

The main traditional arguments used in explaining why money is held have been

(i) time

(ii) uncertainty

(iii) lack of synchronisation of receipts and expenditures

(iv) cost of transacting

(v) the existence of non-pecuniary returns.

Of these, the most common is (iii), the synchronisation argument.

No attempt is made to resolve the issue of the appropriate definition of money. The position followed here will be to use as wide a definition as practicable, that is, to use the medium of exchange function and hence for the empirical work the definition of money used is M_3, that is, the sum of notes and coin of the non-bank sector, demand deposits, fixed deposits (including certificates of deposits) and savings deposits.

This definition, however, may not be the most appropriate to link with economic activity. What an analysis of the definition of money shows based on functional criteria is that the definition of "money" may not be stable; initially it may imply that notes and coin are "money" and should be linked with activity, intermediate development may mean that something like M_3 would be more appropriate. Later development may imply that it is M_4, M_5 or M_6 that is most appropriate. Thus the relationship between "money" and activity may not be fully identified if a constant definition of money is used throughout the sample period.

In this study M_3 has been chosen to be used and is defined as:[3]

$$M_3 = NCNBP + DEPF + DEPS + DEPC - GOVD - INBD \qquad ...(3.1)$$

$$= NCNBP + DEPF + DEPS + DEPC^* \qquad ...(3.1')$$

3. This is the definition of the volume of money given in the Reserve Bank Statistical Bulletin. Also it is the most common definition of the money stock used in other macroeconomic equations of the main components of Gross Domestic Product.

where DEPC* = DEPC - GOVD - INBD, and

NCNBP is notes and coin of the non-bank private sector,

DEPF is fixed deposits (including certificates of deposits, where DEPF = DEPFXCD + DEPCD)

DEPS is savings bank deposits,

DEPC is current account deposits,

GOVD is deposits of the government

INBD is interbank deposits.

(3.2) Derivation of the Money Multiplier

Like Section (2.1) of Chapter II which set out the identities underlying the monetary base this section sets out the derivation of the money multiplier identities assuming the definition of money in M_3. The balance sheets of banks and the private sectors are given in Tables 3.1 to 3.5.

In analysing the behavioural role of the banks in the money multiplier there are two alternatives. Firstly, aggregate all the banks together - this in effect overcomes some problems of modelling but such a procedure could possibly render some aggregates too insensitive to various institutional parameters. Secondly, the banking sector can be disaggregated and the behaviour of savings and trading banks can be examined in more detail thus maximising utilisation of information but unfortunately possibly becoming too bogged down in detail and size.

As an intention of this study is to show that the MM-MB framework can be enhanced with some of the appealing features of

TABLE 3.1 BALANCE SHEET OF THE TRADING BANKS

LIABILITIES		
• Capital and reserves (Net Worth)		TBCR
• Current deposits		DEPC
government	GOVD	
other banks	+INBD	
other	+DEPC*	
• Fixed Deposits		DEPF
fixed	DEPF*	
certificates of deposit	+CD	
• Lender of last resort facility		RBLOLRF
• Other liabilities		TBOL

ASSETS		
• Notes and Coin		NCTB
Notes	NTB	
Coin	+CTB	
• Statutory Reserve Deposits		SRD
• Term Loan Fund		TLF
• Farm Development Loan Fund		FDLF
• Other Deposits with the Reserve Bank		ODTBRB
• Australian Government Securities		GSTB
• Local and Semi-Government Securities		LSGSTB
• Net Foreign Assets		TBNFA
• Loans and Advances		TBLA
STMM	TBLASTMAI	
Other	+TBLAO	
• Other Assets		TBOA

TABLE 3.2 BALANCE SHEET OF THE SAVINGS BANKS

LIABILITIES		ASSETS		
• Capital and Reserves (Net Worth)	SBCR	• Notes and coin		NCSB
• Deposits	DEPS	Notes	NSB	
• Other liabilities	SBOL	Coin	+CSB	
		• Deposits with the Reserve Bank		DSBRB
		• Australian Government Securities		GSSB
		• Local and Semi-Government Securities		LSGSSB
		• Net foreign assets		SBNFA
		• Loans and Advances		SBLA
		STMM	SBLASTMM	
		Other	+SBLAO	
		• Other Assets		SBOA

TABLE 3.3 BALANCE SHEET OF THE NON-BANK PRIVATE SECTOR

LIABILITIES		ASSETS	
• Net Worth	NWNBP	• Notes and Coin (Currency) Notes NNBP Coin CNBP	NCNBP
• Loans and Advances from Trading Banks	TBLANBP	• Australian Government Securities	GSNBP
• Loans and Advances from Savings Banks	SBLANBP	• Local and Semi-Government Securities	LSGSNBP
• Loans and Advances from Non-Bank Financial Intermediaries	NBFILANBP	• Current Deposits with Trading Banks	DEPCNBP
		• Fixed Deposits with Trading Banks	DEPFNBP
		• Savings Deposits with Savings Banks	DEPSNBP
		• Deposits with Non-Bank Financial Intermediaries	DEPNBFINBP
		• Other Assets (including real assets and net foreign assets)	NBPOA

TABLE 3.4 BALANCE SHEET OF THE FOREIGN SECTOR

LIABILITIES		ASSETS	
• Trading Bank Net Foreign Assets	TBNFA	• Australian Government Securities	GSF
• Savings Bank Net Foreign Assets	SBNFA	• Other Assets	FOA
• Other Liabilities	FOL		

TABLE 3.5 BALANCE SHEET OF NON-BANK FINANCIAL INTERMEDIARIES

LIABILITIES		ASSETS		
• Deposits	DEPNBFI	• Notes and Coin		NCNBFI
• Other Liabilities	NBFIOL	Notes	NCNBFI	
		Coin	CNBFI	
		• Australian Government Securities		GSNBFI
		• Local and Semi-Government Securities		LSGSNBFI
		• Loans, advances and Other Assets		NBFILAOA

portfolio theory the second alternative is preferred in this theoretical section. In addition, the more disaggregated approach has the advantage that it can incorporate easily a large amount of the institutional framework which the economic units have to work within.

The following sections discuss the role of each of the economic units in deriving the proximate determinant of the money multiplier.

(i) Savings Bank Behaviour

The savings banks (and the trading banks) can be classified into two groups:

(a) those under the control of the Banking Act, 1959; and

(b) those not under control of this act.

Those banks which are controlled[4] under the Act have to meet certain requirements with regard to their portfolio behaviour, in return for which they receive various forms of "preferential treatment". The regulations require that controlled savings banks hold 7½% of their deposits with the Reserve Bank or in Treasury Notes.[5] These savings banks are also subject to the 50/50 rule[6] which requires that 50% of deposits (including the above 7½%) are in the form of deposits with the Reserve Bank,

4. For a full classification of banks see for example Dewald [35].
5. Banks at one stage also held Treasury Bills, but they have not held these now for a number of years. This regulation was only recently changed from 10%.
6. This rule has varied from 70/30, 65/45, 60/40 and now to 50/50.

Treasury Notes, notes and coin, other Commonwealth Government Securities or Local and Semi-Government Securities. The remainder of the savings banks earning assets are usually in the form of housing loans.

Letting DEPS be total saving bank deposits then

$$DEPS = DEPSCP + DEPSST \qquad \ldots(3.2)$$

where DEPSCP is depositors' funds at the controlled saving banks; and DEPSST is depositors' funds at the uncontrolled savings banks.

The concept of reserves of the banks is introduced next. There appears to be no standard definition of what reserves are and the various alternatives are largely based on what use the concept is to be put. Sharpe in "A Model of the Sources of Growth of the Australian Money Supply" uses the concept of cash or deposits held with the Reserve Bank. This definition is appropriate for an analysis of the base as it is these items that enter the base concept. An alternative concept and one which is very appealing is that reserves are distinguished from other assets of the banks by their risk factor and their liquidity factor, that is, the ease with which they are converted to cash. Cash, deposits with the Reserve Bank and government securities are all riskless and government securities are usually also considered highly liquid given that the usual empirical adjustment period is one quarter and the Reserve Bank's behaviour in regard to discounting government securities. This definition also fits in with the portfolio restrictions imposed on the banks by the Reserve Bank. The definition also allows some "earning assets" to be considered part of reserves. One possible drawback of this classification is that in periods of inflation where interest rates could fluctuate the liquidity factor of government securities changes. Banks may be forced to hold government securities until maturity to avoid capital losses. If this definition is used then it is no longer total reserves of the banks that enters the base but only monetary reserves.

Thus for savings banks, reserves (SBRES), are defined as

$$SBRES = NCSB + DSBRD + GSSB + LSGSSB \qquad \ldots(3.3)$$

that is, the sum of notes and coin held by the savings banks, deposits of the savings banks with the Reserve Bank and savings banks' holdings of Australian government securities and local and semi-government securities. Excess reserves are then defined as total reserves less required reserves. For the definition of reserves being used, required reserves are those which must be held to satisfy some legislative regulation or restriction of banks' asset portfolio choice to those items which enter the definition of reserves (in particular government securities).

Thus excess reserves of all savings banks are defined as:[7]

$$SBXRES = [NCSB + DSBRB + GSSB + LSGSSB] - .5\ DEPSCP \quad \ldots(3.4)$$

7. This equation has the drawback that it assumes that uncontrolled banks do not hold reserves. Whilst these uncontrolled banks are not enforced to hold reserves it is likely that they in fact do, and in fact probably operate quite similarly to the controlled banks.

Rearranging this equation

$$NCSB + DSBRB = SBXRES - [GSSB + LSGSSB] + .5\ DEPSCP \quad ...(3.5)$$

Now let (i) $r = \frac{SBXRES}{DEPS}$ i.e. $SBXRES = r.DEPS$ ...(3.6)

that is, r is the excess reserve ratio of savings banks. Excess reserves are made relative to DEPS (total savings deposits) as these are by far the major liability of savings banks.

(ii) $\bar{m} = \frac{DEPSCP}{DEPS}$ i.e. $DEPSCP = \bar{m}.DEPS$ ...(3.7)

that is, $\bar{m}$ distributes the main liabilities of savings banks between the controlled and the uncontrolled savings banks.

(iii) $\lambda_{GSSB} = \frac{GSSB}{DEPS}$ i.e. $GSSB = \lambda_{GSSB}.DEPS$ ...(3.8)

that is, λ_{GSSB} is the ratio of Australian Government Securities held by the savings banks to savings deposits.

(iv) $\lambda_{LSGSSB} = \frac{LSGSSB}{DEPS}$ i.e. $LSGSSB = \lambda_{LSGSSB}.DEPS$ ...(3.9)

that is, λ_{LSGSSB} is the ratio of Local and Semi-Government Securities to total savings bank deposits.

Therefore, equation (3.5) can be re-written as

$$NCSB + DSBRB = [r + .5m - (\lambda_{GSSB} + \lambda_{LSGSSB})]DEPS \quad ...(3.10)$$

(ii) <u>Trading Bank Behaviour</u>

Using the same concept of reserves as above, total trading bank reserves (TBRES) are defined as

$$TBRES = NCTB + SRD + ODTBRB + GSTB + LSGSTB - RBLOLRF \quad ...(3.11)$$

that is, total trading bank reserves are the sum of notes and coin held by trading banks, statutory reserve deposits, other deposits of the trading banks with the Reserve Bank, trading bank holdings of Australian government securities and local and semi-government securities, less Reserve Bank lender of last resort loans to the trading banks.

This can be re-written as

$$TBRES = SRD + ODTBRB + LGSTOT \qquad ...(3.12)$$

where LSGTOT is total liquid and government securities less Reserve Bank lender of last resort facilities, that is

$$LGSTOT = NCTB + GSTB + LSGSTB - RBLOLRF \qquad ...(3.13)$$

Excess reserves are defined as total reserves less required reserves

$$TBXRES = [SRD + ODTBRB + LGSTOT] - [SRD + LGSREQ] \qquad ...(3.14)$$

where LGSREQ is the required LGS assets of the controlled trading banks.[8]

Now, from equation (3.14)

$$TBXRES = ODTBRB + [LGSTOT - LGSREQ] \qquad ...(3.15)$$

$$= ODTBRB + LGSEXC \qquad ...(3.16)$$

where LGSEXC is excess LGS assets of the trading banks

that is, $LGSEXC = LGSTOT - LGSREQ \qquad ...(3.17)$

$$= (NCTB + GSTB + LSGSTB - RBLOLRF) - LGSREQ \qquad ...(3.18)$$

8. This involves the same assumption for trading banks as was given in footnote 7 for savings banks, that is, that the uncontrolled trading banks do not hold reserves.

Let (i) $w = \dfrac{DEPCCP + DEPFC}{DEPC + DEPF}$, that is ...(3.19)

w reflects the decisions of the public in allocating deposits between trading banks subject to the Banking Act and those that are not. The institutional features embodied in w and $\bar{m}$ allow the analytical method used to incorporate changes in the relative importance of the two groups of institutions.

In addition, assume

(ii) $\alpha = \dfrac{(NCTB + GSTB + LSGSTB)}{DEPC + DEPF}$

i.e. $[NCTB + GSTB + LSGSTB] = \alpha \,.\, [DEPC + DEPF]$[9]

...(3.20)

(iii) $\beta = \dfrac{RBLOLRF}{DEPCCP + DEPFCP}$

i.e. $RBLOLRF = w\beta . [DEPC + DEPF]$ ...(3.21)

(iv) $\delta = \dfrac{LGSREQ}{DEPCCP + DEPFCP}$

i.e. $LGSREQ = \delta w . [DEPC + DEPF]$[10] ...(3.22)

---

9. α can be further divided into

$$\alpha = \alpha_o + \lambda_{GSTB} + \lambda_{LSGSTB}$$

where $\alpha_o = \dfrac{NCTB}{DEPC + DEPF}$

$\lambda_{GSTB} = \dfrac{GSTB}{DEPC + DEPF}$

$\lambda_{LSGSTB} = \dfrac{LSGSTB}{DEPC + DEPF}$

10. δ in fact was equal to .16 between January 1960 to March 1962 and since then has been equal to .18.

Therefore (3.18) can be re-written as

$$\frac{LGSEXC}{DEPC + DEPF} = \alpha - \beta w - \delta w = \alpha - w(\beta + \delta) \qquad \ldots(3.23)$$

that is, $LGSEXC = [\alpha - w(\beta + \delta)].[DEPC + DEPF]$

Also let

$$e = \frac{TBXRES}{DEPC + DEPF}$$

$$\text{i.e. } TBXRES = e.[DEPC + DEPF] \qquad \ldots(3.24)$$

that is, e is the excess reserve ratio of the Trading Banks, with DEPC + DEPF the major liabilities of trading banks.

The statutory Reserve Deposits (SRD) of the trading banks is given by

$$SRD = s.(DEPCCP + DEPFCP) \qquad \ldots(3.25)$$

$$= sw.(DEPC + DEPF) \qquad \ldots(3.26)$$

Using the above relationships and letting

$$\alpha_o = \frac{NCTB}{DEPC + DEPF} \text{ i.e. } NCTB = \alpha_o.[DEPC + DEPF] \qquad \ldots(3.27)$$

then

$$NCTB + ODTBRB + SRD = NCTB + (TBXRES - LGSEXC) + SRD \qquad \ldots(3.28)$$

$$= \alpha_o.[DEPC + DEPF] + e.[DEPC + DEPF]$$
$$- [\alpha - w(\beta + \delta)].[DEPC + DEPF]$$
$$\alpha + sw.[DEPC + DEPF] \qquad \ldots(3.29)$$

$$= [\alpha_o + e - \alpha + w(s + \beta + \delta)].[DEPC + DEPF] \qquad \ldots(3.30)$$

(iii) Non-Bank Public Behaviour

The behaviour of the public in their demand for financial assets is scaled with respect to demand deposits at trading banks (DEPC). The portfolio relationships needed relate to holdings of notes and coin (c), fixed deposits (f), and savings deposits (p). Several proximate parameters are used to explain this behaviour.

$$c = \frac{NCNBP}{DEPC}$$

$$\text{i.e. } NCNBP = c.DEPC \qquad \ldots(3.31)$$

$$f = \frac{DEPF}{DEPC}$$

$$\text{i.e. } DEPF = f.DEPC \qquad \ldots(3.32)$$

$$p = \frac{DEPS}{DEPC}$$

$$\text{i.e. } DEPS = p.DEPC \qquad \ldots(3.33)$$

Ideally, the behaviour of the non-bank private sector should also relate their holdings of deposits with non-bank financial intermediaries (NBFI). Table 3.5 gives the balance sheet for the NBFI, but there is no data which provides this split of non-bank private sector holdings of notes and coin. If the definition of money were to be extended so as to include deposits with NBFI then the behaviour of NBFI and the public's behaviour in relation to deposits with NBFI would have to be modified in a similar fashion as above.

(iv) The Money Supply Equation

The money supply process was summarised by a multiplier-base relationship of the form

$$M_3 = mB$$

where M_3 is the money stock, m is the money multiplier and B is the base. Using the identities and proximate parameters derived above it is now possible to derive the formulation of the money multiplier m.

The definition of the monetary base (the "uses" definition) used is given in equation (2.12) of Chapter II as

$$B = [NCNBP] + [NCSB + DSBRB] + [NCTB + SRD + ODTBRB] + [TLF + FDLF] \qquad \ldots(3.34)$$

Using the expressions (3.31), (3.10) and (3.30) we can derive equation (3.35) by substitution

$$B = c.DEPC + [r + .5\bar{m} - (\lambda_{GSSB} + \lambda_{LSGSSB})].DEPS + [\alpha_o + e - \alpha + w(s + \beta + \delta)].[DEPC + DEPF] + (TLF + FDLF) \qquad \ldots(3.35)$$

Now if use is made of equations (3.32) and (3.33) then

$$B = c.DEPC + p[r + .5\bar{m} - (\lambda_{GSSB} + \lambda_{LSGSSB})].DEPC + [\alpha_o + e - \alpha + w(s + \beta + \delta)][1 + f].DEPC + [TLF + FDLF] \qquad \ldots(3.36)$$

$$= \{c + p[r + .5\bar{m} - (\lambda_{GSSB} + \lambda_{LSGSSB})] + [\alpha_o + e - \alpha + w(s + \beta + \delta)][1 + f]\}.DEPC + [TLF + FDLF] \qquad \ldots(3.37)$$

$$\text{or} \quad B = \{Y\}.DEPC + TLF + FDLF \qquad \ldots(3.38)$$

where Y is the expression in parenthesis in equation (3.37).

It was suggested in Section (2.2) of Chapter II that it may be desirable to replace the expression $M_3 = mB$ by $M_3 = mB^a$, where B^a is the adjusted monetary base. The first item for which the base was adjusted for was for the term and farm development loan funds. That is

$$B^a = B - [TLF + FDLF] \qquad \ldots(3.39)$$

Therefore, using equation (3.38)

$$B^a = \{Y\}.DEPC \qquad \ldots(3.40)$$

$$\text{or } DEPC = \frac{B^a}{\{Y\}} \qquad \ldots(3.41)$$

The money supply was defined in equation (3.1) as

$$MS = NCNBP + DEPS + DEPF + [DEPC - GOVD - INBD] \qquad \ldots(3.1)$$

The above analysis has developed functions relating NCNBP, DEPF and DEPS to DEPC. To complete the system expressions are derived for explaining the last two items, GOVD and INBD as function of DEPC.

Thus let (i) $g = \dfrac{GOVD}{DEPC + DEPF}$ i.e. $GOVD = g.[DEPC + DEPF]$ ...(3.42)

and (ii) $b = \dfrac{INBD}{DEPC + DEPF}$ i.e. $INBD = b.[DEPC + DEPF]$ ...(3.43)

Using the definition of the money supply given by equation (3.1)

$$\begin{aligned} M_3 &= NCNBP + DEPC + DEPF + DEPS - GOVD - INBD \\ &= c.DEPC + DEPC + f.DEPC + p.DEPC - g(1 + f).DEPC \\ &\quad - b(1 + f).DEPC \qquad \ldots(3.44) \\ &= [c + 1 + f + p - (g + b)(1 + f)].DEPC \qquad \ldots(3.45) \end{aligned}$$

Now, equation (3.41) can be used to substitute out for DEPC in equation (3.45), that is

$$M_3 = \frac{[1 + c + f + p \quad - (g + b)(1 + f)]}{\{Y\}} . B^a \qquad \ldots(3.46)$$

Therefore

$$M_3 = \frac{[X]}{[Y]} B^a \qquad \ldots(3.47)$$

where [X] is the term in square brackets of the numerator of equation (3.46) and Y was defined as the term in parentheses in equation (3.37). Hence the multiplier (ma) is equal to

$$ma = \frac{[X]}{[Y]}$$

The alternative definition of the base (the "source" definition) given in equation (2.7) of Chapter II was

$$B = GFE + GSRB + RBATGLGD + [C - RBCR - RBOL] + RBLABDOA$$
$$+ RBLOLRF + NCRB \qquad \ldots(3.48)$$

Now, B^a was defined as

$$B^a = B - [TLF + FDLF] \qquad \ldots(3.49)$$

The base can now be adjusted for the second suggested item, that is, Reserve Bank Lender of Last Resort Facilities (RBLOLRF).

$$B^{a1} = B^a - RBLOLRF \qquad \ldots(3.50)$$

$$= GFE + GSRB + RBATGLGD + [COIN - RBCR + RBOL]$$
$$+ RBLOLRF + RBLABDOA - [TLF + FDLF] - RBLOLRF \qquad \ldots(3.51)$$

$$= [Y].DEPC - \beta w[1 + f].DEPC \qquad \ldots(3.52)$$

$$= [Y] - \beta w[1 + f].DEPC \qquad \ldots(3.53)$$

$$= \{c + p[r + .5\overline{m} - (\lambda_{GSSB} + \lambda_{LSGSSB})]$$
$$+ \alpha_o + e - \alpha + w(s + \delta)[1 + f]\}.DEPC \qquad \ldots(3.54)$$

$$= \{Y^1\}.DEPC \qquad \ldots(3.55)$$

where Y^1 is the expression in parenthesis in equation (3.54). Therefore

$$M_3 = \left[\frac{X}{Y^1}\right] B^{a1} \qquad \ldots(3.56)$$

and the multiplier now becomes

$$ma1 = \left[\frac{X}{Y^1}\right]$$

The next step is to introduce the national stock of monetary reserves (NSMR) which was defined as the sum of

(i) the Reserve Bank stock of gold and foreign exchange (which includes SDR's of Australia with the IMF);

(ii) the Australian IMF Gold Tranche position; and

(iii) the banking system's net foreign asset, that is

$$NSMR = GFE + IMFGT + (TBNFA + SBNFA)^{11} \qquad \ldots(3.57)$$

which can be re-written as

$$GFE = NSMR - IMFGT - (TBNFA + SBNFA). \qquad \ldots(3.58)$$

Equation (3.58) can be used to substitute out GFE in (3.51) giving

$$B^{a1} = NSMR - IMFGT - (TBNFA + SBNFA) + GSRB + RBATGLGD + RBLABDOA + NCRB + [C - RBCR - RBOL] - [TLF + FDLF] \qquad \ldots(3.59)$$

---

11. Using footnote 6 of Chapter II the change in NSMR can be defined as

$$NSMR = NSMR - NSMR_{-1}$$
$$= CAB + [NBPNI + GDNI + NBFINI + \Delta IMFGT - \Delta(TBNFA + SBNFA)]$$

where CAB is the current account balance; NBPNI, GDNI and NBFINI are the non-bank private sectors, the government and the NBFI net capital inflow; and other terms are as defined above.

$$= \text{NSMR} - (\text{TBNFA} + \text{SBNFA}) + (\text{GSRB} - \text{IMFGT}) + \text{RBATGLOGD}$$
$$+ \text{NCRB} + [\text{C} - \text{RBCR} - \text{RBOL}][\text{TLF} + \text{FDLF}] + \text{RBLABDOA} \quad \ldots(3.60)$$

Now, suppose that

$$\text{TBNFA} = \varepsilon.(\text{DEPC} + \text{DEPF}), \text{ and} \quad \ldots(3.61)$$
$$\text{SBNFA} = \varepsilon.\text{DEPS}$$

that is, hypothesise that trading banks and savings banks determined their holdings of net foreign assets in relation to their main liabilities, then

$$(\text{TBNFA} + \text{SBNFA}) = \varepsilon.(\text{DEPC} + \text{DEPF}) + \varepsilon.\text{DEPS} \quad \ldots(3.63)$$
$$= [\varepsilon(1 + f) + p\varepsilon].\text{DEPC} \quad \ldots(3.64)$$

Therefore

$$B^{a2} = B^{a1} - [-(\text{TBNFA} + \text{SBNFA})] \quad \ldots(3.65)$$
$$= \text{NSMR} + (\text{GSRB} - \text{IMFGT}) + \text{RBATGLGD} + \text{RBLABDOA} + \text{NCRB}$$
$$+ [\text{C} - \text{RBCR} - \text{RBOL}] - [\text{TLF} + \text{FDLF}] \quad \ldots(3.66)$$
$$= [Y^{1}].\text{DEPC} + [\varepsilon(1 + f) + p\varepsilon].\text{DEPC} \quad \ldots(3.67)$$
$$= [Y^{11}].\text{DEPC} \quad \ldots(3.68)$$

Therefore

$$M_3 = \frac{[X]}{[Y^{11}]} B^{a2} \quad \ldots(3.69)$$

where

$$Y^{11} = [c + p[r + .5\bar{m} - (\lambda_{GSSB} + \lambda_{LSGSSB})]]$$
$$+ [\alpha_o + e - \alpha + \varepsilon + w(s + \delta)][1 + f]^{12}$$

12. It has been assumed that $\varepsilon = 0$, that is, it is only the trading banks that borrow from overseas. This is consistent with the analysis of trading banks borrowing overseas when they are short of resources hence avoiding Reserve Bank lender of last resort facilities.

and the multiplier is

$$ma2 = \frac{[X]}{[Y^{11}]}$$

Equations (3.47), (3.56) and (3.69) represent money supply equations after various forms of adjustments have been made to the monetary base. The above analysis indicates that such a procedure is the result of a mixture of both supply and demand forces. It should also be realised that these money supply relationships are functions of parameters that are derived from a set of equations which describe either relationships between or definitions concerning actually realised variables. That is, these parameters which constitute the money multipliers and the magnitudes that enter the multiplicants are only the proximate determinants of the money supply. In Chapter IV an example of the theoretical relationships that underlie these proximate determinants is discussed. The variables that determine the proximate determinants will be referred to as the ultimate determinants of the money supply.

(3.3) Effects of Changes in the Proximate Determinants on the Growth of the Money Stock

The equations set out in Chapters II and III can be used to analyse the growth in the money stock. In those chapters the base was made a function of proximate variables (components of the adjusted base) and the money multiplier a function of proximate parameters. The growth in the money stock can be considered as resulting from growth in these proximate variables and parameters.

This analysis is of value for answering many questions, for example

(i) What is the contribution of the base relative to the money multiplier.

(ii) What is the contribution of the foreign sector (net foreign assets) relative to that of the Reserve Bank (net domestic assets), and

(iii) What is the contribution of a run-down in excess LGS assets on the money stock.

However, the analysis has two drawbacks:

(i) The analysis is ex post; that is, it examines the growth in the money stock via only the proximate determinants and by necessity only over the historical past; and

(ii) The analysis is partial; that is, it is based on the assumption that there is no interdependence between the proximate determinants. This implies that

$$\frac{\delta P_i}{\delta P_j} = 0, \quad i \neq j$$

where P_i and P_j are any two proximate determinants (that is, any two elements of the base or multiplier). An approximate measure of the extent to which this assumption is broken in reality can be obtained by considering the correlation matrix between the proximate determinants.

The possibility of interdependence between the proximate parameters or the proximate variables can be the result of a number of possibilities; for example

(i) the policy-makers' reaction function may imply covariation between the different contributions to the growth in the monetary base. Deliberate attempts by the monetary authorities to offset capital inflows will lead to covariation between net foreign assets and net domestic assets;

(ii) the various proximate parameters may have common dependence on common ultimate determinants. This will, in fact, be the case if Tobin's portfolio restrictions are enforced, that is within a sector the estimating equations should have the same explanatory variables.

(iii) a reason for links between proximate parameters and variables is that the behaviour of the foreign sector in determining net capital inflow, for example, may lead to portfolio behaviour that say, initially increases cash balances of the private sector.

It is obvious then that this procedure is limited and as a consequence an analysis of the ultimate determinants influence on the money supply is desirable and a model for examining this aspect is set out in Chapter IV. This partial expost analysis can, however, still provide valuable information. It can show reasons why policies were inappropriate, the importance of particular aspects of behaviour in the money supply process which may guide policy in the future, and how behaviour has changed through time and under differing circumstances.

The analysis develops by differentiating the basic money supply equation[13]

$$M_3 = mB \qquad \ldots(3.1)$$

which gives

$$dM_3 = Bdm + mdB \qquad \ldots(3.70)$$

where d is the differential operator.

There are three paths that can be followed from here each with its own error, with previous studies using one of the first two.

The first alternative is to divide equation (3.70) by the money supply,[14] therefore

$$\frac{dM_3}{M_3} = \frac{Bdm}{M_3} + \frac{mdB}{M_3} \qquad \ldots(3.71)$$

that is

$$\frac{dM_3}{M_3} = \frac{dm}{m} + \frac{dB}{B} \qquad \ldots(3.72)$$

that is,

$$d\log M_3 = d\log m + d\log B$$

13. The analysis is done in terms of the unadjusted base and multiplier for simplicity.

14. The same result can be achieved by initially taking logs of equation 3.1 and then differentiating.

This approach then considers each of the three terms in equation (3.72) as approximating percentage growth rates. This procedure entails two errors, firstly it may entail serious errors if any of the three series are growing rapidly and in such cases their association with percentage changes may be misleading. Secondly, equation (3.72) holds only in continuous time, and hence with discrete data an error is introduced. If the multiplier is calculated empirically residually by division of discrete observations of the money stock and the monetary base, then this second error is removed.

The second alternative approximates equation (3.72) by

$$\frac{dM_3}{M_{3-1}} = \frac{dm}{m_{-1}} + \frac{dB}{B_{-1}} \qquad \ldots(3.73)$$

that is, it maintains the structure of equation (3.72) but uses actual growth rates it thus has two errors; a specification error and the discrete time error. The true form of equation (3.73) is

$$\frac{dM_3}{M_{3-1}} = \frac{dm}{m_{-1}} + \frac{dB}{B_{-1}} + (w_0 + w_1) \qquad \ldots(3.73')$$

where w_0 and w_1 are the error terms resulting from the approximation techniques described.

The third alternative is to go from equation (3.72) to.

$$\frac{M_{3-1}}{M_3} \cdot \frac{dM_3}{M_{3-1}} = \frac{m_{-1}}{m} \frac{dm}{m_{-1}} + \frac{B_{-1}}{B} \frac{dB}{B_{-1}} \qquad \ldots(3.74)$$

that is

$$\frac{dM_3}{M_{3-1}} = \left(\frac{M_3}{M_{3-1}}\right)\left(\frac{m_{-1}}{m}\right)\frac{dm}{m_{-1}} + \left(\frac{M_3}{M_{3-1}}\right)\left(\frac{B_{-1}}{B}\right)\frac{dB}{B_{-1}} + w_0 \qquad \ldots(3.75)$$

This method does not have the specification error of method 2, but it does still have the discrete time approximation to continuous time error but unlike method 1 it has actual percentage changes.

The analysis can be developed in two further ways. Firstly, the base and the multiplier can be decomposed into the formulations derived in Chapters II and III which allows for a detailed examination of the contributions - the formulations for this are given in Appendix 1. It may be of interest for example to know the relative contributions to the base of net foreign assets and net domestic assets, that is

$$dB = d\ NFA + d\ NDA$$

Therefore,

$$\frac{dB}{B_{-1}} = \frac{d\ NFA}{B_{-1}} + \frac{d\ NDA}{B_{-1}}$$

Secondly, it would be expected that the relative contributions of changes in the base and the multiplier will vary over time. (It would not be surprising to expect that the importance of each of the money multipliers parameters to vary with time.) The following graphs and tables demonstrate empirically some of the propositions discussed above. The data used is seasonally adjusted with the exact definition of variables used given in Appendix 2. The data, while seasonally adjusted is not that published by the Australian

Bureau of Statistics or the Reserve Bank of Australia. The series published by these two agencies use the X11Q method which has been criticised for example by Wallis [88]. The method employed in this study removes only the moving average component. This method also has problems as can be seen from the graphs due to the linearization problem when many of the series are grossly non-linear. This has tended to introduce wider fluctuations in the earlier years of the series compared with the series derived by the X11Q method.

Figure 1 shows the money stock (M_3) and the monetary base (the definition used is $\underline{B}'$ defined in equation (2.19) of Chapter II - that is the basic definition with adjustment of net foreign assets for exchange rate changes). Figure 2 shows the implied money multiplier from these definitions of the money stock and the monetary base.

The rapid growth that has occurred in the money stock during the 1970's is shown in the first figure. Figure 1 also shows that the base has not grown at parallel rates. Consequently, as shown in Figure 2 the money multiplier has a strong upward trend.

Periods of rapid change in the multiplier are associated with significant changes in the sources of changes in the money stock. A chief factor in the upward trend in the multiplier has been the gradual decline in the Statutory Reserve Deposit Ratio. This signifies a trend from a large proportion of the money stock being provided by the authorities to one where advances of banks plays a large role. Two significant periods of change can be identified from figure 2. This has important implications for the stability of demand and supply equations of various financial assets and liabilities. The figures also show the high correlation between changes in the money stock and changes in the base for the early 1960's and early 1970's. Table 3.6 shows the average value of the multiplier ending at several points (starting from 1959).

Table 3.6

Mean Values of Money Multiplier

1959/69	1959/70	1959/71	1959/72	1959/73	1959/74	1959/75
3.54	3.56	3.59	3.62	3.64	3.69	3.74

Figure 3 graphs equation (3.72), that is the contributions of relative change in the base and multiplier to relative changes in the money stock. As can be seen from this graph changes in the base often contributed more than the total variation of the money stock. This implies that the multiplier has moved in the opposite direction to compensate. This feature is further demonstrated in figure 4, which shows the relative contributions of the base and the multiplier to a change in the money stock. It in effect is an alternative way of graphing equation (3.72). If both sides of this equation are multiplied by $\frac{100\%}{\text{Dlog } M_3}$, then figure 4 results.

The figure is distorted slightly by some occasionally very large contributions of either the base or the multiplier. The average percentage contribution of the base (and hence implicitly for the multiplier) for the period 1967 to 1972 is 94.8% (and 5.2% for the multiplier).

Figure 5 plots the monetary base and its two components, net foreign assets (gold and foreign exchange) and net domestic assets. The graph shows the significant change in the relative contributions of these two components with 1972 featuring significantly in this changing behaviour.

Figures 6 and 7 plot equations (3.76) and (3.77). In addition figure 8 (like figure 4) plots the relative contributions of changes in the two components of the base to the total change in the base. A lot of interest in the money multiplier-monetary base framework is centred in the U.S. where it is believed the authorities can control the base and that the multiplier is relatively constant. As discussed earlier this is not the case for a small open economy with a relatively fixed exchange rate. Figures 6 and 7 show, however, that for the period 1970-1972 changes in net foreign assets were greater than changes in the base - a result of an overvalued exchange rate. These graphs show the enormous extent to which the central bank attempted to sterilize this growth. This led to the enormous reduction in net domestic assets as shown in figure 5. The post-1972 growth in net domestic assets has largely been in relation to the financing of government deficits and the behaviour of monetary policy.

As the above has shown, in an empirical study it is often useful to subdivide the total period into shorter runs. The criterion on which to determine such subdivisions should be related to the objectives of monetary policy which can be approximated as

(i) a stable price level,

(ii) a low rate of unemployment,

(iii) a satisfactory rate of growth of real production, and

(iv) balance of payments equilibrium.

These criteria can be used to investigate behaviour in periods where:

(i) the growth rate of real production is accelerating ($\Delta \dot{y} > 0$) or decelerating ($\Delta \dot{y} < 0$),

(ii) the rate of inflation is accelerating ($\Delta \dot{p} > 0$) or decelerating ($\Delta \dot{p} < 0$),

(iii) the current account showing a surplus ($CAB > 0$) or a deficit ($CAB < 0$),

(iv) the balance of payments showing a surplus ($BOP > 0$) or a deficit ($BOP < 0$),

(v) the rate of unemployment increasing ($\Delta u > 0$) or decreasing ($\Delta u < 0$),

(vi) the growth rate of money accelerating ($\Delta \dot{M}_3 > 0$) or decelerating ($\Delta \dot{M}_3 < 0$),

(vii) the rate of interest increasing ($\Delta r > 0$) or decreasing ($\Delta r < 0$).

Figures 9 to 16 show changes in the money stock and the monetary base along-side changes in prices (figures 9 and 13), the unemployment rate (figures 10 and 14), changes in real output (figures 11 and 15) and the balance of payments (figures 12 and 16).

These graphs show several interesting features of monetary policy in achieving the objectives of policy; for example the strong growth in money that preceded the very strong growth in unemployment! Also figure 12 shows the general close relationship of money changes to the balance of payments. Also the endogeneity and exogeneity of the base at different times is highlighted (particularly well shown in figure 15).

(3.4) Indicators of Reserve Bank Behaviour

The analysis developed in the previous section is also relevant for the indicator question. From the following definition of the monetary base net domestic assets (NDA) and net foreign assets (NFA) can be defined.

$$B^{a1} = GFE* + GSRB + RBATGLGD + RBLABDOA + NCRB$$
$$+ [C - RBCR - RBOL] - [TLF + FDLF]$$

$$NFA = GFE*$$

$$NDA = GSRB + RBATGLGD + RBLABDOA + NCRB$$
$$+ [C - RBCR - RBOL] - [TLF + FDLF]$$

Net domestic assets can be used as an indicator of discretionary monetary policy. However, a better indicator is provided if NDA is adjusted for changes in the statutory reserve deposit ratio as discussed in section (2.2) of Chapter II. That is

$$NDA* = NDA + B^{r}$$

where B^{r} was defined in equation (2.13).

To extend the indicator analysis even further NDA* can be split into four components

1) NDA1* = RBATGLGD = TB - GDRB

2) NDA2* = GSRB

3) NDA3* = RBLABDOA + NCRB + [C - RBCR - RBOL] - [TLF + FDLF] - B^r

4) NDA4* = B^r

The first item refers to the Reserve Bank's role in financing government deficits and hence is an indicator of the direct fiscal influences on monetary behaviour. The second item refers predominantly to the Reserve Bank's open market operations. Item 3 relates to Reserve Bank lending to the private sector while item 4 is the impact of changes in a Reserve Bank instrument on the monetary base.

From the analysis above

$$\frac{dB^{a1}}{B^{a1}_{-1}} = \frac{NDA1^*_{-1}}{B^{a'}_{-1}} \frac{dNDA1^*}{NDA1^*_{-1}} + \frac{NDA2^*_{-1}}{B^{a'}_{-1}} \frac{dNDA2^*}{NDA2^*_{-1}} + \frac{NDA3^*}{B^{a'}_{-1}} \frac{dNDA3^*}{NDA3^*_{-1}},$$

$$+ \frac{NDA4^*_{-1}}{B^{a'}_{-1}} \frac{dNDA4^*}{NDA4^*_{-1}}$$

On the question of controllability or potential control of the money stock by the authorities, the following information has been suggested by Brunner and Meltzer as being of use.

$$\varepsilon(M_3, i) = 1 - q_i$$

where i = M, B^a, NFA, NDA (NDA1*, NDA2*, NDA3*, NDA4*), and ε refers to the elasticity between the money stock (M3) and variable i.

Brunner and Meltzer suggest that these elasticities, in particular the size of q_i, will imply the extent of controllability or potential controllability of the money stock. The values of $(1 - q_B)$ and $(1 - q_m)$ for the period 1967 to 1972 (to avoid any outlier observations as shown in figure 4) are 1.054 and 19.23 respectively. These imply values of -.054 and -18.23 for q_B and q_m.

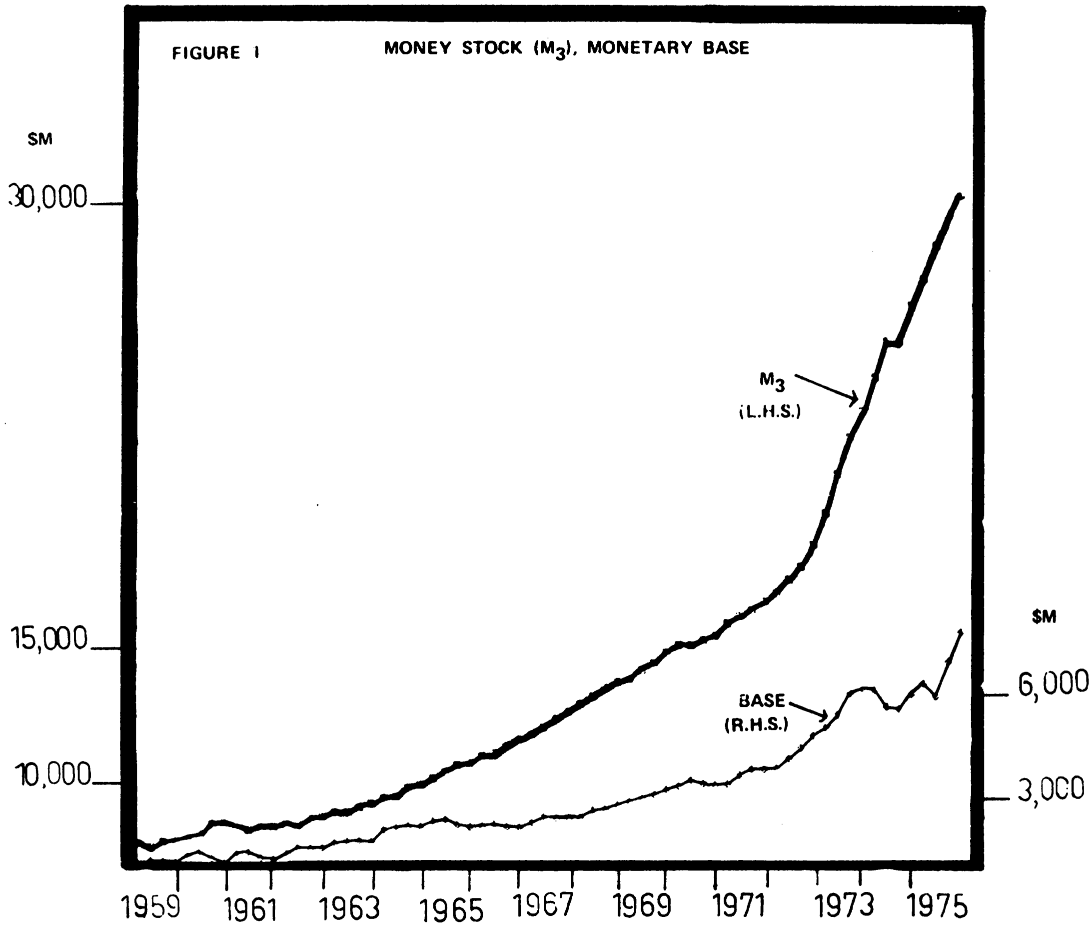


FIGURE 1
MONEY STOCK (M_3), MONETARY BASE
$M
30,000
15,000
10,000
M_3
(L.H.S.)
BASE
(R.H.S.)
$M
6,000
3,000
1959
1961
1963
1965
1967
1969
1971
1973
1975

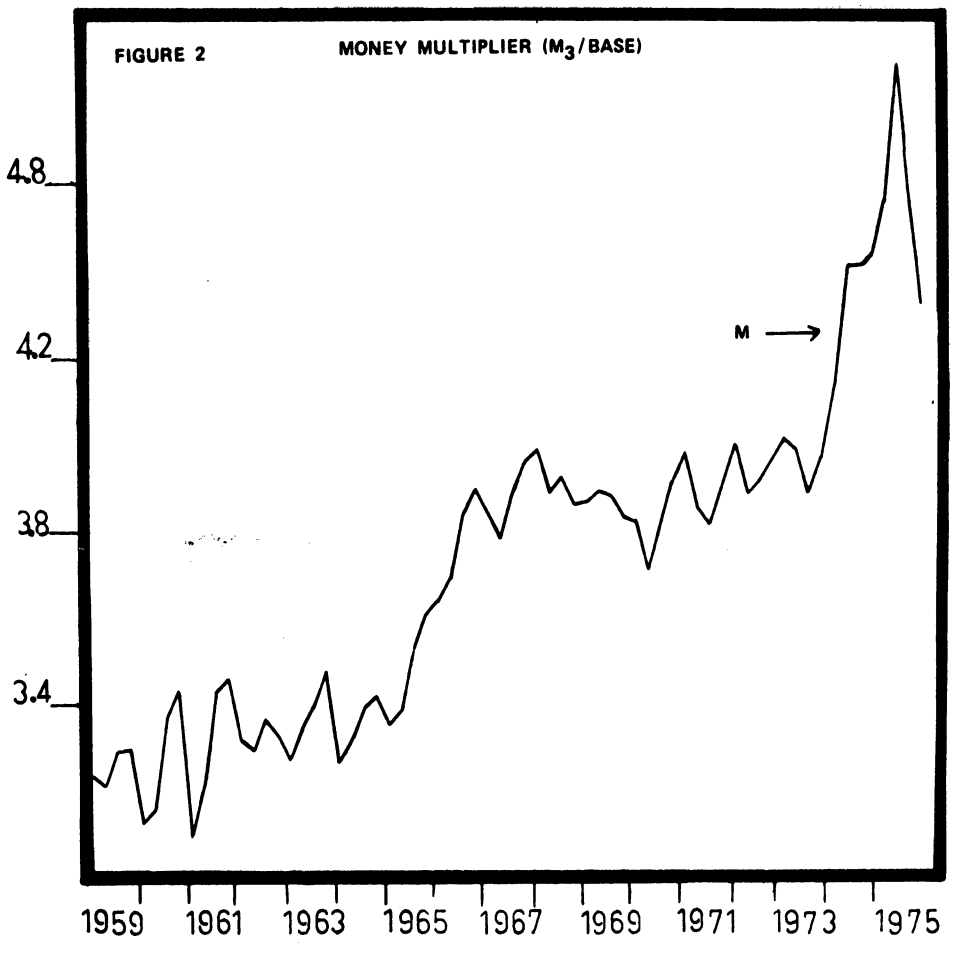


FIGURE 2
MONEY MULTIPLIER (M3/BASE)
M
4.8
4.2
3.8
3.4
1959
1961
1963
1965
1967
1969
1971
1973
1975

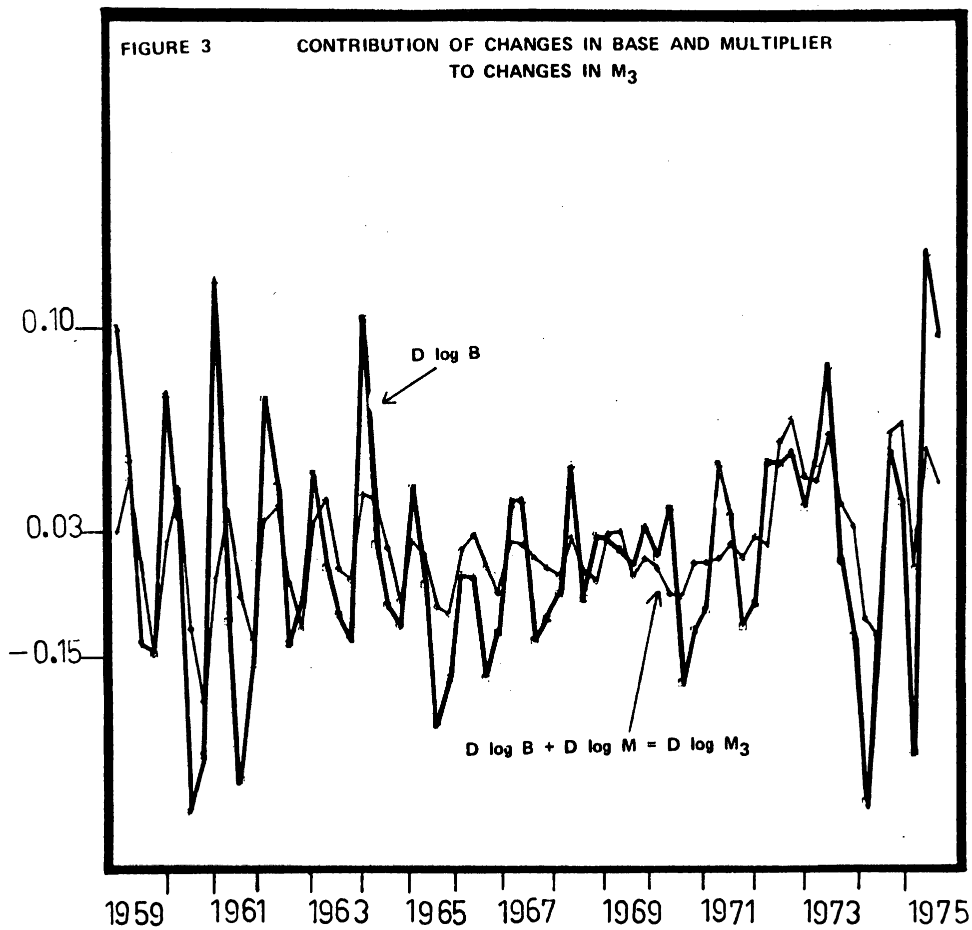
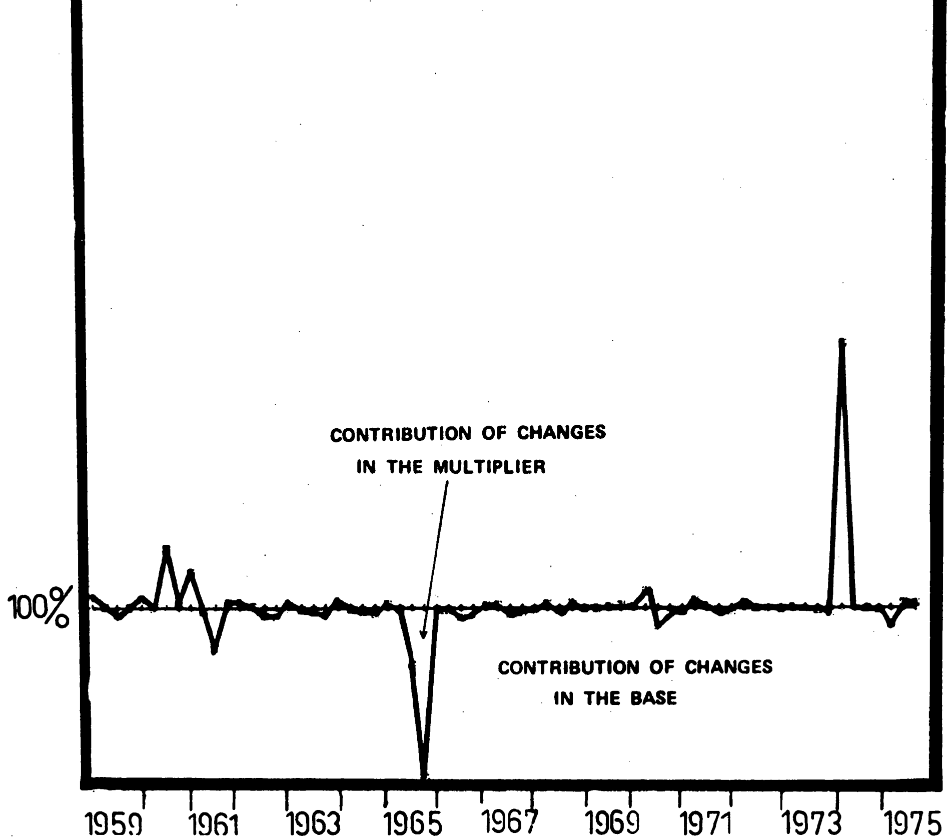
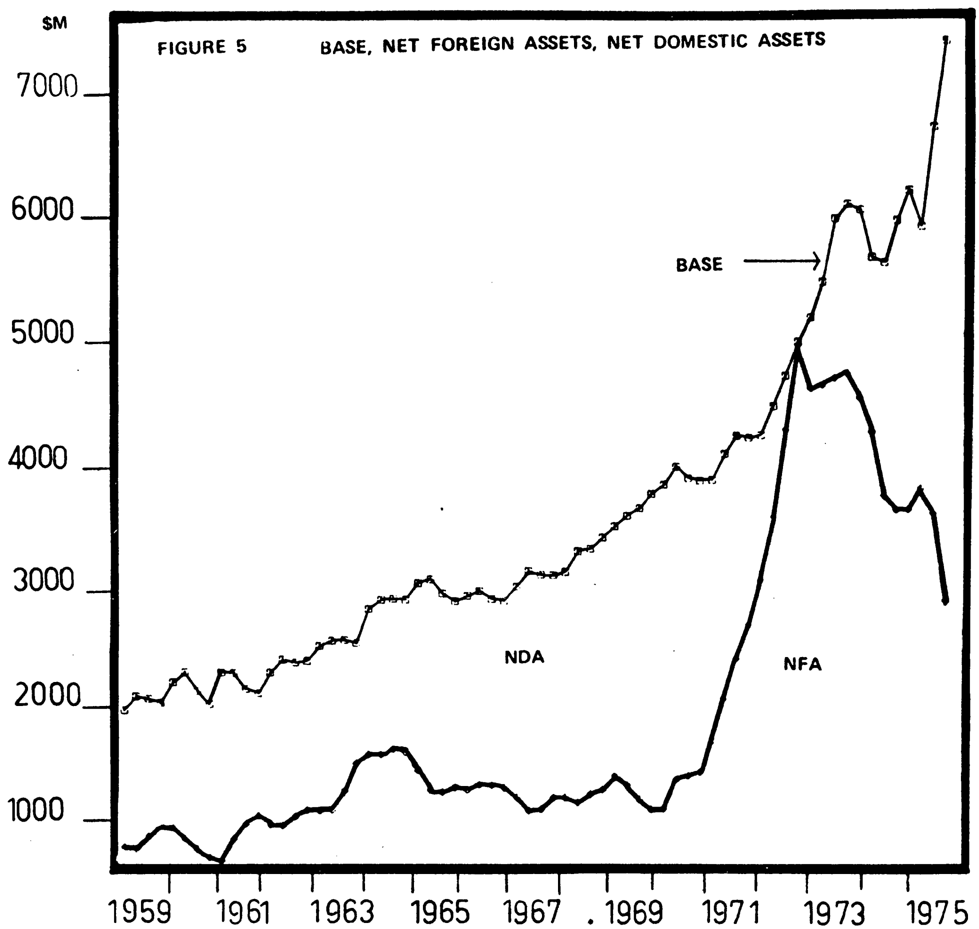


FIGURE 3
CONTRIBUTION OF CHANGES IN BASE AND MULTIPLIER
TO CHANGES IN M_3
0.10
0.03
-0.15
D log B
D log B + D log M = D log M_3
1959
1961
1963
1965
1967
1969
1971
1973
1975

FIGURE 4 RELATIVE CONTRIBUTIONS OF CHANGES IN THE BASE AND MULTIPLIER TO CHANGES IN M_3




$M
FIGURE 5
BASE, NET FOREIGN ASSETS, NET DOMESTIC ASSETS
7000
6000
5000
4000
3000
2000
1000
BASE
NDA
NFA
1959
1961
1963
1965
1967
1969
1971
1973
1975

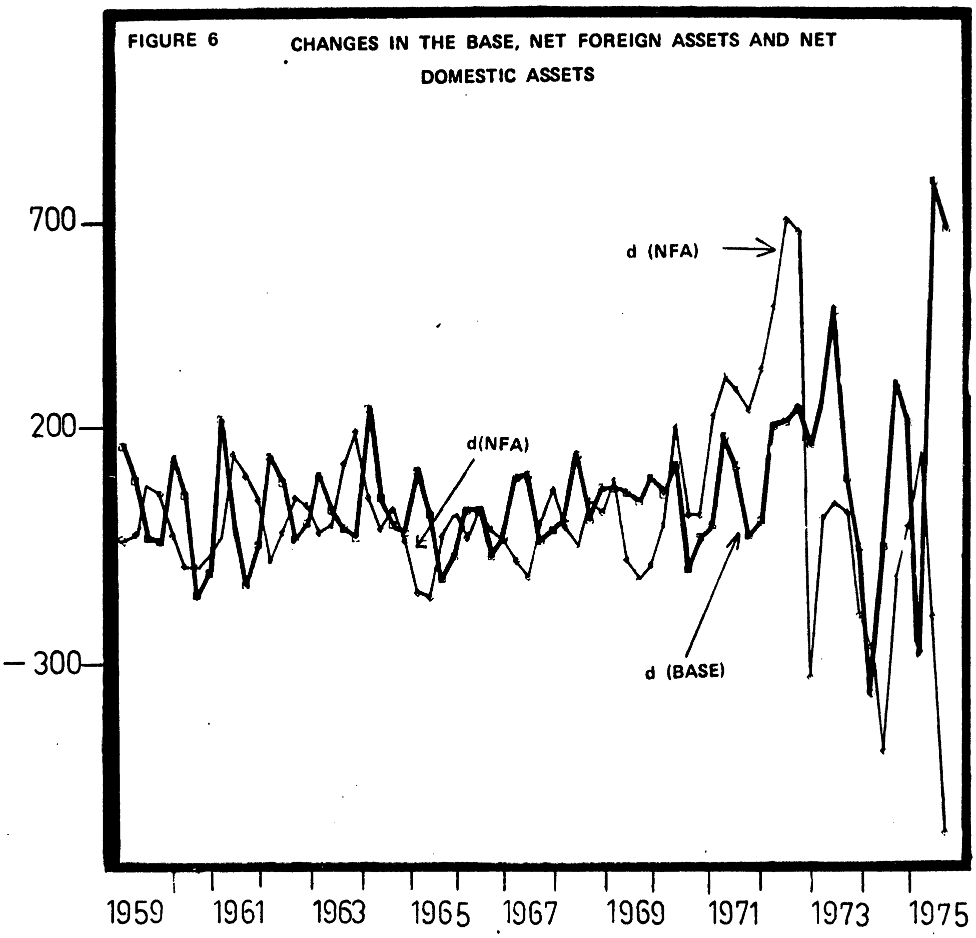


FIGURE 6
CHANGES IN THE BASE, NET FOREIGN ASSETS AND NET DOMESTIC ASSETS
700
200
- 300
d (NFA)
d(NFA)
d (BASE)
1959
1961
1963
1965
1967
1969
1971
1973
1975

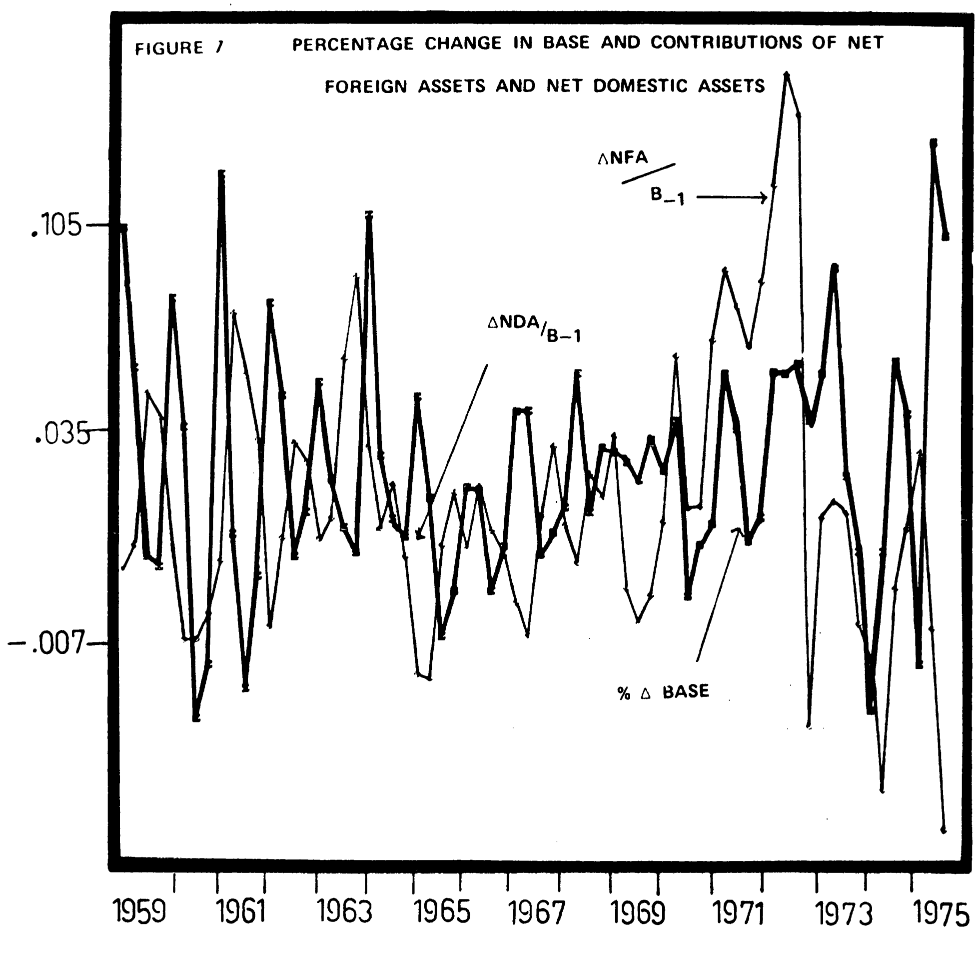
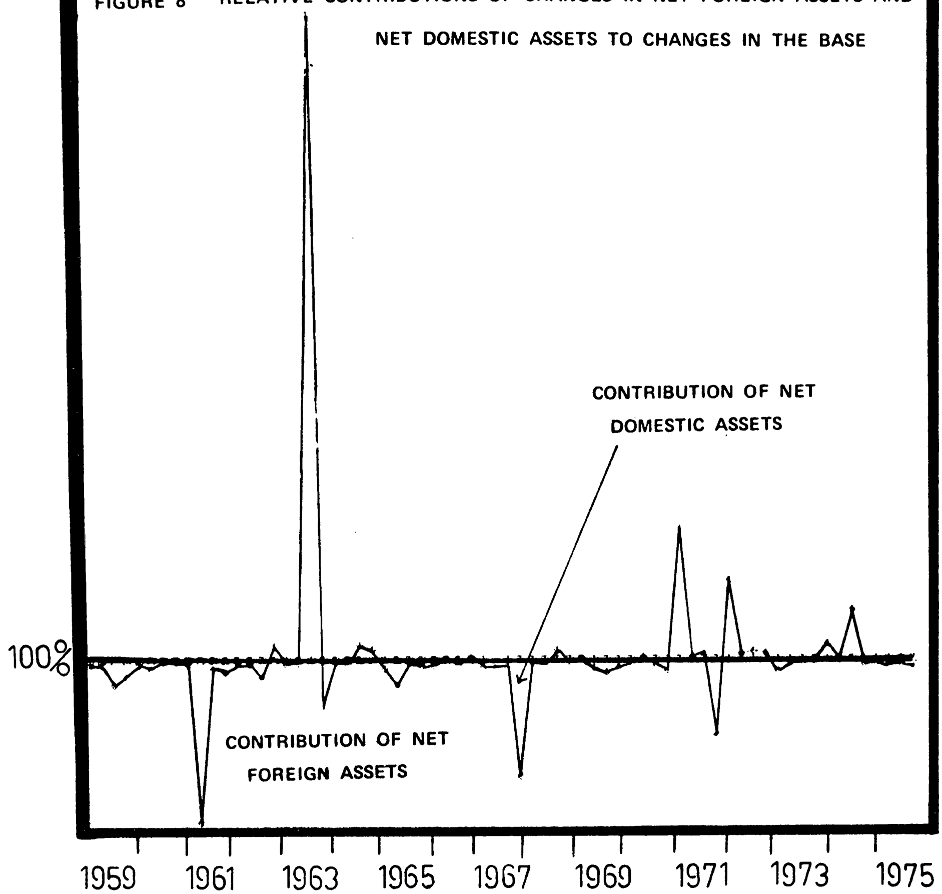


FIGURE 7
PERCENTAGE CHANGE IN BASE AND CONTRIBUTIONS OF NET
FOREIGN ASSETS AND NET DOMESTIC ASSETS
ΔNFA/B-1
ΔNDA/B-1
% Δ BASE
.105
.035
-.007
1959
1961
1963
1965
1967
1969
1971
1973
1975

FIGURE 8 RELATIVE CONTRIBUTIONS OF CHANGES IN NET FOREIGN ASSETS AND NET DOMESTIC ASSETS TO CHANGES IN THE BASE



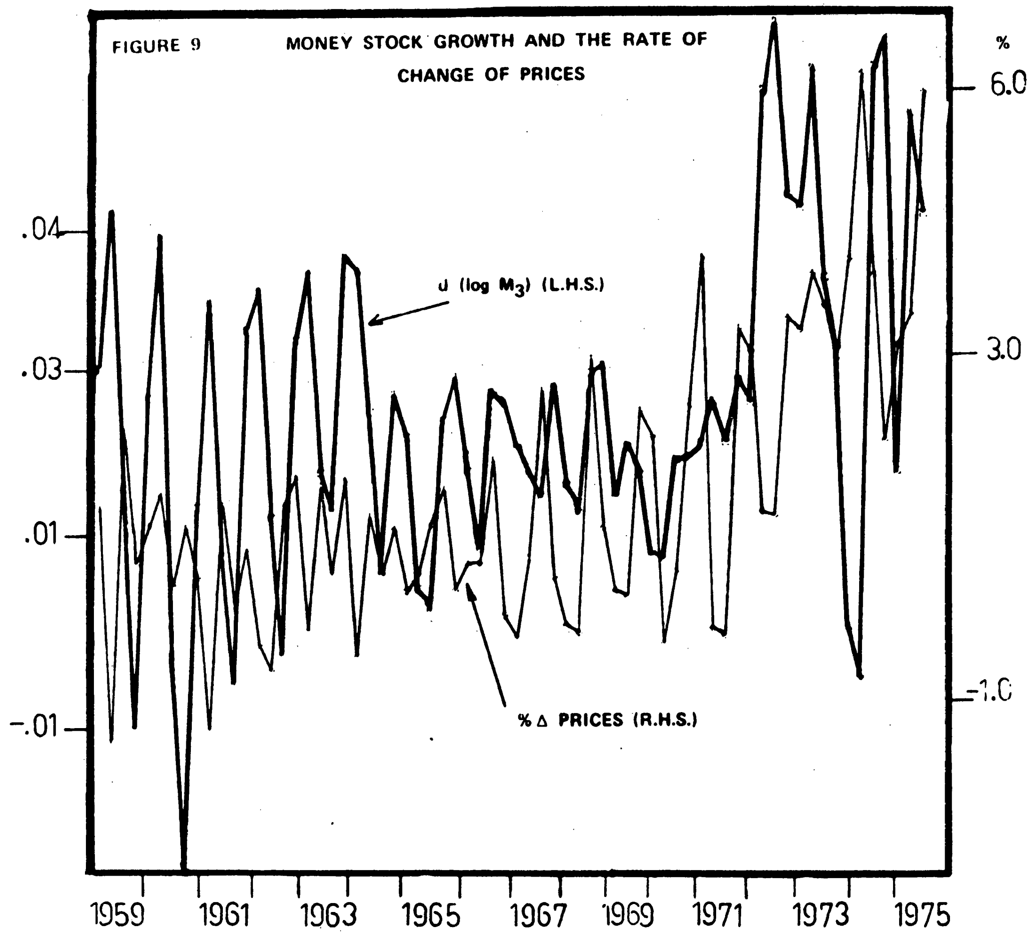


FIGURE 9
MONEY STOCK GROWTH AND THE RATE OF CHANGE OF PRICES
d (log M_3) (L.H.S.)
% Δ PRICES (R.H.S.)
%
.04
.03
.01
-.01
6.0
3.0
-1.0
1959
1961
1963
1965
1967
1969
1971
1973
1975

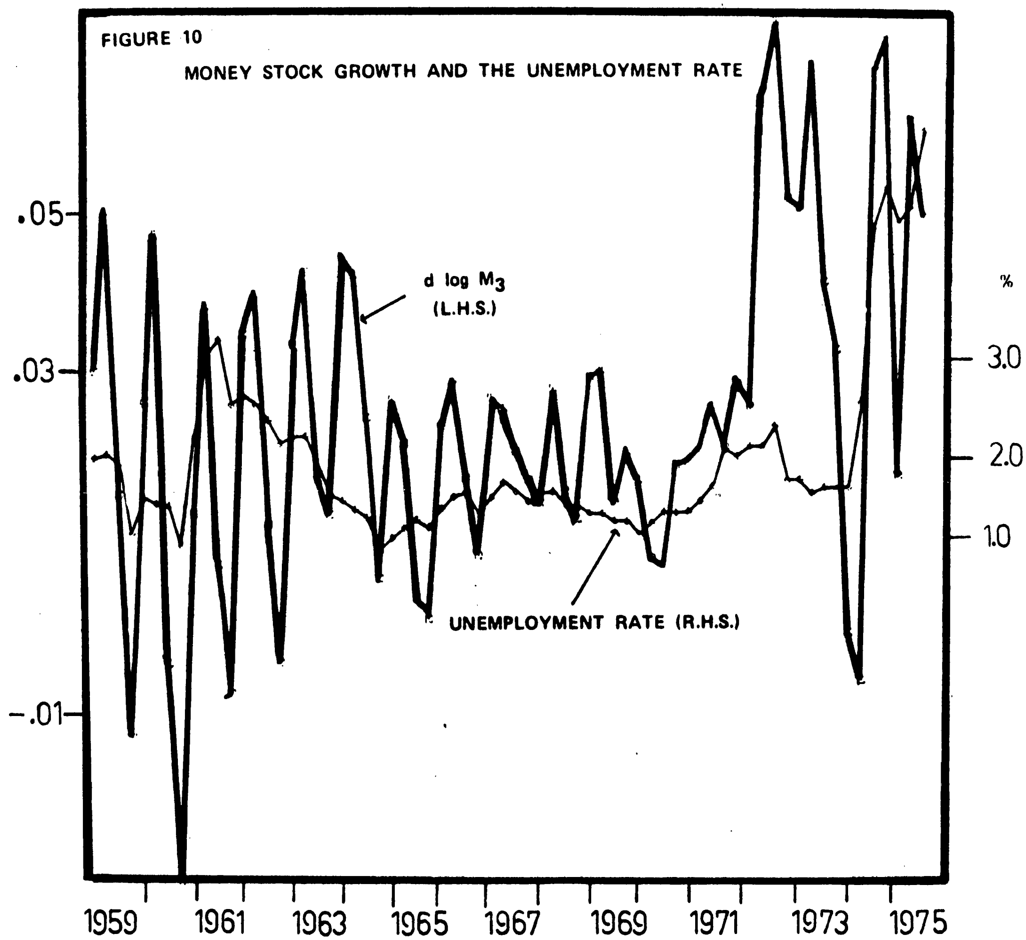


FIGURE 10
MONEY STOCK GROWTH AND THE UNEMPLOYMENT RATE
d log M_3
(L.H.S.)
UNEMPLOYMENT RATE (R.H.S.)
%
.05
.03
-.01
3.0
2.0
1.0
1959
1961
1963
1965
1967
1969
1971
1973
1975

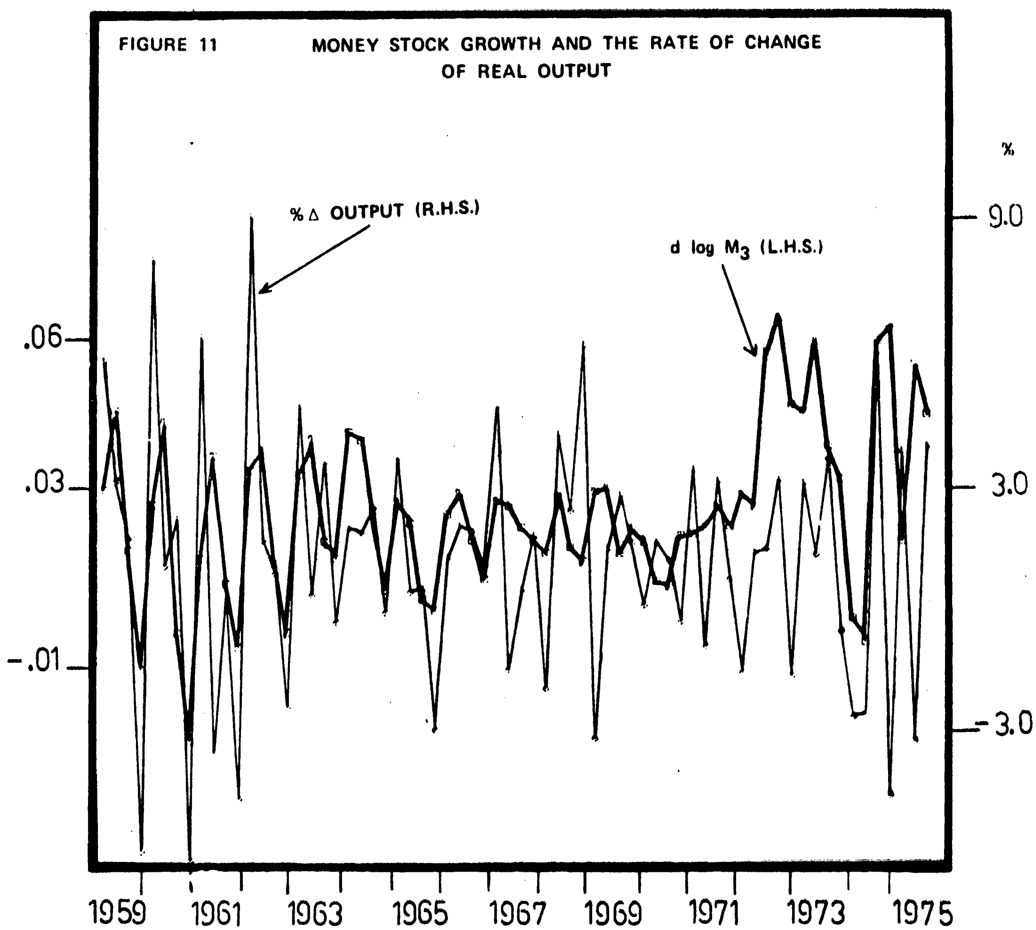


FIGURE 11 MONEY STOCK GROWTH AND THE RATE OF CHANGE OF REAL OUTPUT

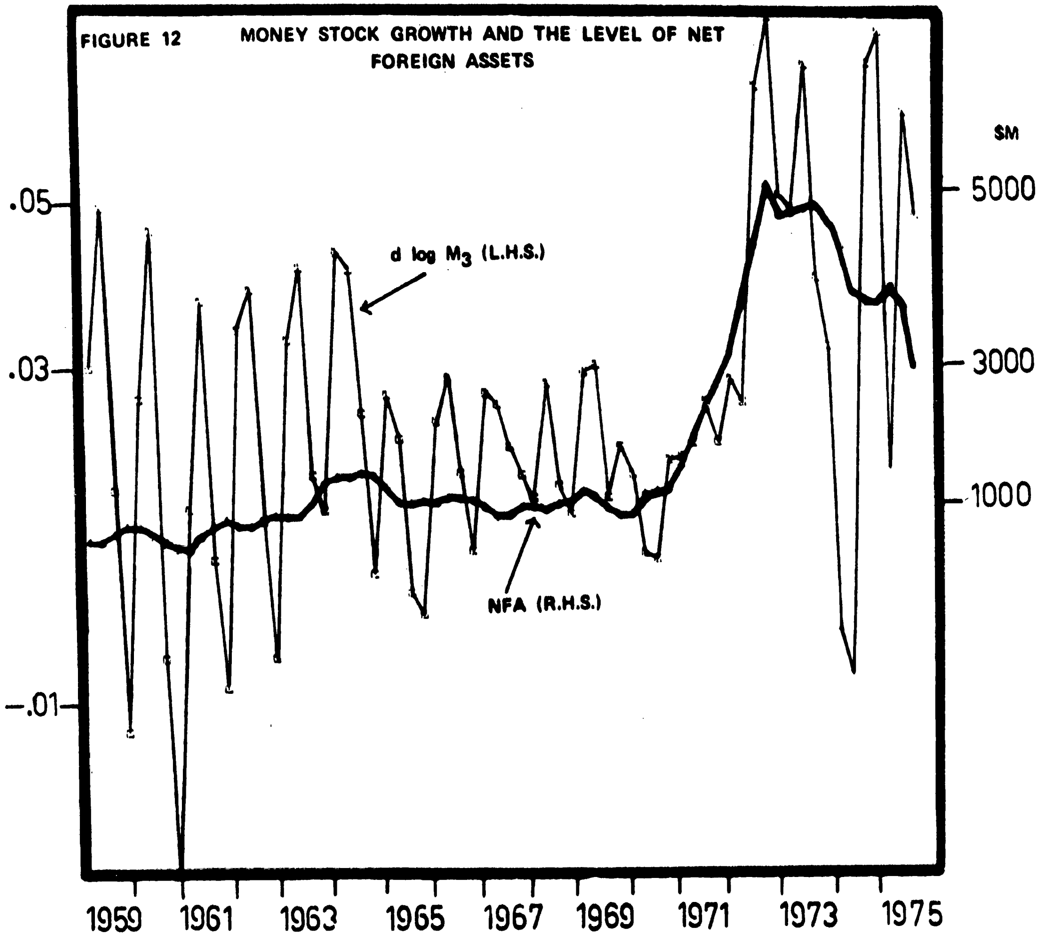


FIGURE 12
MONEY STOCK GROWTH AND THE LEVEL OF NET FOREIGN ASSETS
d log M_3 (L.H.S.)
NFA (R.H.S.)
$M
.05
.03
-.01
5000
3000
1000
1959
1961
1963
1965
1967
1969
1971
1973
1975

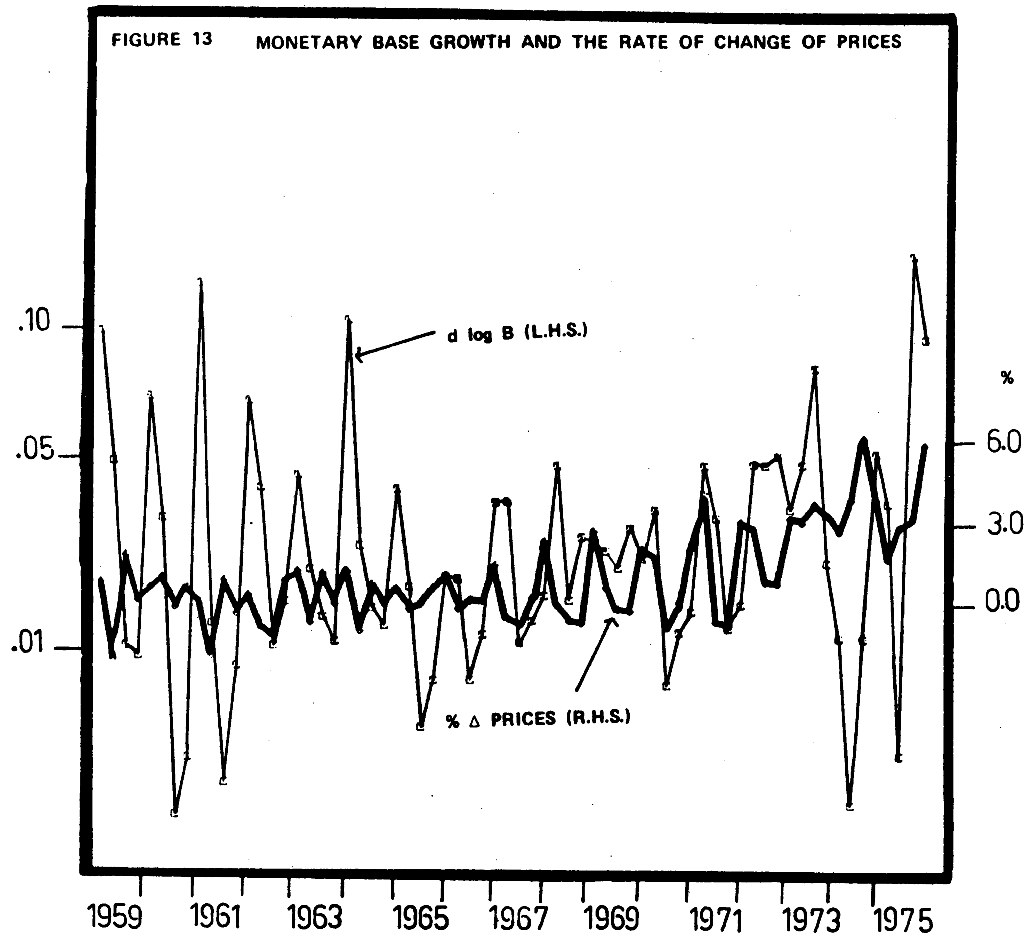


FIGURE 13 MONETARY BASE GROWTH AND THE RATE OF CHANGE OF PRICES
d log B (L.H.S.)
% Δ PRICES (R.H.S.)
.10
.05
.01
%
6.0
3.0
0.0
1959
1961
1963
1965
1967
1969
1971
1973
1975

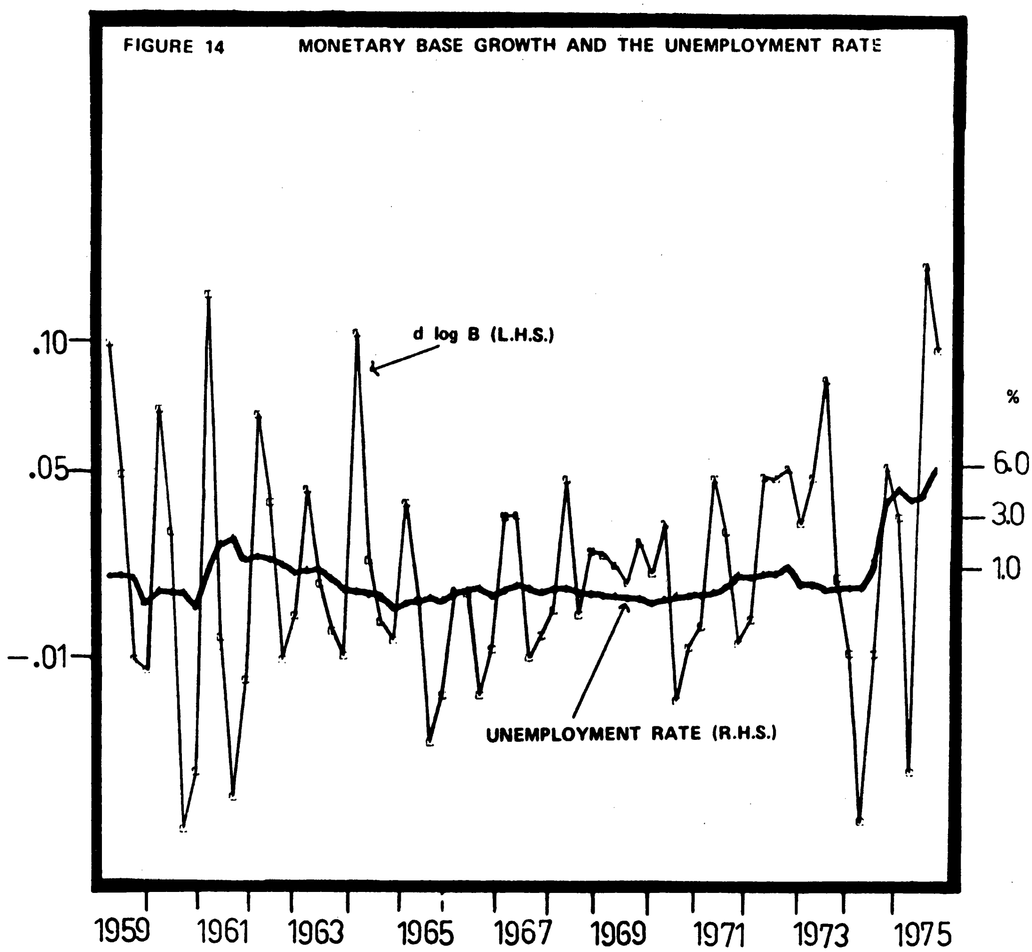


FIGURE 14
MONETARY BASE GROWTH AND THE UNEMPLOYMENT RATE
d log B (L.H.S.)
UNEMPLOYMENT RATE (R.H.S.)
.10
.05
-.01
%
6.0
3.0
1.0
1959
1961
1963
1965
1967
1969
1971
1973
1975

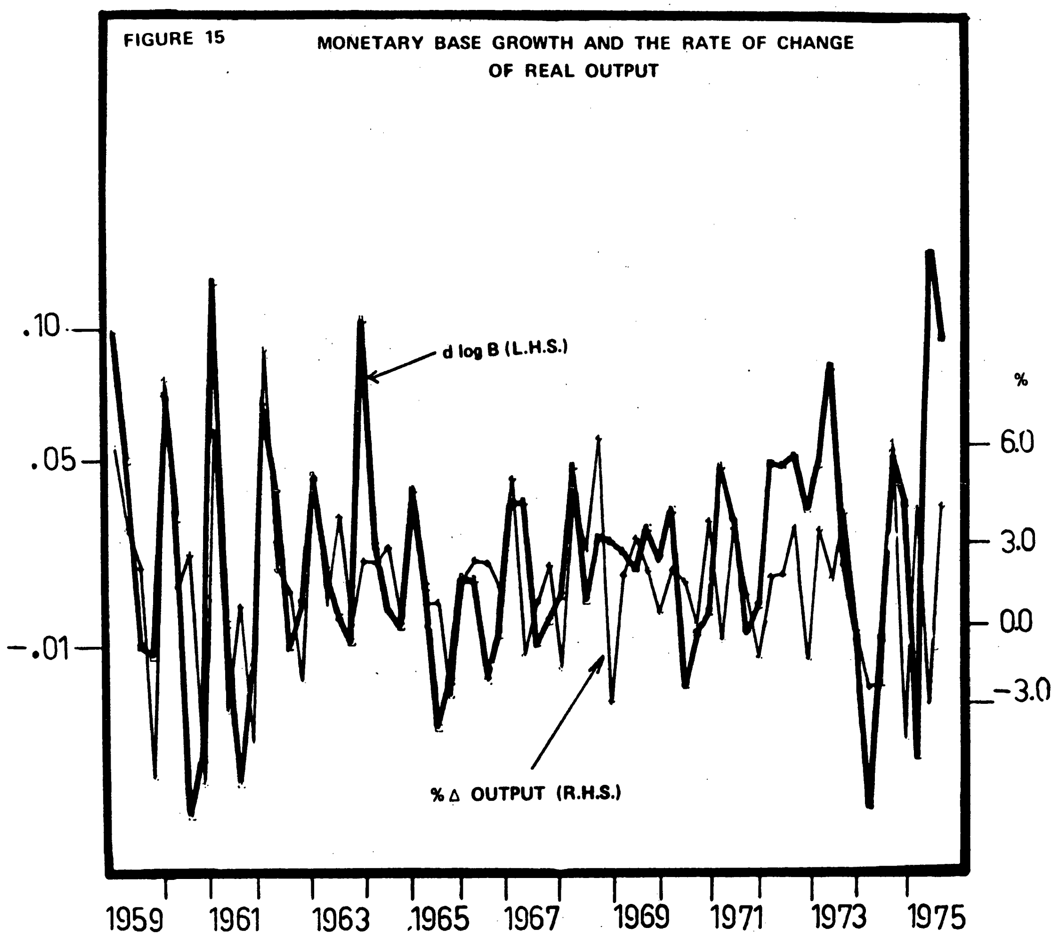
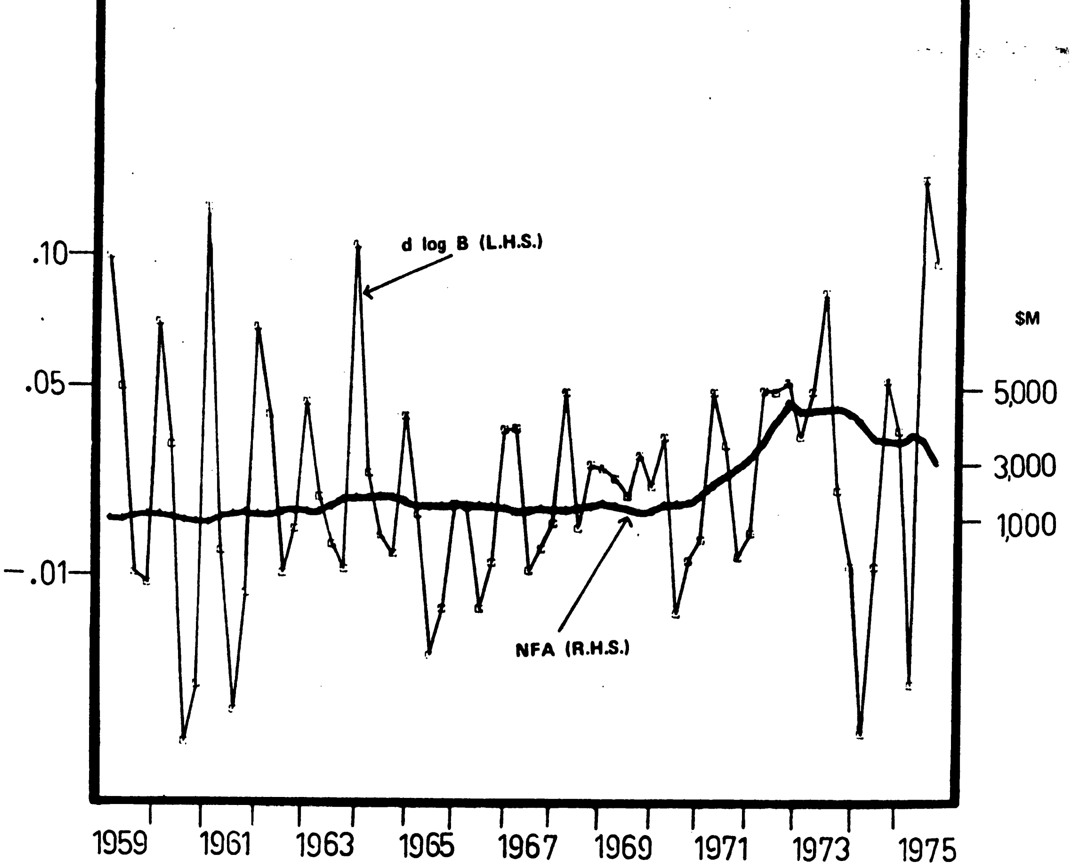


FIGURE 15
MONETARY BASE GROWTH AND THE RATE OF CHANGE OF REAL OUTPUT
d log B (L.H.S.)
% Δ OUTPUT (R.H.S.)
.10
.05
-.01
%
6.0
3.0
0.0
-3.0
1959
1961
1963
1965
1967
1969
1971
1973
1975

FIGURE 16 MONETARY BASE GROWTH AND THE LEVEL OF NET FOREIGN ASSETS



CHAPTER IV

ENDOGENOUS ASPECTS OF THE MONEY MULTIPLIER - MONETARY BASE FRAMEWORK

(4.1) Introduction

Section (3.3) of Chapter III derived an expression which related the growth in the money stock to changes in the proximate determinants of the multiplier and base. It was pointed out in that section, that this procedure is of most value for expost examination of the money stock, as it assumed that the various parameters are independent. Some reasons were given why the parameters could in fact be interdependent. These factors included:

(i) the policy-makers' reaction function may imply covariation between the different contributions to the growth of money, for example, deliberate attempts to offset capital inflow; and

(ii) the various proximate parameters may have common dependence on common ultimate determinants.

If the MM-MB framework is to be of value for other than expost analysis the model needs to be extended from the proximate determinants of the money stock to the ultimate determinants. That is, the analysis must now proceed from the discussion of the identities underlying the money supply process to the behavioural relationships. Section (4.2) develops the endogenous behaviour of the base while sections (4.4), (4.5) and (4.6) examine the endogenous behaviour of the multiplier. Section (4.3) looks at the distribution of the monetary base.

(4.2) Endogenous Aspects of the Monetary Base

"... there still seems little or no awareness that taking the level of H [base money] as exogenously given pushes out of sight the most important parts of the adjustment process. All too often in the literature this total is taken as given, as exogenous, as fixed by the authorities, and no further steps are taken to examine the factors determining its level." (Goodhart, [45, p.245]).

The usual argument for the exogeneity of the base is that it is set by the authorities to achieve their intermediate target of a particular level of a money aggregate. Whilst this is even inappropriate for the "conventional" money supply process,[1] the Australian situation is characterised by the authorities having interest rates as their intermediate target.

Thus in order to examine the money supply process properly it is necessary to examine the endogenous determination of the monetary base. This starts with an examination of the behavioural relations underlying the sources of the monetary base.

As shown in Chapter II the sources definition of the base is comprised of two components, firstly a foreign component resulting from the balance of payments, and secondly a domestic component resulting from the government deficit. These two components are

---

1. For example, the authorities must have a reaction function which dictates how offsetting movements in the multiplier and some uncontrolled components of the base are carried out to achieve the money aggregate target.

linked by the flow of funds identity that states that the deficit (or surplus) of a particular sector must be financed by flow of funds by other sectors. Thus the government deficit (surplus) is linked by this identity to the surplus or deficit of other sectors including the overseas sector, that is, by changes in gold and foreign exchange.

There is a choice with regard to the level of disaggregation that the base can be examined. At the highest level of aggregation, the base can be derived as a single reduced form equation.[2] However, this aggregative approach does not identify explicitly major features of the adjustment process. This adjustment process has major implications for policy as the recent literature has shown on the effectiveness, for a "small" country of monetary policy under a fixed exchange rate regime with high capital mobility. This suggests then, that a more disaggregative approach is preferable.

This disaggregated approach splits the balance of payments into two sections, firstly the current account which is the result of basically real phenomenon, for example, the terms of trade, and secondly the capital account which links capital flows and portfolio balance. Thus the monetary base is subject to the forces that govern the international transmission of goods and services and capital flows.

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2. This is done by Sharpe [81].

The significance of the balance of payments and especially capital flows on the monetary base has become more important recently with the increasing integration of world economies. Several recent studies have attempted to show the increasing integration of the Australian economy with the rest of the world. Barry and Guille [9] attempted to show that the lag of the Australian business cycle behind the world business cycle has shortened dramatically. Hence foreign cyclical impulses are transmitted much quicker and hence possibly aggravating domestic stabilization problems.

Porter [77] presents some further empirical evidence on economic integration. This work has been updated and extended by Carmichael [23] whose results show the systematic adjustment of Australian interest rates and prices to be in close accord with those of other countries.

These results give prime face evidence for the Balance of Payments Theory of the Money Supply or what is usually referred to as the Monetary Theory of the Balance of Payments.[3] This theory suggests that under fixed exchange rates, a small open economy cannot control its nominal money stock and that this stock is demand determined hence any independent domestic credit policy intended to change the money stock will be offset by changes in foreign reserves. This hypothesis states that any change in the interest rate differential between countries will lead to an inflow

3. See for example Johnson [50].

or outflow of foreign reserves, neutralizing the desired monetary impact. This requires the interest rate elasticity of international capital flows to be relatively high. As a result of this, such countries cannot escape adjusting to at least the world inflation rate unless they adjust the exchange rate, hence the often heard cries for more flexible exchange rates to achieve greater autonomy.

There is an alternative hypothesis that questions whether the interest rate elasticity of international capital flows is high enough to deny countries their independence in money stock determination. This requires that the capital inflow from an increase in domestic interest rates is smaller than the reduction in the monetary base caused by the interest rate policy.

The question of which hypothesis is true seems to be an empirical question.

An adequate explanation of the monetary base must explain

(i) the current account;

(ii) the capital account; and

(iii) the government deficit.[4]

A substantial study of (i) and (ii) has been recently undertaken by Norman [67]. As pointed out by Norman the recent literature, especially the monetary theory of the balance of payments,

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4. What in fact is needed is an explanation of the Reserve Bank's holdings of government securities which if this is a residual item means an explanation of the deficit and the non-Reserve Bank's sector's holdings of government securities. The first is considered here and the latter is discussed in Sections (4.4), (4.5) of Chapter IV.

has stressed that trade and capital flows are a part of a general international adjustment process. However, in Australia most studies of the balance of trade have not fallen within the framework.

"The studies which have analysed imports and exports in isolation have not emphasized the role of trade as one of the channels of international adjustment. Most of these studies have been based on the synthesis of the elasticities and absorption approaches, which neglected the role of price linkages in the international adjustment process ... The single equation stock and flow adjustment explanations of international capital movement are also limited by their focus on only one channel of international adjustment. The flow adjustment model is similar to the elasticities - absorption explanation of trade, in that it attempts to explain capital flows as independent phenomena. The stock adjustment model recognises that international capital flows are but a manifestation of more fundamental adjustments to the world system. However, both approaches neglect the price channel of adjustment, as they assume that international interest rate differentials move exogenously, and ignore the other quantity linkages."

The balance of payments constraint can be written as

$$\Delta GFE = (X\$ - I\$) + TC\$$$

$$= P_x . x - P_i i + TC\$$$

where ΔGFE is change in gold and foreign exchange,

x is real exports,

P_x is the price of exports

i is real imports, and

P_i is the price of imports

TC$ is capital inflow

The first two terms consist of the current account items, that is exports and imports of goods and services. The second term consists of the capital account which is the net change in foreign liabilities and foreign assets. Changes in these last two items reflect direct investment in real assets, portfolio investments in long-term financial assets, and investments in short-term financial assets.

A suitable explanation of the balance of payments constraint requires an explanation that falls within the international linkage approach. In the system presented exports and export prices are determined endogenously, imports are linked with the determination of output and also linked with the Caton and Higgins [24] framework of interrelating inventories and imports. Import prices are given exogenously. Equations for capital flows are discussed in sections (4.4) and (4.5) with the portfolio behaviour of the money multiplier. This is because the portfolio constraints discussed in Chapter I link capital flow decisions with the other portfolio decisions made by the private sectors.

Econometric work with exports in Australia has consistently proved unrewarding even when considerable disaggregation has been used. This is especially true in forecasting. Consequently, exports are often made exogenous. In this study, however, the proposed export, export prices and import equations are based on those presented by Jonson, Moses, and Wymer [52] is a study of the Australian economy. In their model changes in real exports are the result of two adjustment disequilibrium terms and an exchange rate expectations term. The export equation is given by equation (4.1), that is

$$D\log x = \alpha_1(\log \hat{x}^d - \log x) + \alpha_2(\log \hat{x}^s - \log x) + \beta_1 QE \qquad \ldots(4.1)$$

where x is real exports, $\hat{x}^d$ refers to desired demand for exports, $\hat{x}^s$ refers to desired supply of exports, and QE is exchange rate expectations.

Desired demand and supply functions for exports are given by

$$\log \hat{x}^d = \log x_o + \log x_w + \beta_2 \log(P_x/EP_w) \qquad \ldots(4.2)$$

$$\log \hat{x}^s = \log x_o' + \beta_3 t + \beta_4 \log(P_x/P) \qquad \ldots(4.3)$$

where x_o and x_o' are constants; x_w is world exports; P_x is the price of exports in \$A; P_w is world prices in \$US; E is the exchange rate; t is time; and P is the domestic output price.

The first disequilibrium term in equation (4.1) suggests that changes in exports are the result of disequilibrium between the desired demand for exports and actual exports. Desired demand for exports is determined by world demand, in this case proxied by world trade measured as world exports, and relative prices. The competitiveness of Australian exports is captured by the price of Australian exports relative to world prices.

It is probably unrealistic to think that has a horizontal supply of exports function, and consequently the disequilibrium between the desired supply of exports and actual exports also leads to changes in exports. The desired supply of exports is a function of time, and relative prices. In $\hat{x}^s$ the relative price term is the price of exports relative to the domestic price level. This suggests that producers of tradeable goods are price sensitive in regard to which market they supply. If there is a movement in relative prices in favour of the domestic economy then more output is directed to this market.

The third term in equation (4.1) is a dummy variable representing exchange rate expectations. This term suggests that flows of commodities as well as capital are sensitive to possible exchange rate changes. If a devaluation is expected then this will encourage exporters to hold off exporting until after the expected devaluation.

The equation for export prices is given by

$$D\log P_x = \alpha_3(\log \hat{P}_x - \log P_x) + \beta_5 \log(^P/EP_w) + \beta_6 QE \quad \ldots(4.4)$$

where

$$\log \hat{P}_x = \log E.P_i \quad \ldots(4.5)$$

Changes in export prices are related to the dis-equilibrium between world prices ($\log \hat{P}_x = \log E.P_i$) and actual export prices. In the long run export and import prices must be equal and so export prices adjust to world import prices (expressed in \$A) with a simple first order adjustment process. The second term in equation (4.4) suggests that changes in the cost structure of Australian production has a direct effect on export prices making Australian prices less competitive. QE again captures the role of exchange rate expectations.

In the Caton and Higgins study of imports the linkages between imports and inventories are stressed. Inventories play the role of a buffer asset for firms. This asset allows firms to meet unexpected demand fluctuations without costly adjustments. A discrepancy between actual and desired inventories will therefore signal to decision makers the need for changes in production, imports or pricing policy. In a similar fashion imports and domestic production are related as they together form new aggregate supply which is required to meet demand. Any deficiency between aggregate demand and supply is cushioned by the buffer asset stocks.

This suggests that there is a close interrelationship between the imports function, the domestic output function and inventories. These relationships are set out as

$$D\log i = \alpha_4(\log \hat{i} - \log i) + \beta_7(\log \hat{v} - \log v) \qquad \ldots(4.6)$$

$$D\log y = \alpha_5(\log \hat{y} - \log y) + \beta_8(\log \hat{v} - \log v) \qquad \ldots(4.7)$$

where

$$\log \hat{i} = \log \left[i_o \left(\frac{EP_i(1 + t_3)}{P} \right)^{\beta_9} e^{\beta_{10} QE} \right] .S \qquad \ldots(4.8)$$

$$\log \hat{y} = \log \left[1 - i_o \left(\frac{EP_i(1 + t_3)}{P} \right)^{\beta_9} e^{\beta_{10} QE} \right] .S \qquad \ldots(4.9)$$

$$S = d + DK + DKg + x + g \qquad \ldots(4.10)$$

$$\log \hat{v} = v_o S \qquad \ldots(4.11)$$

where v is stocks (inventories) and t_3 is an effective tariff rate.

Changes in imports are the result of a partial response of imports to desired imports and the gap between desired and actual inventories. Desired imports are a proportion of sales (S) where sales is the sum of household expenditure (d), private investment (DK), public investment (DKg), exports (X), and government current expenditure (g).

The proportion of sales that are met by imports is a function of relative prices; the Australian value of exogenously world determined import prices relative to domestic prices. Relative prices are also a function of an effective tariff rate (t_3). Like exports, imports are also a function of exchange rate expectations: an expected devaluation leading importers to postpone importing until after the devaluation.

Changes in output are a function of the discrepancy between desired and actual output, and desired and actual inventories. Desired output is a proportion of sales, the proportion being one less the proportion of desired aggregate supply met by desired imports. Desired inventories are a simple function of sales. Equations (4.6) and (4.7) show that the discrepancy between actual and desired inventories (which has arisen to cushion some unexpected disequilibrium) has to be made up from either domestic production or imports.

The government's cash flow deficit can be written as

$$CFD = [D(P.Kg) + P_g.g + P_g.ycb + f(r, r_{-1}, \ldots r_{-n}, GS, GS_{-1}, \ldots GS_{-n})] - \left[T_1 + T_2\right] \qquad \ldots(4.12)$$

That is, the cash flow deficit is equal to the difference between expenditure, given by the first bracketed term, and revenue, given by the second bracketed term.

Expenditure is equal to government capital expenditure (D(P.Kg) where P is the price of output, and Kg is the real government capital stock, and D is the differential operator; government current expenditure (Pg.g where Pg is the price of government expenditure, and g is the real value of government current expenditure), government cash benefits (Pg.ycb, where ycb is real cash benefits), and interest payments on government debt $(f(r_i, GS_i))$, that is interest payments are a function of the current and past interest rates r_i, and the current and past outstanding supply of government bonds (GS_i).

Government revenue is comprised of income taxes (T_1) and expenditure taxes (T_2). Income taxes comprise payments of PAYE personal income tax, payments of non-PAYE personal income tax, and payments of company taxes. Expenditure taxes comprise various indirect taxes, customs duties, sales taxes, and payroll taxes.

Given the nature of government current and capital expenditure it has become common practice to treat real government expenditure items as exogenous. Standard procedure is, however, to estimate the price of output (P) and government prices (Pg).

In the Jonson et al model the price of output is given by

$$D\log P = \alpha_6(\log \hat{P} - \log P) + \beta_{11}(\log \hat{v} - \log v) + \beta_{12}(\log \hat{m} - \log {}^{M}/P) \qquad \ldots(4.13)$$

where

$$\log \hat{P} = \log \frac{wL}{y} \qquad \ldots(4.14)$$

$$\log \hat{M} = m_o + \log y + \beta_{13} \log r + \beta_{14} \log r_w + \beta_{15}{}^{QE} + \beta_{16}(EP_{w/P}) \qquad \ldots(4.15)$$

Equation (4.13) suggests that changes in prices result from prices adjusting towards equilibrium prices which are determined by unit labour costs (where w is wages, L is labour demand, and y is output). Changes in prices are also assumed to depend on the disequilibrium in the goods market ($\log \hat{v} - \log v$), and the money market ($\log \hat{m} - \log {}^{M}/P$). Disequilibrium in the goods market was discussed above. In that discussion the buffer role of inventories was stressed and that the disequilibrium between desired and actual inventories signalled the need for change for example in pricing policies. The disequilibrium in real money balances also plays a similar buffer and signalling role. Desired money balances are a function of income (y), domestic and foreign interest rates (r, r_w), and exchange rate expectations captured by QE as discussed above and by $\log EP_{w/P}$ which indicates that in the long run purchasing power parity must hold.

The equation for government prices is given by

$$D\log Pg = \alpha_7(\log \hat{P}g - \log Pg) \qquad \ldots(4.16)$$

where

$$\log \hat{P}g = \log P + \log y/_L \qquad \ldots(4.17)$$

This suggests that the desired price of government goods is equal to the costs of any inputs plus the marginal product of labour, that is, there is no value added by the government. Changes in government prices are therefore the result of prices partially adjusting to this desired level.

The equations for tax revenue are:

$$D\log T_1 = \alpha_8(\log \hat{T}_1 - \log T_1) \qquad \ldots(4.18)$$

where

$$\log \hat{T}_1 = T_{01} + \log t_1 + \log (P.y) \qquad \ldots(4.19)$$

and

$$D\log T_2 = \alpha_9(\log \hat{T}_{21} - \log T_2) + \alpha_{10}\log(\hat{T}_{22} - \log T_2) \qquad \ldots(4.20)$$

where

$$\log \hat{T}_{21} = T_{02} + \log t_2 + \log P.d \qquad \ldots(4.21)$$

$$\log \hat{T}_{22} = T_{03} + \log t_3 + \log EP_i . i \qquad \ldots(4.22)$$

T_1 is income taxes and t_1 is the exogenously given income tax rate which operates on the tax base given by nominal output $(P.y)$. T_2 is expenditure taxes; T_{21} refers to expenditure taxes based on private sector expenditure such as sales tax, t_2 is the exogenously given expenditure tax rate which operates on the tax base given by nominal private consumption expenditure $(P.d)$. T_{22} refers to customs duties, t_3 is an effective tax rate which operates on the tax base given by the nominal value of imports expressed in Australian dollars $(EP_i.i)$.

Both equations for tax receipts are modelled simply as adjusting towards tax payable.

An approximation to interest payments on debt is to assume that such payments are a function of the current interest rate and the current level of bonds held by the non-bank public. That is

$$f(r.GS_{NBP}) \qquad \ldots(4.23)$$

This requires an explanation of the interest rates and the non-bank private sector's holdings of government debt. The latter is explained in Section (4.4) on the endogenous behaviour of the non-bank private sector.

Jonson et al explains the interest rate by a government reaction function which takes the following form

$$\begin{aligned} D\log r = {} & \alpha_{10}(\log r^{o} - \log r) + \beta_{17}\log\,(^{GFE}/M3) \\ & + \beta_{18}(\log\,^{L}/N) + \beta_{19}\log(^{M3}/M3{*}e^{\lambda t}) + \beta_{20}\,QS \end{aligned} \qquad \ldots(4.24)$$

where r^{o} is an empirically determined constant steady state equilibrium interest rate; L and N are labour demand and supply respectively; $M3^{*}e^{\lambda t}$ is the volume of money if money had grown at its steady state growth rate (λ) starting from an initial position of equilibrium ($M3^{*}$); QS is dummy variable to account for the very sharp rise in interest rates during the recent credit squeeze.

This suggests that the interest rate adjusts towards its equilibrium rate but modified by disequilibrium in the financial market as measured by the discrepancy between the actual volume of money and the steady state trend volume of money. Also the ratio of gold and foreign exchange relative to the money stock, and the ratio of labour demand to supply capture the traditional assignment decision problem relating to external balances and full employment.

(4.3) Distribution of the Monetary Base

The previous section examined the endogenous determination of the monetary base from the sources definition. Equation (2.12) of Chapter II showed that the base must be held by either

(i) the non-bank public in the form of currency;

(ii) the saving banks in the form of currency or deposits with the Reserve Bank; or

(iii) the trading banks also in the form of currency or deposits with the Reserve Bank.

Given that the base has been derived from the sources definition how is its distribution amongst the users of the base decided? The majority of studies of the money supply process only consider one side of the balance sheet, that is, the asset side of the non-bank private sector or alternatively the liability side of the banks. In Section (4.2) above the source of the monetary base was derived. By considering the other side of the balance sheets usually neglected it can show how this source base is distributed. That is, how the base is split into its various uses.

This analysis is carried out by the use of what are usually called bank credit multipliers. However, it is probably more appropriate to call them earning asset multipliers of the various financial intermediaries. Given that the liability side of the banks can be considered in a multiplier-base framework, then so must the asset side of the banks balance sheet.

The analysis states that the banks earning assets are equal to an earning asset multiplier times the adjusted monetary base. An expression for earning assets, EA, (net of capital accounts) could be obtained for trading banks, savings banks and non-bank financial intermediaries by using the following method

$$EA = \text{Major Liabilities} - \text{Other non-earning assets} \qquad \ldots(4.25)$$

Given EA and the monetary base, B, an earning asset multiplier, "k" is derived which links EA and B, that is,

$$EA = k\ B \qquad \ldots(4.26)$$

The banks can be considered to have to supply earning assets equal to EA and this must equal the demand for earning assets by the public (in the form of advances) and by the banks themselves in their balanced portfolio behaviour (in the form of earning assets acting as reserves, for example government securities). Thus earning assets can be considered as the sum of a government securities item and a loan item. The earning asset multiplier, k, will therefore be comprised of parameters representing the portfolio behaviour of the public, the banks and any restrictions imposed on portfolio behaviour by the Reserve Bank.

The usual definition of non-earning assets of the banks is banks reserves, and these were defined in Chapter III as cash and non-interest bearing deposits of the banks with the central bank. However, in Chapter III reserves were defined so as to include some earning assets. Therefore earning assets are equal to the major liabilities of banks less the non-earning asset component of reserves. The earning asset multipliers for the banks can now be derived.

(i) Savings Banks

$$EASB = DEPS - [SBRES - (GSSB + LSGSSB + DSBRD)] \quad \ldots(4.27)$$

Equation (4.27) states that the earning assets of the savings banks are equal to savings banks' major liabilities (DEPS) less non-earning assets which in general are the savings banks' reserves. However, as noted above, reserves where defined to include some earning assets, for example, government securities -

$\lambda_{GSSB}.DEPS$, $\lambda_{LSGSSB}.DEPS$, and deposits with the Reserve Bank (DSBRD). Thus, savings banks' reserves are adjusted for the components that are earning assets (GSSB + LSGSSB + DSBRD).

Therefore,

$$EASB = DEPS - [SBRES - (GSSB + LSGSSB + DSBRD)]$$

$$= DEPS - [SBRQRES + SBXRES - (GSSB + LSGSSB + DSBRD)]^{5,6} \quad \ldots(4.28)$$

$$= DEPS - [.5DEPSCP + r.DEPS - (\lambda_{GSSB}DEPS + \lambda_{LSGSSB}DEPS + \phi DEPS)] \quad \ldots(4.29)$$

$$= pDEPC - [.5p\bar{m}DEPC + rpDEPC - (\lambda_{GSSB} + \lambda_{LSGSSB} + \phi)pDEPC] \quad \ldots(4.30)$$

$$= [p - .5p\bar{m} - rp + (\lambda_{GSSB} + \lambda_{LSGSSB} + \phi)p]DEPC \quad \ldots(4.31)$$

$$= p(1 - .5\bar{m} - r - \lambda_{GSSB} - \lambda_{LSGSSB} - \phi)DEPC \quad \ldots(4.32)$$

now $DEPC = \frac{B^a}{Y}$

thus $$EASB = \frac{p(1 - .5\bar{m} - r - \lambda_{GSSB} - \lambda_{LSGSSB} - \phi)B^a}{Y} \quad \ldots(4.33)$$

---

5. Let $\frac{DSBRD}{DEPS} = \phi$ i.e. $DSBRD = \phi\ DEPS$

   i.e. the ratio of Savings Banks' deposits with the Reserve Bank and their main liability DEPS.

6. An alternative is to let (SBRES - GSSB - LSGSSB - DSBRB) = NCSB.
   Therefore
   $$EASB = DEPS - NCSB$$
   $$= (p - \bar{p}p)DEPC$$
   $$= p(1 - \bar{p})DEPC$$
   $$= \frac{p(1 - \bar{p})B^a}{Y"}$$

   where $\bar{p} = NCSB/DEPS$

(ii) Trading Banks

The same procedure as above can be used for the trading banks to give

$$EATB = DEPC + DEPF - [TBRES - (GSTB + LSGSTB)] \quad ...(4.34)$$

$$= DEPC + DEPF - [(TBXRES + TBRQRES) - (GSTB + LSGSTB)] \quad ...(4.35)$$

$$= DEPC + DEPF - [(TBXRES + SRD + LGSREQ) - (GSTB + LSGSTB)] \quad ...(4.36)$$

$$= DEPC + fDEPC - [(e + sw + \partial w)(1 + f)DEPC - (\alpha_1 + \alpha_2)(1 + f)DEPC] \quad ...(4.37)$$

$$= \{(1 + f)[1 - (e + sw + \partial w) + (\alpha_1 + \alpha_2)]\} DEPC \quad ...(4.38)$$

$$= \frac{\{(1 + f)[1 - (e + sw + dw) + (\alpha_1 + \alpha_2)]\}}{Y'} B^a \quad ...(4.39)$$

(4.4) Endogenous Aspects of the Money Multiplier - Derivation of Portfolio Constraints

As was shown in Chapter III the multiplier is a complex function of various proximate parameters which reflect the asset portfolio decisions of economic units. At any point in time these parameters have a particular numerical value which when combined with each other determine a numerical value for the multiplier. When this value of m is multiplied by the value of the adjusted base at that same point in time the result is the money supply. This is definitional.

However, these "point" values of the parameters and hence the multiplier are not necessarily equilibrium values.

For example

$$NCNBP = C.DEPC \qquad ...(4.40)$$

states that at any point in time, c is equal to the ratio of notes and coin, held by the non-bank private sector to their holdings of current deposits. However, this may not be the ratio that the private sector desires to hold given the prevailing interest rate, other rates of return, the inflation rate etc. If the point values are not desired ratios then a portfolio adjustment process is envoked which results in possibly all economic units attempting to rearrange their portfolios to achieve equilibrium.

As the system is not in continuous equilibrium some dynamic adjustment process must be formulated in which the disequilibrium point values of the proximate determinants are adjusted to their desired levels. Without resorting to models of intertemporal behaviour for all economic units the possible adjustment mechanisms reduce to

(i) the simple stock adjustment model; or

(ii) the generalised or multivariate stock adjustment model.

The multivariate stock adjustment model was developed in the belief that the univariate model neglected important cross-adjustment feedback effects. The multivariate stock adjustment model can also be conceived of as being derived from the solution of an intertemporal decision making process (see for example Purvis [78]). This generalisation allowed the short-run behaviour of economic units resulting from some disturbance to equilibrium to be different to the behaviour in the medium and longer run. This multivariate stock adjustment framework appears to be confirmed by the estimating forms derived from intertemporal behaviour models.[1]

However, recent work by Cooper[2] has suggested that the optimal behavioural path can be approximated by the univariate model. However, there does appear to be some peculiarities to this adjustment process as were discussed in Chapter I. Jonson et al's [45] model of the Australian Economy uses basically a univariate stock adjustment model with the addition of the disequilibrium in one or two other central assets in several equations; for example, disequilibrium in money balances and inventories influencing prices, wages, expenditure, output and imports. These additional asset disequilibriums are used due to the special role they play as buffer stocks which cushion disequilibrium elsewhere in the model and act as signalling devices. The specification of the adjustment mechanism is thus open to some debate. The procedure to be used in this section is the multivariate model.

As was discussed in Chapter I the desired demand for assets can be made homogeneous in terms of demand deposits. The procedure followed however is not simply to replace W_t (wealth) in equation (1.1) by $DEPC_t$ (current deposits). The reason for

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1. See for example, Parkin et al [72].

2. Cooper, R.J. [29].

this is that various balance sheet constraints need to be imposed and these often relate to wealth. Wealth must still enter the equation if these various balance sheet restrictions relating to wealth are to be imposed. The model developed here is therefore slightly different in structure to that used to describe Tobin's model in Chapter I.

Net worth can be held in the form of n assets (liabilities can be considered as negative assets). The assumption of dichotomising the savings and wealth allocation decisions is continued in the same manner as Tobin's total wealth is predetermined by the savings decision. Consequently only (n - 1) of the asset choices are independent which allows for one of the asset functions to be considered as a residual.

The n desired asset functions can be written as

$$\hat{y}_t = BX_t . D_t \qquad \ldots(4.41)$$

where $\hat{y}_t$ is a n x 1 vector of desired asset demands; B is a n x (n + 3) matrix of structural coefficients; X_t is a (n + 3) x 1 vector of explanatory variables consisting of a constant, n interest rates, income, and the ratio of wealth to deposits; D_t is $DEPC_t$. Equation (4.41) comprises of n equations of the form

$$\hat{y}_{i,t} = \sum_{j=1}^{n+3} \beta_{ij} X_j, \quad i = 1,\ldots,n \qquad \ldots(4.42)$$

Because wealth is predetermined there is an exanti and an expost restriction to be met. Firstly

$$r' \hat{y}_t = W_t \qquad \ldots(4.43)$$

is the exanti condition. Secondly,

$$r' \, y_t = W_t \qquad \ldots(4.44)$$

That is, desired and end of period actual holdings of assets y_i, must sum to wealth (W_t).r' is a 1 x n vector in which each element is equal to unity and y_t is the vector of actual holdings of the n assets.

From (4.43) and (4.41)

$$r'\hat{y}_t = r'BX_t . D_t = W_t \qquad \ldots(4.45)$$

$$= [\beta_{ij}]_{\substack{i=1,\ldots n \\ j=1,\ldots n+3}} \cdot \begin{bmatrix} 1 \\ r_1 \\ \vdots \\ r_w \\ y \\ W/D \end{bmatrix}_t \cdot D_t = W_t \qquad \ldots(4.46)$$

$$= [\beta_{ij}]_{\substack{i=1,\ldots,n \\ j=1}} \cdot [1] \cdot D_t$$

$$+ [\beta_{ij}]_{\substack{i=1,\ldots n \\ j=2,\ldots n+2}} \cdot \begin{bmatrix} r_1 \\ \vdots \\ r_n \\ y \end{bmatrix}_t \cdot D_t$$

$$+ [\beta_{ij}]_{\substack{i=1,\ldots n \\ j=n+3}} \cdot [W/D]_t \cdot D_t \qquad \ldots(4.47)$$

By considering arbitrary variations in the exogenous variables the following n + 3 constraints on the coefficients can be derived.

$$r'[\beta_{ij}] = 0 \qquad j = 1,\ i = 1,\ldots,n \qquad \ldots(4.48)$$

$$r'[\beta_{ij}] = 0 \qquad j = 1,\ldots,n+2 \qquad \ldots(4.49)$$
$$i = 1,\ldots,n$$

$$r'[\beta_{i,n+3}] = 1 \qquad i = 1,\ldots,n \qquad \ldots(4.50)$$

These restrictions imply that the constant terms summed over all the equations equal zero, i.e. $\sum_i \beta_{ij} = 0, \quad j = 1.$ This is different to the model discussed in Chapter I, where the constants summed to unity. This change is a result of changing the variable in which the equations are homogeneous. Secondly, the coefficients of any interest rate or income term must sum across equations to zero. Thirdly, a change in wealth must be distributed across the various assets.

As the system is not in continuous equilibrium a dynamic adjustment system must be imposed.

> "No one seriously believes that either the economy as a whole or its financial subsector is continuously in an equilibrium. Equations like the ones described above do not hold every moment of time. Consequently, analysts and policy-makers can hope to receive no more than limited guidance from comparative static analysis of the full effects of 'changing' exogenous variables, including the instruments of policy. They need to know also the laws governing the

system in disequilibrium." Brainard and Tobin [13], p.105 .

The dynamic adjustment process is the same as that given in equation (1.5) of Chapter I, that is, a multivariate stock adjustment model.[3] That is,

$$y_t - y_{t-1} = A(\hat{y}_t - t_{t-1}) + \partial_{\Delta W}\Delta W_t \qquad \ldots(4.51)$$

where $A = [\alpha_{h,g}]$; $h,g = 1,\ldots,n$ is a matrix of adjustment terms which measure the impact of disequilibrium elsewhere in the model on a particular asset. $\partial_{\Delta W}$ is a vector which gives the proportions of a net change in wealth that are held in the form of each asset.

Equation (4.51) can be rewritten as

$$\Delta y_t = A\hat{y}_t - Ay_{t-1} + \partial_{\Delta W}\Delta W_t \qquad \ldots(4.52)$$

that is

$$\Delta y_t = A[BX_t \cdot D_t] - Ay_{t-1} + \partial_{\Delta W}\Delta W_t \qquad \ldots(4.53)$$

$$= [AB]X_t \cdot D_t - Ay_{t-1} + \partial_{\Delta W}\Delta W_t \qquad \ldots(4.54)$$

$[AB] = [\alpha_{i,j}]$ is the matrix of the full model impact multipliers of a change in an explanatory variable.

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3. To be truly in the money multiplier - monetary base framework vein the dynamics could be specified in terms of ratios with the denominator being demand deposits. Equation (4.41) could be re-written as

$$(\hat{y}/_D)_t = BX_t$$

and then $y/_D$, $\hat{y}/_D$ and $\Delta(W/_D)$ would replace y, $\hat{y}$ and ΔW in equation (4.51). Exactly the same restrictions as derived below are implied.

It can also be seen that a Tobin style specification of desired asset holdings can be assumed, that is

$$\hat{y} = BX_t$$

where wealth is an explanatory variable in X_t, for example, and a multiplier adjustment process incorporated. Thus the dependent variables can relate to ratios rather than levels. This then makes the analysis similar to studying the savings ratio for example.

Now,

$$\Delta W_t = W_t - W_{t-1} \qquad \ldots(4.55)$$

$$= W_t - r'y_{t-1} \qquad \ldots(4.56)$$

Therefore,

$$\Delta y_t = [\tilde{AB}]\tilde{X}_t.D_t + [\alpha_{n,n+3}][W/_D]_t.D_t - Ay_{t-1}$$

$$+ \partial_{\Delta W}[W_t - r'y_{t-1}] \qquad \ldots(4.57)$$

$$= [\tilde{AB}]\tilde{X}_t.D_t + [\alpha_{n,n+3} + \partial_{\Delta W}].W_t$$

$$- [A + \partial_{\Delta W}r']y_{t-1} \qquad \ldots(4.58)$$

where $[\tilde{AB}] = [\tilde{\alpha}_{ij}]$ and $\tilde{X}$ are the same as $[AB]$ and X except the terms relating to $W/_D$ have been excluded, that is, the $(n + 3)$th column of $[AB]$ and the $(n + 3)$th row of X are excluded.

Adding y_{t-1} to both sides of (4.58) gives

$$y_t = [\tilde{AB}]\tilde{X}_t.D_t + [\alpha_{n,n+3} + \partial_{\Delta W}].W_t$$

$$+ [I_n - A - \partial_{\Delta W}r']y_{t-1} \qquad \ldots(4.59)$$

Again considering change in the exogenous variables the following restrictions are derived.

(i) $r'\,[\alpha_{ij}] = 0, \quad j = 1,\ldots,n + 2$ ...(4.60)

(ii) $r'\,[\alpha_{n,n+3} + \partial_{\Delta W}] = 1$ ...(4.61)

(iii) $r'\,(I_n - \partial_W r') = r'A$ ...(4.62)

Equation (4.60) suggests that the impact multipliers of an explanatory variable other than wealth must sum to zero across all equations. Equation (4.61) suggests that the effect of a change in wealth is to lead to possibly changes in all asset holdings to take up that increase. The third restriction given by (4.62) implies that the column sums of the adjustment matrix (A) are a constant.

The analysis so far in this section has conclusively shown that the money multiplier-monetary base framework can be formulated in such a way that the portfolio restrictions, similar to those derived from Tobinesque models, can be imposed. Thus the second of the major criticisms of this approach has been shown to be unjustified. The first, that the monetary base is treated as exogenous has been shown to be false in Section (4.2).

(4.5) Endogenous Aspects of the Money Multiplier - Behaviour of the Non-Bank Private Sector

The multiplier derived in Chapter III has three proximate determinants that are derived from the behaviour of the non-bank public. The three allocation parameters are the currency ratio(c), the fixed deposit ratio (f), and the savings deposit ratio (p). Section (4.4) has shown that these allocation decisions have to be related to all other assets into which wealth is allocated if portfolio restrictions are to be imposed correctly.

Table 4.1 sets out a balance sheet for the non-bank private sector. If it is assumed that net worth, foreign liabilities and other assets are given exogenously then the allocation problem is to distribute $NW_p + FL_p - OA_p$ amongst the

TABLE 4.1

BALANCE SHEET OF THE NON-BANK PRIVATE SECTOR*

LIABILITIES			ASSETS		
Net Worth	NW_p		Currency	NC_p	(r_C)
Foreign Liabilities	FL_p		Government securities	GS_p	(r_B)
Advances from Trading Banks	A_{TB}	(r_{AT})	Local and Semi-Government Securities	$LSGS_p$	(r_L)
Advances from Savings Banks	A_{SB}	(r_{AS})	Current Deposits	D	(r_D)
			Fixed Deposits	DEPF	(r_F)
			Savings Deposits	DEPS	(r_P)
			Real Consumer Assets	Z	(r_{Z})
			Real Capital (including equities)	K	(r_K)
			Foreign Assets	FA_p	(r_W)
			Other Assets	OA_p	

*Bracketed items are the rates of return on the various assets and liabilities.

nine alternative assets and two liabilities.[4] Foreign liabilities can be considered exogenous in the sense that foreigners in their allocation decision choice will determine what they want to invest in foreign assets.

The desired currency, fixed deposit and savings deposit ratios can be written as

$$\hat{C} = \hat{NCp}/_D = \beta_{10} + \beta_{11}r_c + \beta_{12}r_B + \beta_{13}r_L + \dots + \beta_{19}r_w + \beta_{1,10}r_{AT} + \beta_{1,11}r_{AS} + \beta_{1,12}(NW_p + FL_p - OA_p) \quad \dots(4.63)$$

$$\hat{f} = \hat{DEPF}/_D = \beta_5 0 + \beta_5 1r_c + \beta_5 2r_B + \beta_5 3r_L + \dots + \beta_5 9r_W + \beta_5 10r_{AT} + \beta_5 11r_{AS} + \beta_5 12(NW_p + FL_p - OA_p) \quad \dots(4.64)$$

$$\hat{p} = \hat{DEPS}/_D = \beta_6 0 + \beta_6 1r_C + \beta_6 2r_B + \beta_6 3r_L + \beta_6 9r_W + \beta_6 10r_{AT} + \beta_6 11r_{AS} + \beta_6 12(NW_p + FL_p - OA_p) \quad \dots(4.65)$$

These three equations are part of the general system

$$\hat{\tau} = \hat{Yi}/_D = BX_t = [\beta_{ij}] \begin{bmatrix} 1 \\ \underline{r} \\ NW_p^* \end{bmatrix} \quad \dots(4.66)$$

where $\underline{r}$ is the vector of interest rates, $\underline{r}' = [r_C, r_B, r_L \dots r_W, r_{AT}, r_{AS}]$, Y_i's are the various assets (liabilities) and $NW_p^* = NW_p + FL_p - OA_p$.

4. As FL_p and OA_p are given exogenously and if it is assumed that changes in them do not alter net worth then a change in either of these items has to lead to an equivalent change elsewhere in the portfolio. Theses changes are therefore similar to changes in wealth. It is possible that $(NW_p + FL_p - OA_p)$ should enter as two or possible three separate terms with the sum of the coefficients on each being the same, but the distribution over assets being different.

These three desired asset demand functions then enter the generalised adjustment process.

$$NC_p - NC_{p,-1} = \alpha_{11}(\hat{NC}_p - NC_{p,-1}) + \alpha_{12}(\hat{GS}_p - GS_{p,-1})$$
$$+ \alpha_{13}(\hat{LSGS}_p - LSGS_{p,-1}) + \ldots + \alpha_{1,11}(\hat{A}_{SB} - A_{SB,-1})$$
$$+ \partial_{\Delta W,1}\Delta(\hat{NW}_p + FL_p - OA_p) \qquad \ldots(4.67)$$

$$DEPF - DEPF_{-1} = \alpha_{51}(\hat{NC}_p - NC_{p,-1}) + \alpha_{52}(\hat{GS}_p - GS_{p,-1})$$
$$+ \ldots + \alpha_{5,11}(\hat{A}_{SB} - A_{SB,-1}) + \partial_{\Delta W,5}\Delta(NW_p + FL_p - OA_p)$$
$$\ldots(4.68)$$

$$DEPS - DEPS_{-1} = \alpha_{61}(\hat{NC}_p - NC_{p,-1}) + \alpha_{62}(\hat{GS}_p - GS_{p,-1})$$
$$+ \ldots + \alpha_{6,11}(\hat{A}_{SB} - A_{SB,-1}) + \partial_{\Delta W,6}\Delta(NW_p + FL_p - OA_p)$$
$$\ldots(4.69)$$

Again these are part of the generalised system

$$y_i - y_{i,-1} = A[\hat{y}_i - y_{i,-1}] + \partial_{\Delta W}\Delta(NW_p + FL_p - OA_p) \qquad \ldots(4.70)$$

where $A = [\alpha_{ij}]$ is the matrix of adjustment coefficients and $\partial_{\Delta W}$ is the vector of change in wealth effects. The constraints derived in the previous section in equation (4.48), (4.49), (4.50), (4.60), (4.61) and (4.62) must also hold for equations (4.66) and (4.70) above.

Given that exogenously determined "wealth" $(NW_p + FL_p - OA_p)$ has to be distributed between the nine assets and two liabilities, then one of these assets (or liabilities) can be considered as a residual. The choice of the residual asset is quite arbitrary but as was discussed in Chapter II with regard to financing the government deficit some one item may be a true residual. The ideal choice of the residual item is the buffer asset of the non-bank private sector. This is most likely to be demand deposits. This choice of deposits as the residual would also be advantageous in that it would check the consistency of the model as once the source base is given, demand deposits can be derived from the base.

(4.6) Endogenous Aspects of the Money Multiplier - Behaviour of the Banking Sector

Portfolio behaviour of the banking sector can be divided into two sections. The first relates to savings banks' behaviour, while the second relates to trading banks' behaviour.

Considering saving banks' behaviour first, their major source of earning asset funds is savings deposits which are exogenously given to the banking sector as they are determined by the portfolio behaviour of the non-bank private sector. The balance sheet for saving banks was given in Table 3.2 of Chapter III. If saving banks net worth (SBCR), other liabilities (SBOL) and other assets (SBOA) are considered as exogenous, then changes in savings deposits have to be allocated to the following earning assets: deposits with the Reserve Bank - DSBRB; Australian Government Securities - GSSB; Local and Semi Government Securities - LSGSSB; Net Foreign Assets - SBNFA; and Loans and Advances - SBLA (= SBLASTMM + SBLAO) and non-earning assets - currency held by savings banks - NCSB.

Savings banks are required to keep 7% of savings deposits as basically deposits with the Reserve Bank. Therefore the savings banks have

$$DEPS - .07\ \bar{m}\ DEPS + SBCR^* \qquad \ldots(4.71)$$

to allocate to NCSB, $(DSBRB - .07\ \bar{m}\ DEPS)$, GSSB, LSGSSB, SBNFA and SBLA, where $SBCR^* = SBCR + SBOL - SBOA$. As set out in Chapter III, $\bar{m}$ is the ratio of saving deposits at banks under the control of the Banking Act to total savings deposits. This can be considered an exogenous variable.

The savings banks are also required to hold another 40% of their deposits in the form of Australian or Local and Semi-Government Securities. Therefore

$$GSSB + LSGSSB = [GSSBX + LSGSSBX] + [GSSBREQ + LSGSSBREQ] \qquad \ldots(4.72)$$

$$= [GSSBX + LSGSSBX] + .4\ \bar{m}\ DEPS \qquad \ldots(4.73)$$

where GSSBX, LSGSSBX are saving banks' holdings of securities in excess of their required holdings of these assets (GSSBREQ and LSGSSBREQ). Therefore savings banks have

$$DEPS - .07\ \bar{m}\ DEPS - .4\ \bar{m}\ DEPS + SBCR^*$$

$$= .47\ \bar{m}\ DEPS + SBCR^* = W_S + SBCR^* \qquad \ldots(4.74)$$

to distribute between NCSB, $(DSBRB - .07\ \bar{m}\ DEPS)$, GSSBX, LSGSSBX, SBNFA and SBLA (= SBLASTMM + SBLAO). Equation (4.74) therefore becomes the "wealth" constraint in the savings banks' portfolio decision.

The seven desired asset decisions can be made homogeneous in terms of savings deposits and hence implicitly in terms of current deposits, that is

$$\hat{Y}_i/_{DEPS} = BX_t \qquad \ldots(4.75)$$

where Y_i's are NCSB, (DSBRB - .07 $\bar{m}$ DEPS), GSSBX, LSGSSBX, SBNFA, SBLASTMM, SBLAO. X_t is the vector of explanatory variables, that is, a constant, the vector of interest rates $\underline{r} = r_C$, r_{DSBRB}, r_B, r_L, r_W, r_{ASTMM}, r_{AS}, and SBCR* + W_S. B is a matrix of structural coefficients. The constraints derived in equations (4.48), (4.49) and (4.50) must also hold for matrix B in (4.75).

The dynamics are introduced by again using a multivariate stock adjustment model such that

$$y - y_{-1} = A(\hat{y} - y_{-1}) + \partial_{\Delta W}(SBCR* + W_S) \qquad \ldots(4.76)$$

where y is the vector of assets (liabilities). The constraints derived in equations (4.60), (4.61) and (4.62) must also hold for equation (4.76).

The savings banks have also to determine the distribution of [.4 $\bar{m}$ DEPS] between Australian Government Securities and Local and Semi-Government Securities. This can be done as a portfolio allocation problem as above but with the "wealth" constraint being .4 $\bar{m}$ DEPS with this to be distributed between two assets with only two competing rates of return.

The portfolio behaviour of the banks can be studied in a similar way as the above. Trading banks' major source of earning asset funds are current and fixed deposits which can be considered as predetermined by the non-bank private sector portfolio behaviour. The balance sheet for trading banks was given in Table 3.1 of Chapter III. If it is assumed as it was for savings banks, that trading bank capital and reserves, other liabilities and other assets are exogenously given then demand and fixed deposits have to be allocated to the following non-earning and earning assets - currency (NCTB), Statutory Reserve Deposits (SRD), Term Loan Funds (TLF), Farm Development Fund (FDLF), Other Deposits with the Reserve Bank (ODTBRB), Australian Government Securities (GSTB), Local and Semi-Government Securities (LSGSTB), Net Foreign Assets (TBNFA), Loans and Advances to Short Term Money Market and Others (TBLASTMM + TBLAO). An additional liability which is determined by the trading banks themselves is lender of last resort facilities from the Reserve Bank.

Trading Banks have two main portfolio restrictions imposed on their behaviour by the authorities. Firstly, Trading Banks are required to have with the Reserve Bank Statutory Reserve Deposits which are a given percentage of deposits. Secondly, they must hold another given percentage of deposits in the form of liquid and government securities, that is, the LGS requirement (∂).

As with demand and fixed deposits, Trading Banks Advances (TBLA) are also determined from the portfolio behaviour of the non-bank private sector. If it is also assumed that the Term and Farm Development Loan Funds (TFL and FDLF) are also exogenously given then the Trading Banks have the following to allocate

$$(TBCR + TBOL - TBOA - TLF - FDLF) + DEPC + DEPF - SRD$$

$$- LGSREQ - TBLA \qquad ...(4.77)$$

$$= TBCR* + DEPC + DEPF - SRD - LGSREQ - TBLA \qquad ...(4.78)$$

$$= TBCR* + (1 + f - (S + \partial)(1 + f) - a)\ DEPC \qquad ...(4.79)$$

$$= TBCR* + WT \qquad ...(4.80)$$

where f, S, ∂ and a are defined as

$$f = DEPF/_{DEPC}$$

$$S = SRD/_{(DEPC + DEPF)}$$

$$\partial = LGSREQ/_{(DEPC + DEPF)}$$

$$a = TBLA/_{DEPC}$$

If it is assumed for simplicity that required LGS assets are either held in the form of securities then trading banks' holdings of securities can be divided into excess and required holdings, that is,

$$GSTB + LSGSTB = (GSTBX + LSGSTBX) + (GSTBREQ + LSGSTBREQ) \qquad ...(4.81)$$

$$= (GSTBX + LSGSTBX) + (1 + f)\ DEPC \qquad ...(4.82)$$

The "wealth" constraint given by (4.80) has to be allocated between NCTB, QDTBRB, GSTBX, LSGSTBX, TBNFA, TBLASTMM, TBLAO, and (-RBLOLRF). The eight portfolio decisions can be made homogeneous in terms of demand deposits.

$$\hat{Y}_i/_{DEPC} = BX_t \qquad ...(4.83)$$

where the Y_i's are the assets (liabilities) listed above. X_t is the vector of explanatory variables, that is

$$X' = [1, r_C, r_{ODTBRB}, r_B, r_L, r_W, r_{ASTMM}, r_{AT}, r_{LOLRF}, TBCR* + W_T]$$

B is the matrix of structural coefficients. As with the model for saving bank behaviour the constraints on the matrix B derived in equations (4.48), (4.49) and (4.50) should be imposed in equation (4.83).

Again as with the non-bank public and the savings banks, the dynamics are introduced by using a multivariate stock adjustment model, that is

$$y - y_{-1} = A(\hat{y} - y_{-1}) + \partial_{\Delta W}(TBCR* + W_T) \qquad \ldots(4.84)$$

where y is the vector of assets (liabilities) listed above. The constraints derived in equations (4.60), (4.61) and (4.62) should also be imposed on equation (4.84).

The distribution of $\partial(1 + f)$ DEPC between Australian Government Securities and Local and Semi-Government Securities can be considered as a portfolio allocation problem with $[\partial(1 + f).DEPC]$ as the "wealth" constraint.

In Section (4.2) on the endogenous determination of the monetary base it was mentioned that net capital inflow would be discussed in the sections on the portfolio behaviour of the private sectors. It can be seen by considering the balance sheets of the non-bank private sector (Table 3.3) and the Savings and Trading Banks (Tables 3.1 and 3.2), that net foreign assets appear in each. In deriving the portfolio equations above for the non-bank and banking sectors three endogenous equations (FA_p, TBNFA, SBNFA) and one exogenous variable (FL_p) were proposed. These four variables combine to determine net capital inflow.

CHAPTER V

THE FORMATION TABLE APPROACH TO MONEY STOCK DETERMINATION

(5.1) Derivation of the Formation Table

In Chapter II it was shown how the monetary base can be derived from reorganising the balance sheets of the authorities, these being the Reserve Bank and the Treasury. The "formation table" approach to modelling money stock changes is also based on the reorganisation of balance sheet identities, but this time, not only of the authorities but also the balance sheets of the banking and non-bank private sectors.

The fact that the formation table approach also includes the balance sheets of the banking and the non-bank private sectors means that responses which were earlier distinguished as having their effect via either the monetary base or the money multiplier are now incorporated into a single framework.

All the components of the money stock are liabilities in one of the balance sheets mentioned above. The formation table therefore reorganises the balance sheets so as to group each of these liabilities together. The approach is therefore like the money multiplier-monetary base framework both grounded on accounting identities. Also like the MM-MB framework, these identities imply nothing about causal relationships. To understand the causal relationships the underlying portfolio relationships of each of the items in the balance sheets have to be considered.

In Chapter III the money stock was defined as M_3, that is

$$M_3 = NCNBP + DEPF + DEPS + DEPC - GOVD - INBD$$
$$= NCNBP + DEPF + DEPS + DEPC^* \qquad \ldots(5.1)$$

where

DEPC* = DEPC - GOVD - INBD

NCNBP = notes (NNBP) and coin (CNBP) of the non-bank private sector

DEPF = fixed deposits (including certificates of deposit) with trading banks

DEPS = savings bank deposits

DEPC = current account deposits with trading banks

GOVD = deposits of the government with trading banks

INBD = interbank deposits

Now notes and coin of the non-bank private sector are equal to

$$NNBP = N - NTB - NSB - NRB \qquad \ldots(5.2)$$

$$CNBP = C - CTB - CSB - CRB \qquad \ldots(5.3)$$

that is

$$NCNBP = NC - NCTB - NCSB - NCRB \qquad \ldots(5.4)$$

Therefore

$$M_3 = NC + (DEPC^* + DEPF - NCTB) + (DEPS - NCSB) \qquad \ldots(5.5)$$
$$= N + (DEPC^* + DEPF - NCTB) + (DEPS - NCSB) + C \qquad \ldots(5.6)$$

From the Reserve Bank Balance Sheet

$$\begin{aligned} N = {} & GFE + GSRB + RBLOLRF + RBATGLGD + RBLABDOA + NRB \\ & + CRB - RBCR - SRD - TLF - FDLF - ODTBRB - DSBRB - RBOL \qquad \ldots(5.7) \end{aligned}$$

$$\begin{aligned} = {} & GFE + [GSRB + RBATGLGD] + RBLOLRF + [RBLABDOA \\ & + NCRBA] - [RBCR + RBOL] - SRD - [TLF + FDLF] \\ & - [ODTBRB + DSBRB] \qquad \ldots(5.8) \end{aligned}$$

$$\begin{aligned} = {} & GFE + GSRB + (TB - GDRB) + (RBRCA + RBCB + RBLSTMM \\ & + RBFSG + NRB + CRB + RBOA) - (RBCR + RBOL) - SRD \\ & - (TLF + FDLF) - (ODTBRB + DSBRB) \qquad \ldots(5.9) \end{aligned}$$

From the balance sheet of the Trading Banks

$$\begin{aligned} DEPC^{*} + DEPF - NCTB = {} & SRD + [TLF + FDLF] + [ODTBRB] \\ & + [GSTB + LSGSTB] + TBNFA + RBLA + TBOA - RBLOLRF \\ & - TBOL - TBCR - GOVD - INBD \qquad \ldots(5.10) \end{aligned}$$

From the balance sheet of the Savings Banks

$$\begin{aligned} DEPS - NCSB = {} & [DSBRB] + [GSTB + LSGSSB] + SBNFA \\ & + SBLA + SBOA - SBOL - SBCR \qquad \ldots(5.11) \end{aligned}$$

Summing the left and right hand side of equations (5.8), (5.9), (5.10) and adding coin gives

$$\begin{aligned} M_3 = {} & GFE + [GSRB + TB - GDRB] + RBLOLRF + [RBRCA + RBCB \\ & + RBLSTMM + RBFSG + RBOA + NCRBA] - [RBCR + RBOL] \\ & - SRD - [TLF + FDLF] - [ODTBRB + DSBRB] + SRD \\ & + [TLF + FDLF] + [ODTBRB] + [GSTB + LSGSTB] + TBNFA \\ & + TBLA + TBOA - RBLOLRF - TBOL - TBCR - GOVD - INBD \\ & + [DSBRB] + [GSSB + LSGSSB] + SBNFA + SBLA + SBOA \\ & - SBOL - SBCR + C \qquad \ldots(5.12) \end{aligned}$$

$$
\begin{aligned}
= {} & \text{GFE} && \ldots(5.12.1)\\
& + [\text{GSRB} + \text{GSTB} + \text{GSSB}] + c && \ldots(5.12.2)\\
& + [\text{TB} - \text{GDRB}] && \ldots(5.12.3)\\
& + [[\text{RBRCA} + \text{RBCB} + \text{RBLSTMM} + \text{RBFSG} + \text{RBOA} && \\
& + \text{NCRB}] - [\text{RBCR} + \text{RBOL}]] && \ldots(5.12.4)\\
& + [[\text{LSGSTB} + \text{LSGSSB}] + [\text{TBNFA} + \text{SBNFA}] + [\text{TBLA} && \\
& + \text{SBLA}] + [\text{TBOA} + \text{SBOA}] - [\text{TBCR} + \text{SBCR}] && \\
& - [\text{TBOL} + \text{SBOL}]] - (\text{GOVD} + \text{INBD}) && \ldots(5.12.5)\\
& + c &&
\end{aligned}
$$

The formation table can therefore be written as

<u>TABLE 5.1 THE MONEY STOCK FORMATION TABLE</u>

1.	Reserve Bank Holdings of Gold and Foreign Exchange	(5.12.1)
2.	Government Securities held by the Reserve Bank, banks, and coin	(5.12.2)
3.	Government Cash Position with Reserve Bank	(5.12.3)
4.	Other Reserve Bank Transactions	(5.12.4)
5.	Other Bank Transactions (including advances)	(5.12.5)
6.	Money Stock	(5.1)

There are various versions of this basic formation table, and many of the alternatives are expressed in charge form. Table 5.2 sets out the formation table used for policy analysis by the Reserve Bank of Australia.

Table 5.2 can be verified in the following manner. Item 1 of Table 5.2 corresponds exactly with the change in item 1 of Table 5.1. Government debt (net), item 2 in Table 5.2 was defined in equation (2.31) of Chapter II as the net change in Australian and State Governments' indebtedness to the non-government sectors, that is

$$GDN = DBR + \Delta RBFSG - \Delta GSGOVT^{a} + \Delta C \qquad \ldots(5.13)$$

where DBR is the domestic borrowing requirement defined as

$$DBR = CFD - (\Delta OB + \Delta OFT) = \Delta LR + \Delta TN + \Delta TB - \Delta GDRB \qquad \ldots(5.14)$$

where

CFD is the cash flow deficit

OB is net overseas borrowing

OFT is other financing transactions in Australia

LR is net loan raisings (excludes change in securities on issue due to Special Loans or LCIR cancellations

TN is treasury notes

TB is treasury bills

GDRB is government cash deposits with the Reserve Bank

RBFSG is Reserve Bank Financing of State Governments

GSGOVT is Australian Government's own holdings of debt

$\Delta GSGOVT^{a}$ is $\Delta GSGOVT$ adjusted by adding LCIR cancellations and subtracting Special Loans

C is coin

Equation (5.13) can be re-written as

$$GDN = [\Delta BRB + \Delta TNRB + (\Delta TB - \Delta GDRB) + \Delta RBFSG]$$

$$GDN = CFD - (\Delta OB + \Delta OFT) + \Delta RBFSG - \Delta GSGOVT^{a} + \Delta C \qquad \ldots(5.15)$$

$$= \Delta LR + \Delta TN + (\Delta TB - \Delta GDRB) + \Delta RBFSG - \Delta GSGOVT^{a} + \Delta C \qquad \ldots(5.16)$$

TABLE 5.2
FORMATION OF BANK LIQUIDITY AND MONEY SUPPLY
Movements - $ million

		Major trading banks	Other trading banks	Savings banks (b)	Private non-bank sector (c)
Reserve Bank holdings of gold and foreign exchange (a)					
Government debt (net) (a)					
Reserve Bank claims on the private sector					
i) Rural Credits advances					
ii) Commercial bills					
iii) Loans to STMM dealers					
iv) Loans to trading banks					
Deduct private sector (Non LGS) claims on the Reserve Bank					
i) SRD					
ii) Term and Farm Loan Funds					
Miscellaneous Reserve Bank accounts					
Discrepancy					
Sub-total - change in LGS Assets					
Loans, advances etc.					
(a) Refinanced by ARDB					
(b) Other					
Loans to STMM					
(a) Local and semi-govt securities					
(b) Overseas funds					
(c) Float					
(d) SRD & Term and Farm Loan Funds					
(e) Other					
Deduct private non-bank holdings of CGS (a)					
Deposits of banks, notes and coin of private non-bank sector; total = money supply					
Deduct government and interbank deposits					
Volume of money					

M1 $m   M3 $m

$$= [\Delta BRB + \Delta TNRB + (\Delta TB - \Delta GDRB) + \Delta RBFSG] + [\Delta BTB + \Delta TNTB] + [\Delta BSB + \Delta TNSB] + [\Delta BNBP + \Delta TNNBP] + \Delta C \quad \text{...(5.17)}$$

$$= [\Delta GSRB + (\Delta TB - \Delta GDRB) + \Delta RBFSG] + [\Delta GSTB] + [\Delta GSSB] + [\Delta GSNBP] + \Delta C \quad \text{...(5.18)}$$

Equation (5.18) defines government debt (net). Item 3 from Table 5.2 is equal to

$$\Delta(RBRCA + RBCB + RBLSTMM + RBLOLRF) \quad \text{...(5.19)}$$

Items 4 and 5 of Table 5.2 are defined as

$$\Delta(SRD + TLF + FDLF) \quad \text{...(5.20)}$$

$$\Delta[(NCRB + RBOA) - (RBCR + RBOL) - (ODTBRB + DSBRB)] \quad \text{...(5.21)}$$

Item 6 of Table 5.2 is assumed to be zero for simplicity. Therefore item 7 of Table 5.2 is the sum of GFE and items (5.18), (5.19) and (5.21), less item (5.20), that is

$$\Delta GFE + [\Delta GSRB + (\Delta TB - \Delta GDRB) + \Delta RBFSG] + \Delta GSTB + \Delta GSSB + \Delta GSNBP + \Delta C + \Delta(RBRCA + RBCB + RBLSTMM + RBLOLRF) + \Delta(NCRB + RBOA) - \Delta(SRD + TLF + FDLF) - \Delta(ODTBRB + DSBRB) - \Delta[RBCR + RBOL] \quad \text{...(5.22)}$$

Items 8 and 9 of Table 5.2 are loans and advances of trading and savings banks, that is

$$\Delta(\mathrm{TBLASTMM} + \mathrm{TBLAO} + \mathrm{SBLASTMM} + \mathrm{SBLAO})$$
$$= \Delta(\mathrm{TBLA} + \mathrm{SBLA}) \qquad \ldots(5.23)$$

Item 10 of Table 5.2 is equal to (assuming for simplicity that FLOAT equals zero)

$$\Delta(\mathrm{LSGSTB} + \mathrm{LSGSSB} + \mathrm{TBNFA} + \mathrm{SBNFA} + \mathrm{SRD} + \mathrm{TLF} + \mathrm{FDLF})$$
$$+ \Delta(\mathrm{ODTBRB} + \mathrm{DSBRB}) + \Delta(\mathrm{TBOA} + \mathrm{SBOA}) - \Delta(\mathrm{TBCR} + \mathrm{SBCR}$$
$$+ \mathrm{TBOL} + \mathrm{SBOL}) - \Delta\mathrm{RBLOLRF} \qquad \ldots(5.24)$$

Item 11 of Table 5.2 is equal to

$$\Delta\mathrm{GSNBP} \qquad \ldots(5.25)$$

Item 13 is

$$(\mathrm{GOVD} + \mathrm{INBD}) \qquad \ldots(5.26)$$

Adding items 7 to 10 and subtracting items 11 and 13, that is, (5.22) + (5.23) + (5.24) - (5.25) - (5.26), gives

$$[\Delta\mathrm{GSRB} + (\Delta\mathrm{TB} - \Delta\mathrm{GDRB}) + \Delta\mathrm{RBFSG} + \Delta\mathrm{GSTB} + \Delta\mathrm{GSSB}$$
$$+ \Delta\mathrm{GSNBP} + \Delta\mathrm{C} + \Delta(\mathrm{RBRCA} + \mathrm{RBCB} + \mathrm{RBLSTMM} + \mathrm{RBLOLRF})$$
$$+ \Delta(\mathrm{NCRB} + \mathrm{RBOA}) - \Delta(\mathrm{SRD} + \mathrm{TLF} + \mathrm{FDLF}) - \Delta(\mathrm{ODTSRB} + \mathrm{DSBRB})$$
$$- \Delta(\mathrm{RBCR} - \mathrm{RBOL})$$
$$+ \Delta(\mathrm{TBLA} + \mathrm{SBLA})$$
$$+ \Delta(\mathrm{LSGSTB} + \mathrm{LSGSSB} + \mathrm{TBNFA} + \mathrm{SBNFA} + \mathrm{SRD} + \mathrm{TLF} + \mathrm{FDLF})$$
$$+ \Delta(\mathrm{ODTBRB} + \mathrm{DSBRB}) + \Delta(\mathrm{TBOA} + \mathrm{SBOA}) - \Delta(\mathrm{TBCR} + \mathrm{SBCR}$$
$$+ \mathrm{TBOL} + \mathrm{SBOL}) - \Delta\mathrm{RBLOLRF}$$
$$- \Delta(\mathrm{GOVD} + \mathrm{INBD})$$
$$- \Delta\mathrm{GSNBP} \qquad \ldots(5.27)$$

$= \Delta GFE$ ...(5.28.1)

$+ \Delta[GSRB + GSTB + GSSB] + \Delta C$ ...(5.28.2)

$+ \Delta[TB - GDRB]$ ...(5.28.3)

$+ \Delta[[RBRCA + RBCB + RBLSTMM + NCRB + RBFSG + RBOA]$

$- \Delta[RBCR + RBOL]]$ ...(5.28.4)

$+ \Delta[[LSGSTB + LSGSSB] + [TBNFA + SBNFA] + [TBLA + SBLA]$

$+ [TBOA + SBOA] - [TBCR + SBCR + TBOL + SBOL]$

$- [GOVD + INBD]]$ ...(5.28.5)

This verifies that equation (5.28) is the change form of equation (5.12).

(5.2) Two Measures of Primary Liquidity

Primary liquidity or liquidity base (LB) from the formation table approach is given in change form by equation (5.22) in section (5.1). In levels form this is

$LB = GFE$

$+ [GSRB + (TB - GDRB) + RBFSG] + [GSTB + GSSB$

$+ GSNBP] + C + [RBRCA + RRCB + RBLSTMM + RBLOLRF]$

$+ [NCRB + RBOA] - [SRD + TLF + FDLF]$

$- [ODTBRB + DSBRB] - [RBCR + RBOL]$ ...(5.29)

The monetary base is the primary liquidity source for the MM-MB framework, and it was given by equation (2.7) of Chapter II, that is

$B = GFE$

$+ [GSRB + (TB - GDRB) + RBFSG] + C + [RBRCA + RBCB$

$+ RBLSTMM + RBLOLRF] + [NCRB + RBOA] - [RBCR + RBOL]$

...(5.30)

The difference between these two measures of primary liquidity is

$$LB - B = [GSTB + GSSB + GSNBP] - [SRD + TLF + FDLF] - [ODTBRB + DSBRB] \quad \ldots(5.31)$$

Item 11 in the formation table deducts private sector holdings of government securities. If this is subtracted from the liquidity base then a new measure of primary liquidity can be defined, that is

$$\begin{aligned} LB^* = {} & GFE \\ & + [GSRB + (TB - GDRB) + RBFSG] + [GSTB + GSSB] \\ & + C + [RBRCA + RBCB + RBLSTMM + RBLOLRF] \\ & + [NCRB + RBOA] - [SRD + TLF + FDLF] \\ & - [ODTBRB + DSBRB - RBCR + RBOL] \end{aligned} \quad \ldots(5.32)$$

The difference between the two base measures is now

$$LB^* - B = [GSTB + GSSB] - [SRD + TLF + FDLF] - [ODTBRB + DSBRB] \quad \ldots(5.33)$$

This shows a dilemma which has caused considerable confusion between the two approaches to the money supply process. This dilemma relates to the role played by the deficit. The role of the deficit in the liquidity base is given above in (5.32), that is

$$[GSRB + TB - GDRB + RBFSG] + [GSTB + GSSB] \quad \ldots(5.34)$$

which can be expressed as

$$GS - GSNBP \quad \ldots(5.35)$$

that is, (5.34) is equal to total government securities less government securities held by the non-bank private sector.

The role of the deficit in the monetary base was given in (5.30, that is

$$[GSRB + (TB - GDRB) + RBFSG] \quad \ldots(5.36)$$

which can be expressed as

$$GS - GSNBP - [GSTB + GSSB] \quad \ldots(5.37)$$

that is, total government securities less government securities held by the total private sector.

There is considerable confusion, I believe, about the effects of a change in the holdings of government securities by the banks. In the monetary base framework, it appears that sale of government securities to the banks has the same impact as sales of government securities to the private non-bank sector, that is no change on the base (both GS and GSNBP + GSTB + GSSB increase equally).

It would appear from (5.34), however, that an increase in the holdings of government securities by the banks will increase the liquidity base and hence have a different impact than sales of government securities to the non-bank private sector.

This dilemma can be reconciled by realising that ΔGS, ΔGSTB, ΔGSSB, and ΔGSNBP refer not only to the change in government securities arising from the financing of a new deficit but also changes in holdings of securities that relate to the financing of previous deficits.

The monetary base definition would appear to be most appropriate if the changes in holdings of government securities related solely to the financing of new deficits. The liquidity base definition would appear to be most appropriate if these changes related only to previous deficits.

If changes in the holdings of government securities are the result solely of the financing of the deficit, it is immaterial to which of the two groups that comprise the private sector that the securities are sold.[1]

Changes in the holdings of government securities by the banks if acquired from the non-bank public will have an immediate influence on the money supply. But in a similar way, if the non-bank public acquire government securities from the banks, this will also have an immediate but opposite impact on the money supply.

The question of which measure of base liquidity is the most appropriate is very difficult to answer. In periods of small deficits or surpluses, then the formation table's liquidity base measure may be more useful as ΔGSTB, ΔGSSB and ΔGSNBP will all probably affect the money supply. However, in periods of high deficits when ΔGSTB, ΔGSSB and ΔGSNBP can be dominated by the acquisition of new securities, then the monetary base definition may be most appropriate.

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1. This refers to the initial impact of the sale of the securities and abstracts from second round effects that may result, for example, from a fractional reserve banking system.

(5.3) The Relevance of the Money Multiplier-Monetary Base Framework to Australia

Goodhart has been a major critic of the MM-MB framework in general on at least two grounds, both of which were mentioned in Chapter I. These were:

(i) the fixed coefficient approach of the framework. Goodhart has even been critical of the attempts to make these parameters of the multipliers behavioural equations. This criticism has been based on a preference for general equilibrium portfolio balance theories of the Tobin form; and

(ii) the usual assumption in these models of an exogenous monetary base.

Both of these arguments relate only to trivial MM-MB models of the money supply process. The framework in general, however, is able to overcome these criticisms as was shown in Chapter IV.

One general advantage of the money supply process which is not easily incorporated into Tobin general equilibrium models is the institutional features of a fractional reserve system. These disadvantages and advantages are not unique to Australia but they are worthy of mention. But before going on to peculiarities of the Australian system, one more general characteristic of the system needs clarification. The MM-MB framework is couched in terms of a money aggregate, a money multiplier and a money base. The framework therefore has some connotation of liquidity creation.[2] The money aggregate is supported or generated by the money base.[3] The money aggregate is usually the sum of currency (a liability of the authorities) and several items which are liabilities of savings and trading banks. That is, the system disregards the asset side of the banks' balance sheets.

The question can be asked: has any "net liquidity" been created? Is the money supply process a "gross liquidity" framework because it looks at only one side of the balance sheet?

The MM-MB framework can and has been extended to include bank credit multipliers or more appropriately bank earning asset multipliers.[4] These multipliers relate the monetary base to an aggregate derived from the asset side of the banks' balance sheet. Hewson and Niehans state:

> "... what matters for the spending decisions of households and firms is, in general, not gross liquidity. In addition to their assets, a great deal may also depend on their liabilities to banks ... What we need is a concept which reflects both assets and liabilities. We shall call it 'net liquidity'."
> (Niehans and Hewson [65 p. 12 ff].)

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2. The Reserve Bank defines private sector liquidity as private sector holdings of LGS assets, that is, currency, cash with the Reserve Bank and government securities.
3. The following analysis is based on ideas expressed in Hewson [48] and Niehans and Hewson [65].
4. See, for example, Burger [22] and Section (4.3) of Chapter IV.

Because both sides of the balance sheet must balance, it may at first appear that net liquidity must always be equal to zero. However, this is not so.

> "To quantify aggregate net liquidity, we have to assign weights to different assets and liabilities intended to reflect the degree of their 'moneyness' ... In terms of these concepts it can be said that the traditional money supply theory assumes that currency and deposits (either including or excluding time deposits) have liquidity one, while bank claims (except reserves) have liquidity zero. With this assumption, net, and gross liquidity coincide; the creation of money is equivalent to the creation of liquidity."
> (Niehans and Hewson [65, p.13, ff].)

The implications that the money supply process is deficient in the light of these comments is true but can be considered as somewhat harsh. The analysis of the money supply process can incorporate general equilibrium portfolio balance theory. For example, such a system would give equations for each of the liabilities and assets of the trading banks, D_i and A_j respectively. The contribution of trading banks to gross liquidity of the non-bank private sector would be measured as

$$GL_T = \lambda_1 D_1 + \dots \lambda_n D_n = \sum_i \lambda_i D_i \qquad \dots(5.38)$$

where the λ_i are the liquidity coefficients. The contribution of the trading banks to net liquidity, however, would be

$$NL_T = \sum_i \lambda_i D_i - \sum_j \lambda^*_j A_j \qquad \dots(5.39)$$

where λ_j^* are the liquidity coefficients for the assets of the banks.

> "Creation of net liquidity for the non-bank sector clearly required that assets and liabilities are 'mismatched'."
>
> (Niehans and Hewson [65, p.15].)

This process, however, can also be incorporated into the MM-MB framework. In place of the simple proximate parameters for the money multiplier (e.g. f, the fixed deposit ratio) liquidity weighted parameters (for example, $(\lambda_f . f)$), can be used resulting in a gross liquidity weighted money aggregate. Similarly, liquidity weights can be used in the earning asset multipliers of the banks producing for each type of financial intermediary a liquidity weighted asset aggregate. If these aggregates are then summed across intermediaries it then allows for a net liquidity factor to be determined.

Turning now to those arguments that relate to Australia in particular, it is seen that these are usually put forward because of the differences between the Australian institutional setting and the "conventional" setting for the MM-MB framework.

Two differences between the Australian situation and the conventional one are usually stressed. Firstly, in the conventional case, interest rates are market determined whereas in Australia the Reserve Bank sets the interest rates and enters the bond market so as to maintain these rates. Secondly, the conventional case has banks and the public operating interest sensitive portfolios in competitive markets. Whereas in Australia, the banking system is oligopolistic and hence market shares are paramount.[5]

The first point relates to the choice of an intermediate target of the authorities. In the conventional case, the money supply or some related money aggregate is used. In the Australian situation interest rates are used. A third possibility is some combination of the above two. The second point rests on whether the differences in behaviour between oligopolistic firms and perfectly competitive firms substantially alters the analysis.

Firstly, it must be pointed out that the MM-MB framework is valid in spite of these two features of the Australian setting. It was argued in Chapter I that this framework can be conceived as a general equilibrium portfolio balance model, homogeneous in demand deposits rather than wealth, and with an additional identity imposed on the system. The latter identity <u>must</u> hold and hence if the system is unworkable in Australia so are Tobin type portfolio balance models.

What is at question then is the framework's usefulness in light of these features. Purvis [79] considers the usefulness of the monetary base concept and hence the MM-MB framework on only two criteria: (i) as an indicator of Reserve Bank policy, and (ii) as a measure of liquidity.

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5. See Purvis [79] for example.

On the second criteria, if Hewson and Niehan's "net liquidity" concept is relevant then the base is inadequate as a measure of liquidity like any other 'one side of the balance sheet' aggregate. However, a net liquidity base concept could possibly be derived by applying liquidity coefficients to both the uses and source definitions of the base and then subtracting these aggregates.

In either the conventional case[6] or the Australian case, the central bank has an intermediate target, the achievement of which requires forecasts of both the monetary base and the money multiplier. If we take the U.S. during the latter 1960's and early 1970's as the conventional case, it is seen that the U.S. also fails on Purvis' criterion as, even though the U.S. may have been following a money stock target, it was operating under a fixed exchange rate regime. Under such a regime the Federal Reserve Bank does not have control of the balance of payments. If movements in the balance of payments were undesirable, then the Federal Reserve Bank had to offset these by changes in its other policy instruments.

Given the nature of the U.S. economy, in particular the relative unimportance of the external sector to the U.S., this may be a relatively minor point but even so the most appropriate measure of the Federal Reserve Bank's intentions

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6. Purvis uses the word "conventional" by which I think it is reasonable to assume he is referring to the United States experience. It has been in the U.S. that the MM-MB framework has been developed most and used most.

would not be the total monetary base but some subaggregate over which the Federal Reserve does have total control.

Given the nature of the Australian economy, again in particular the relative importance of the external sector, it is not at all surprising that the total base is an inappropriate indicator of Reserve Bank policy. However, this is not to say that the Reserve Bank does not control (or have considerable influence over) some subaggregates. Various indicators of Reserve Bank policy were suggested in Section (3.4) on Indicators of Reserve Bank Behaviour. These hybrids of the monetary base are adequate or good indicators of certain features of central bank behaviour. The indicator value of the total monetary base concept therefore seems a relatively poor criterion to gauge the value of the framework.

Purvis' specific criticism was that with an interest rate policy, the monetary base is endogenous and hence not under the control of the Reserve Bank. Given that with a fixed exchange rate system the Reserve Bank cannot control the balance of payments, this implies that net domestic assets as well as net foreign assets are outside the control of the central bank. This implies two things, firstly that the Reserve Bank's holdings of government securities plus their advances to the government less government deposits with the Reserve Bank are a "true" residual item in the deficit financing equation. This was discussed in Section (2.3) of Chapter II.

Secondly, the consequences of an open market operation are uncertain. This is because, firstly, once the authorities set the price of securities they cannot also set the quantities that are held. Secondly, Purvis suggests that this uncertainty is compounded by the fact that the Reserve Bank is prepared to discount trading banks' holdings of government securities at little or no cost to the banks, which leads the banks to have a quantity of government securities in excess of any legal requirement to act as a buffer asset. As the banks may change their holdings of these buffer assets relatively cost free, the banks can use their excess holdings of LGS assets to frustrate Reserve Bank policy, for example, an increased call to SRD's can be met by discounting excess holdings of government securities rather than reducing advances.

If the market for government securities is a stable market, and one would hope that it is if monetary policy is to contribute to economic stabilization policy, then the first point presents no great problem. If a stable demand function for government securities exists and is known with reasonable accuracy, then the quantity of bonds held by the public, including the banks, is easily estimated. This situation is not greatly different to that where the central bank is endeavouring to fix quantities rather than prices. Here the supply curve of government securities is vertical but the interest rate has to be forecast from the demand curves for government securities. Thus, to determine the impact of an open market sale of x dollars worth of securities on the money supply, the demand curves of the bank and non-bank private sectors need to be known with reasonable accuracy. Thus, while net domestic assets may become controlled, the money multiplier has to be estimated as it will be a function of the endogenous interest rate on bonds. In addition, as for the U.S., the total base for Australia would still not be controlled or an indicator as net foreign assets are still endogenous under a fixed exchange rate regime.

In the conventional model, Purvis suggests that an open market sale of bonds to the banks is financed by the banks decreasing their required SRD reserves below the legally required level. After an adjustment period, this deficiency is restored by decreasing advances. In the Australian situation, Purvis believes the acquisition of the bonds put on the market by open market operations is financed by the banks liquidating other bonds with the Reserve Bank at little or no cost to the banks themselves and so producing no net effects. Purvis suggests that excess LGS assets play a buffer stock role and that interest rates are probably not important in determining the holdings of these assets.

Purvis' conclusions are quite surprising; even though he describes excess LGS assets as a buffer stock, he fails to recognize the role played by a true buffer asset. A buffer stock is an asset which can be used to alleviate disequilibrium elsewhere in a portfolio but in the most efficient manner. Disequilibrium between the actual and desired holdings of such a buffer asset indicates the need for change but the use of a buffer asset allows required adjustments to take place in a smooth orderly fashion.

The conventional model described by Purvis is hardly characterized by smooth, relatively costless adjustment. Rather the adjustments are quick and expensive. Firstly, the deficiency in required reserves probably involves a penalty interest charge for the duration of the deficiency. Secondly, this deficiency is probably removed quickly in order to minimise the penalty interest charges by the calling in of advances thus probably offending and losing customers.

In the Australian situation, it may be true that in the very short run excess LGS assets play the role of a true buffer asset. They allow the bank to quickly meet a new legal requirement without an immediate major reshuffling of the bank's portfolio. Consequently, in the very short run the O.M.O. is offset. But the banks will have a desired level of excess LGS asset holdings which will be interest sensitive. The banks will attempt to restore their holdings of excess LGS assets to their desired level. In making this orderly readjustment, the O.M.O. becomes effective. It is true that the length of the adjustment period may also be a function of expectations and moral suasion exerted by the authorities in addition to interest rates.

This again suggests that trying to use the monetary base as an indicator may be inappropriate, yet there may exist some hybrid measure that performs the indicator function satisfactorily.

All this leads to the conclusion that the criterion used by Purvis are inadequate and inappropriate for evaluating the usefulness of the monetary base.

(5.4) Reconciliation Between the Formation Table and the Money Multiplier - Monetary Base Framework

As mentioned above in section (5.1) the formation table tells nothing about causal relationships. Indeed the main criticism of this approach has been that in practice the formation table has been used very mechanistically and is of little value in critically analysing policy alternatives. These criticisms of the formation table approach arise as the portfolio relationships that underlie this approach are not usually made explicit but are in the "heads" of those who use the formation table.

These criticisms are remarkably similar to those given by critics of the money multiplier - monetary base framework. The advocates of the latter approach also believe that their framework is logically and intuitively more appealing from a basic insight point of view. The identities for the two approaches to modelling money stock determination must be equivalent, both being derived from the same balance sheets of the authorities, the banks, and the non-bank private sectors. Considering both approaches in their basic mathematical form (that is, before the underlying causal relationships are considered) the MM-MB framework has the following advantages over the formation table approach.

(i) the explicit inclusion of policy variables under the direct control of the monetary authorities;

(ii) the establishment of a definite link between these control variables and the monetary aggregates; and

(iii) the recognition of the existing institutional framework within which the policy and decision makers must operate, and in particular that the banking system in Australia is a fractional reserve system.

Both models can be expanded past the identities which underly them by explicitly modelling, and preferably in an econometric fashion, the interrelated portfolio decisions.

If it is assumed that the underlying portfolio theory of how decisions are made is known, and it is in fact the same as the model set out in Chapter IV, then it can be shown that the two models of the money supply process are equivalent.

Equation (5.12) set out the basic identity behind the formation table approach. This equation can be modified by setting

$$\begin{aligned}[\mathrm{GSRB} + \mathrm{GSTB} + \mathrm{GSSB} + \mathrm{TB} - \mathrm{GDRB}] &= [\mathrm{GSRB} + \mathrm{GSTB} + \mathrm{GSSB} + \mathrm{TB} - \mathrm{GDRB}]_{-1} \\ &\quad + [-\mathrm{CFD}] - \Delta \mathrm{GSNBP} \qquad \ldots(5.40)\end{aligned}$$

$$= [GSRB + GSTB + GSSB + TB - GDRB]_{-1}$$

$$+ [D\ P.Kg) + Pg.g + Pg.yeb + f(rB)$$

$$- T_1 - T_2] - \Delta GSNBP \qquad ...(5.41)$$

Also GFE can be rewritten as

$$GFE = GFE_{-1} + P_x X - P_i.i + CI \qquad ...(5.42)$$

Therefore equation (5.12) can be rewritten as

$$GFE_{-1} + [GSRB + GSTB + GSSB + TB - GDRB]_{-1} \qquad ...(5.43.1)$$

$$- [TBCR + TBOL - TBOA] - [SBCR + SBOL - TBOA] \qquad ...(5.43.2)$$

$$+ [[RBRCA + RBCB + RBLSTMM + RBFSG + RBOA + NCRB -$$

$$[RBCR + RBOL]] \qquad ...(5.43.3)$$

$$- [GOVD + INBD] \qquad ...(5.43.4)$$

$$+ [[LSGSTB + LSGSSB] + [TBNFA + SBNFA]$$

$$+ [TBLA + SBLA]] \qquad ...(5.43.5)$$

$$+ [D(P_1 Kg) + Pg.g + Pg.ycb + f(rB) - T_1 - T_2] \qquad ...(5.43.6)$$

$$+ [P_x.X - P_i.i + TC\$] \qquad ...(5.43.7)$$

$$- \Delta GSNBP \qquad ...(5.43.8)$$

Items (5.43.1), (5.43.2), (5.43.3) and (5.43.4) can be considered as predetermined or exogenous.

The component (5.43.6) can be explained by the same endogenous functions for P, Pg, T_1 and T_2 as were set out in Section (4.2) of Chapter IV. That is, by equations (4.13), (4.16), (4.18) and (4.20). Similarly P_x, X, and i can be explained by functions (4.4), (4.1) and (4.6).

Capital inflow (TC$) is comprised of TBNFA, SNBFA, FAp and FLp. Equations (4.74), (4.66) and (4.60) explain the first three items respectively while Foreign Liabilities of the public can be considered as exogenous.

The items TBLA and SBLA are also explained by equations (4.60), that is advances are assumed to be determined by the non-bank private sector. Local and semi-government securities held by trading and savings banks can be divided into two groups, firstly those arising from portfolio restrictions imposed by the authorities and secondly excess holdings of these securities. That is

$$\begin{aligned} & LSGSTB + LSGSSB = LSGSTBX + LSGSTBREQ \\ & + LSGSSBX + LSGSSBREQ \end{aligned} \qquad \ldots(5.44)$$

LSGSTBREQ and LSGSSBREQ are determined by the portfolio decisions that split required LGS assets of trading bank ($\gamma(1+f)DEPC$) and required LGS asset of savings banks ($.4\ \bar{m}\ DEPS$) between Australian Government securities and local and semi government securities. LSGSTBX and LSGSSBX are determined by equation (4.74) and (4.66) respectively.

The final item $\Delta GSNBP$ is determined in the non-bank private sector equations given by (4.60). Therefore corresponding to each endogenous item in the formation table there is an equation set out in Chapter IV which can explain that item.

Therefore given the same conception of how the economy works the two approaches can make use of the same endogenous functions. This has a further implication in regard to Purvis' comments regarding the appropriateness of the monetary base concept for Australia. If the two approaches to modelling the money supply process are identical in both identities and causal relationships then Purvis' criterion on which he decides that the monetary base is inappropriate for Australia must themselves be inappropriate or equally valid for the formation table approach.

CHAPTER VI

EMPIRICAL ESTIMATES OF A MODEL OF THE AUSTRALIAN MONEY SUPPLY PROCESS

(6.1) The Basic Model and Some Alternatives

This section sets out a model of the Australian economy. One sector of this very aggregative model relates to the money supply process. The basic model is that recently developed by Jonson, Moses and Wymer [52].

Some parts of the previous chapters have been devoted to demonstrating the applicability of the money multiplier-monetary base framework for Australia and its equivalence to the formation table approach. With this hopefully established this chapter estimates a model of the money supply process based on the formation table approach. One of the other aims of earlier chapters was to show the impact of various portfolio restrictions that can be imposed on the structural coefficients of the model. This chapter's chief aim is to demonstrate the impact of some of these restrictions. Like most models only a subset of the total set of possible restrictions is imposed.

The structural model estimated by Jonson et al is set out below. The whole model is given as Jonson et al estimated their model using Full Information Maximum Likelihood estimation techniques (FIML). This means that the model is estimated as a simultaneous system. This then allows for factors such as simultaneity in causation between money and output.

The Jonson et al model is both unconventional and innovative. It is very aggregative relative to most other Australian models and attempts to implement some recent developments in monetary economics. One central innovation of particular importance is the role of money as a buffer asset as distinct from money being modelled as just any other asset in the full spectrum of assets. This feature has two implications. Firstly the short-run behaviour of money is determined residually and secondly there is an apriori belief that many of the off diagonal terms in the portfolio adjustment matrix will be zero.

These and some other features of the model (to be discussed further below) are taken as given. The aim of this chapter is not to show that there are some possibly inappropriate features of this model and hence go on to build a possibly improved model. The aim however is to show the effects that the existence or non-existence of portfolio restriction can have on a model. This objective can adequately be demonstrated in this simplified if perhaps incorrectly specified model.

THE JONSON, MOSES, WYMER MODEL OF THE AUSTRALIAN ECONOMY

1. Household expenditure

$$D\log d = \alpha_1(\log \hat{d} - \log d) + \gamma_1(\log \hat{m} - \log {}^{M}/P)$$

$$\log \hat{d} = d_0 + \log(y - {}^{T_1}/P + c) + \beta_1 \log r$$

$$\log \hat{m} = m_0 + \log y + \beta_2 \log r + \beta_3 \log r_w + \beta_4 QE + \beta_5 \log {}^{EP_w}/P$$

2. Net business fixed investment

$$Dk = \alpha_2 [\alpha_3({}_6{}^{y}/K - r + D\log P) + \lambda_1 - k]$$

3. Exports of goods and services

$$D\log x = \alpha_4(\log \hat{x}^d - \log x) + \beta_7(\log \hat{x}^s - \log x) + \beta_8 QE$$

$$\log \hat{x}^d = x_0 + \log x_w + \beta_9 \log({}^{P_x}/EP_w)$$

$$\log \hat{x}^s = x_0 + \lambda_1 t \qquad + \beta_{10} \log({}^{P_x}/P)$$

4. Imports of goods and services

$$D\log i = \alpha_5(\log \hat{i} - \log i) + \beta_{11}(\log \hat{v} - \log v{*}e^{\lambda_1 t})$$

5. Output

$$D\log y = \alpha_6(\log \hat{y} - \log y) + \beta_{12}(\log \hat{v} - \log v)$$

$$\hat{i} = [i_0(\frac{EP_i(1+t_3)}{P})^{\beta_{13}} e^{\beta_{14} QE}]_s$$

$$\hat{y} = [1 - i_0(\frac{EP_i(1+t_3)}{P})\beta_{13}{}_e\beta_{14}QE]_S$$

$$\hat{v} = v_o{}^S$$

$$S = d + DK + DK_g + x + g$$

6. Price of output

$$D\log P = \alpha_7 \log {}^{P_0 wL}/y - \log P) + \beta_{15}(\log \hat{v} - \log v)$$

$$+ \gamma_2(\log \hat{m} - \log {}^M/P)$$

7. Price of government current goods and services

$$D\log P_g = \alpha_8(\log P + \log(1-\beta_6)^y/L - \log P_g)$$

8. Price of exports

$$D\log P_x = \alpha_9(\log EP_i - \log P_x) + \beta_{16}\log({}^P/EP_w) + \beta_{17}QE$$

9. Average weekly earnings

$$D\log W = \alpha_{10}[\log(1-\beta_6)^Y/L - \log {}^W/P] + \beta_{18}\log {}^L/N$$

$$+ \beta_{19}\log ({}^W A/W_A{}^*e^{\lambda_3 t}) \qquad + \gamma_3(\log \hat{m} - \log {}^M/P)$$

$$\log P = P_0 + \beta_{20}\log EP_w + (1-\beta_{20})\log P$$

10. Labour supply

$$D\log N = \alpha_{11}(\log \hat{N} - \log N)$$

$$\log \hat{N} = N_0 + \beta_{21}\log \frac{[(1-t_1)wL]}{Py} + \log L$$

11. Labour demand

$$D\log L = \alpha_{12}[\log(1-\beta_6)\,{}^{y}/L - \log {}^{w}/P]$$

12. Non-bank demand for government securities

$$D\log B = \alpha_{13}(\log \hat{b} - \log {}^{B}/P)$$

$$\log \hat{b} = b_0 + \log y + \beta_{22}\log r - \beta_{22}\log r_w + \beta_{23}QE$$
$$+ \beta_{24}\log \,{}^{EP_w}/P$$

13. Net capital inflow

$$D\log F = \alpha_{14}(\log \hat{f} - \log {}^{F}/P)$$

$$\log \hat{f} = f_0 + \log y + \beta_{25}\log r - \beta_{25}\log r_w + \beta_{26}QE$$
$$+ \beta_{27}\log \,{}^{EP_w}/P - \beta_{28}QF$$

14. Bank advances

$$D\log A = \alpha_{15}(\log \hat{A} - \log A) + \beta_{29}\log [Py/(Py)*e^{(\lambda_1 + \lambda_2)t}]$$

$$\log \hat{A} = A_0 + \log M + \beta_{30}\log r + \beta_{31}\log r_w + \beta_{32}QA + \beta_{33}QF$$

15. Direct taxes

$$D\log T_1 = \alpha_{16}(\log \hat{T}_1 - \log T_1)$$

$$\log \hat{T}_1 = T_{01} + \log t_1 Py$$

16. Indirect taxes

$$D\log T_2 + \alpha_{17}(\log \hat{T}_{21} - \log T_2) + \alpha_{18}(\log \hat{T}_{22} - \log T_2)$$

$$\log \hat{T}_{21} = T_{02} + \log t_2 Pd$$

$$\log \hat{T}_{22} = T_{03} + \log t_3 EP_i i$$

17. Balance of payments

$$DR = P_x X - EP_i i + DF$$

18. Supply of money

$$DM = DR + D(PK_g) + P_g g + P_g C - T_1 - T_2 - DB + DA + f(rB)$$

19. Change in inventories

$$DV = y + i - d - DK - DK_g - x - g$$

20. Bond rate

$$D\log r = \alpha_{19} \log {}^{r_o}/r + \beta_{34} \log {}^{R}/M + \beta_{35} \log {}^{L}/N$$

$$+ \beta_{36} \log \left({}^{M}/M^{*}e^{(\lambda_1 + \lambda_2)t}\right) + \beta_{37} QS$$

21. Exchange rate

$$D\log E = \alpha_{20} \log \left[{}^{(P/P)_w}/E \right] + \beta_{38} \log {}^{R}/M + \beta_{39} \log {}^{L}/N$$

$$+ \beta_{40} \log \left({}^{M}/M^{*}e^{(\lambda_1 + \lambda_2)t}\right) + \beta_{41} QUS + \beta_{42} QER$$

22. Business fixed capital stock

$$\frac{DK}{K} = k$$

Note: A subscript of zero indicates a constant.

The endogenous variables are:

d	real household expenditure
k	net business fixed investment
x	real exports of goods and services
i	real imports of goods and services
y	real output (net of depreciation)
p	price of output
p_g	price of government goods and services
p_x	price of exports
W	average weekly earnings
N	labour supply
L	labour demand
B	bonds held by private (non-bank) sector
F	net Australian capital owned by overseas residents
A	all bank advances to private sector
T_1	direct tax receipts
T_2	indirect tax receipts
R	foreign exchange reserves
M	stock of money (M_3)
v	stock of inventories
r	bond rate
E	exchange rate ($^{\$A}/\$US$)
K	stock of business fixed capital

The variables assumed to be exogenous are:

P_w	world prices ($US)
P_i	Australian import prices ($US)
r_w	world interest rate
x_w	world exports
g	Australian government current spending
DK_g	Australian government capital spending
c	cash benefits to persons
t_1	income tax rate
t_2	expenditure tax rate
t_3	tariff rate
w_A	award wages
t	time
QA	dummy variable for requests to limit advances, 1961
QE	dummy variable for exchange rate expectations, 1972-4
QER	dummy variable for timing of exchange rate changes, 1972, 1973, 1974
QF	dummy variable for capital controls, 1973-4
QS	dummy variable for credit squeeze, 1961, 1973
QUS	dummy variable for devaluation of $US, 1973

A number of features of this model are worth noting. Firstly the endogenous behaviour of the base is captured via equations 3, 4, 8 and 13.

Secondly, desired asset holdings of the non-bank private sector are divided into two groups. Firstly, the desired demand for non-durable and durable consumption plus housing expenditure is not fully integrated with the full spectrum of other asset choices. That is a form of dichotomised decision making is assumed. The second group of decisions relate to the holding of money, bonds, and net foreign assets.[1]

The Jonson et al model also assumes that there are only two interest rates - the interest rate on government bonds and the world interest rate adjusted for exchange rate expectations. This implies that there is only a constant differential between any other unspecified rate of return and either of these two rates.

These assumptions imply that the matrix of structural coefficients for this group of decisions, that is the matrix B in the notation of Chapter IV, has a priori restrictions imposed on it in the form of certain elements being set equal to zero.

In addition it can be noted that the adjustment matrix for this group of decisions (A) is diagonal (excluding the dummy variable QF is the net capital inflow equation).

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1. The Jonson et al model in fact also assumes separability between the decisions relating to the holding of real capital and the decisions relating to expenditure and the holding of financial assets.

The reason for the bond adjustment parameter (α_{13}) being made equal to the net capital inflow adjustment parameter (α_{14}) needs to be discussed. It can be noted that α_{14} refers to the portfolio adjustment of both domestic and foreign agents - net capital inflow being the difference between capital inflow and capital outflow. The earlier theoretical chapters would suggest at first glance that the speed of adjustment of bonds should be the same as that of capital outflow. However, there are quite valid reasons why Jonson et al may desire to impose this restriction on net capital inflow. The work of Frenkel and Rodriguez[1] for example suggests that asset composition can adjust instantaneously which if true suggests that α_{14} should equal α_{13}.

By taking the Jonson et al model as given and by using this instantaneous asset adjustment argument, stress can be given to the feature that with a diagonal adjustment matrix the speed of adjustment for all assets must be the same. This assumption is tested in the empirical work by attempting to estimate α_{13} and α_{14} separately. As discussed below the results suggest that this is an appropriate assumption.

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1. Frenkel, J.A., and C.A. Rodriguez "Portfolio Equilibrium and the Balance of Payments: A Monetary Approach", American Economic Review, Sept. 1975.

This restriction is however commonly imposed in portfolio models. The restriction is usually applied in linear form, that is, that the within equation sum of the impact effects of interest rates is zero. The Jonson et al model is specified in log linear form and consequently the restriction is imposed on elasticities rather than impact effects. This does not lead to problems in this model as the mean of world and domestic interest rates are very similar (4.8% and 4.2% respectively) thus making the log linear restriction equivalent to the linear restriction.

As was noted in Chapter I a particular restriction for a diagonal matrix A is that the speed of adjustment for all equations should be the same. The model therefore imposes the cross equation restriction that the speed of adjustment in the bonds and net capital inflow equations are the same, that is $\alpha_{13} = \alpha_{14}$. As can be seen from equation 18 actual changes in money holdings are determined residually.

There are some further interesting features of the portfolio behaviour assumed in the specification of desired holdings of money, bonds and net capital inflow. Firstly, across equation column restrictions are not imposed as desired net capital inflow contains the sum of two desired assets each determined by a different group. Firstly, the domestic sector has its desired holdings of foreign assets and secondly foreigners have desired holdings of domestic assets. These two items combine to give net capital inflow. Across equation restrictions should implicitly exist between desired holdings of money, bonds and foreign assets.

Secondly, in both bonds and net capital inflow equations interest rate effects across these equations are restricted so that they sum to zero. Also worthy of note is that these restrictions are not imposed in the desired money balances specification. From the discussion of Chapter IV it can be seen that these restrictions are not part of the usual balance sheet restrictions.

[See Insert Opposite]

Thirdly, Jonson et al have assumed unitary income elasticities in log $\hat{m}$, log $\hat{b}$ and log $\hat{f}$. They argue that these

The Jonson et al model could also be considered as treating wealth as endogenous. Thus it is not wealth but the determinant of wealth that enters the asset decision process. The problems of properly modelling asset portfolio decisions when wealth is endogenous is still an unresolved area in economics.

restrictions are imposed for steady state property requirements and because Jonson et al argue that income is a proxy for wealth. [See Insert Opposite] Therefore the restrictions derived in Chapter IV on wealth are applied to income. Suppose the Jonson et al equations for $\log \hat{m}$, $\log \hat{b}$ and $\log \hat{f}$ are rewritten in simplified form as

$$\hat{m} = m_0 y r^{\partial_1} r_w^{\partial_2} = (m_0 r^{\partial_1} r_w^{\partial_2}) y \qquad \ldots(6.1)$$

$$\hat{b} = b_0 y r^{\partial_3} r_w^{\partial_4} = (b_0 r^{\partial_3} r_w^{\partial_4}) y \qquad \ldots(6.2)$$

$$\hat{f} = f_0 y r^{\partial_5} r_w^{\partial_6} = (f_0 r^{\partial_5} r_w^{\partial_6}) y \qquad \ldots(6.3)$$

where Jonson et al assume

$$\partial_1 = -\partial_2 \qquad \ldots(6.4)$$

$$\partial_3 = -\partial_4 \qquad \ldots(6.4.2)$$

$$\partial_5 = -\partial_6 \qquad \ldots(6.4.3)$$

If income is used as a proxy for wealth then this partly gets away from the dichotomized decision making process. That is, "wealth" is no longer exogenous as income is determined endogenously. The desired expenditure equation from the Jonson et al model can be written as

$$d = d_0 y r^{\gamma_7} = (d_0 r^{\gamma_7}) y \qquad \ldots(6.5)$$

The Jonson et al model should therefore have an implicit constraint on the constant terms d_0, m_0, b_0, f_0. But the full spectrum of interest rates are missing from the specification of log d.

Equation 18 of the model is the formation table identity; that is

$$DM = DGFE + [D(P.Kg) + Pg.g + Pg.ycb + f(r.B)] - [T_1 + T_2] - DGS_{NBP} + DA$$

DGFE represents the foreign contribution while domestic credit expansion is equal to

$$\Delta DCE = [D(P.Kg) + Pg.g + Pg.ycb + f(r.B)] - [T_1 + T_2] - DGS_{NBP} + DA \qquad \text{...(6.6)}$$

The deficit is explained by use of equations 6, 7, 12, 20, 15 and 16. As can be seen from equation (6.6) it is only the holdings of government securities by the non-bank private sector that enter domestic credit expansion. It appears therefore, that in this model the banking sector does not determine any items in the money supply process. To overcome this Jonson et al assume that advances of the banking sector (A) are supply determined. That is the bank supply advances to the public rather than advances being demand determined. (It is interesting to note that Jonson et al specified the desired supply of advances as homogeneous in money. That is, in a money multiplier-monetary base framework.)

Again in this equation a unitary elasticity of money is imposed which suggests that money is used as a proxy for the wealth of banks.

The equivalence of the two possible money supply frameworks was shown in section 5.4 of Chapter V but there are some interesting features of the Jonson et al model that make a review of this worthwhile.

Firstly, the uses definition of the monetary base was defined in equation (2.12) of Chapter II, that is

$$B = NCNBP + (NCSB + DSBRB) + (NCTB + SRD + ODTBRB) + (TLF + FDLF) \quad ...(2.12)$$

In addition, the money stock was defined in equation (3.1') of Chapter III, that is

$$M_3 = NCNBP + (DEPC^* + DEPF) + DEPC \quad ...(3.1')$$

Using the balance sheets of trading and savings banks, DEPC* and DEPF can be replaced in equation (3.1') to give

$$\begin{aligned}
M_3 = {} & NCNBP + [NCTB + SRD + TLF + FDLF + ODTBRB + GSTB \\
& + LSGSTB + TBNFA + TBLA + (TBOA - TBOL - TBCR) \\
& - RBLOLRF - GOVD - INBD] \\
& + [NCSB + DSBRB + GSSB + LSGSSB + SBNFA \\
& + SBLA + (SBOA - SBOL - SBCR)] \\
= {} & [NCNBP + (NCTB + NCSB \\
& + SRD + TLF + FDLF + ODTBRB + DSBRB)] \\
& + (TBNFA + SBNFA) \\
& + [(TBOA - TBOL - TBCR - GOVD - INBD - RBLOLRF) \\
& + (SBOA - SBOL - SBCR)] \\
& + [(GSTB + GSSB) + (LSGSTB + LSGSSB)] \\
& + (TBLA + SBLA) \\
= {} & B(BASE) \\
& + (TBNFA + SBNFA) \\
& + [(TBOA - TBOL - TBCR - GOVD - INBD - RBLOLRF) \\
& + (SBOA - SBOL - SBCR)] \\
& + [(GSTB + GSSB) + (LSGSTB + LSGSSB)] + TBLA + SBLA)
\end{aligned}$$

Consequently,

$$
\begin{aligned}
B = M_3 - \{ & (TBNFA + SBNFA) - (LSGSTB + LSGSSB) \\
& - [(TBOA - TBOL - TBCR - GOVD - INBD - RBLORF) \\
& + (SBOA - SBOL - SBCR)] \} \\
& - (GSTB + GSSB) \\
& - (TBLA + SBLA)
\end{aligned}
$$

that is, the monetary base is equal to the money stock less government securities held by the banks, less advances of the banks, less miscellaneous items. For simplicity let it be assumed that the miscellaneous items are approximately zero, therefore the base can be written as

$$B = M_3 - B_B - A$$

where B_B is bonds held by the banks, and

A is advances of the banks.

In equation 14 of the Jonson et al model desired advances where defined as

$$\log \hat{A} = A_0 + \log M + \beta_{30}\log r + \beta_{31}\log r_w + \beta_{32}QA + \beta_{33}QF$$

which upon exponentiating gives

$$
\begin{aligned}
\hat{A} &= A_0 r^{\beta_{30}} r_w^{\beta_{31}} e^{\beta_{32}QA} e^{\beta_{33}QF} . M \\
&= a_0 . M
\end{aligned}
$$

that is, desired advances are homogeneous in the money stock. Assuming that the banks' portfolio behaviour is modelled correctly, this equation implies that there is an implicit equation for banks' holdings of government securities which is also homogeneous in the money stock, that is

$$\hat{B}_B = b_0 . M$$

where b_0 will like a_0 be a function of r, r_w etc.

Therefore

$$B = M - a_0 M - b_0 M$$
$$= (1 - a_0 - b_0)M$$

Alternatively,

$$M_3 = \left(\frac{1}{1 - a_0 - b_0}\right).B$$

This shows that the formation table framework for modelling the money supply process in the Jonson et al model can formally be restructured as a money multiplier - monetary base framework. This time, the multiplier is in terms of parameters (a_0, b_0) which were not discussed in Chapter III, but were implicit in that chapter as only one side of the balance sheets were considered. Therefore, the model estimated in this empirical section is both in the formation table approach and within the money multiplier - monetary base framework.

Jonson et al's estimates of their model are given in section (6.2). Along with those estimates two other sets of estimates are given. These two alternative sets of estimates correspond to two slightly different models than the one set out by Jonson et al.

The first alternative has the following changes compared to the Jonson et al model.

(i) the expenditure tax equation is changed to

16. $D\log T_2 = \alpha_{18}(\log T_2 - \log T_2)$

These changes are substantial alterations to the money supply process. As discussed on page 21 the money supply process consists of those behavioural equations needed to explain the determination of the stock of money. These changes comprise major alterations to the form of the demand for money equation and to the sources of the money base.

That is

$$\log \hat{m} = m_0 + \log y + \beta_1 \log r + \beta_2 \log r_w \qquad \ldots(6.9)$$

where both β_1 and β_2 are estimated.

[See Insert Opposite]

(6.2) Empirical Results and Implications

The empirical estimates of the 3 models discussed in section (6.1) are given in Table 6.1. The parameter estimates are full information maximum likelihood estimates derived from the sample period 1959(3) to 1974(4). Variable definitions and sources corresponding to the empirical variables in the model's specification are given in Appendix 2.

In Table 6.1 Model 1 refers to the Jonson, Moses, Wymer results which are presented in [52]. Models 2 and 3 refer respectively to the two alternative models discussed in section (6.1).

The log likelihood value for the three models is 194.120, 193.707, and 193.774 respectively. The results show that the changes suggested in Models 2 and 3 produce not only significant changes in the equations that were altered but the simultaneity of the system has led to substantial changes elsewhere.

The changes made to Model 1 to give Model 2 and 3 were all related to the money supply process. Firstly the expenditure tax equation was altered to remove the use of an effective tax rate. Secondly the specification of the net capital inflow equation was altered from a simple portfolio equation consistent with the bond equation to a more general portfolio model which is more representative of the monetary approach to the balance of payments

TABLE 6.1

PARAMETER ESTIMATES OF THREE MODELS OF THE AUSTRALIAN ECONOMY

MODEL 1		MODEL 2		MODEL 3	
Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
.5552	7.21	.5017	6.12	.5001	6.51
.4801	4.04	.5670	4.55	.5759	4.47
.1*		.1*		.1*	
1.9742	3.47	1.7315	3.36	1.8459	3.41
.4300	4.19	.4900	4.78	.4833	4.75
.5*		.5*		.5*	
.3676	5.44	.3192	5.35	.3205	5.37
.4806	5.88	.4114	5.38	.4336	5.47
.3723	3.80	.4794	4.78	.4153	4.33
.4111	4.75	.4026	4.53	.3456	4.24
.1288	4.66	.1180	4.40	.1211	4.46
.1309	7.73	.1183	6.83	.1184	6.79
.1192	8.47	.0772	6.50	.0698	6.13
.1192	8.47	.0772	6.50	.0698	6.13
.26*		.26*		.26*	
2.6385	6.11	2.4644	6.08	2.4468	6.13
.3649	3.22	.2992	2.95	.2969	2.98
.3009	3.47	ø		ø	
.1353	4.25	.1897	5.73	.1661	5.01
.1276	5.35	.1138	4.85	.1103	4.78
-.2489	5.99	-.1877	4.83	-.2501	6.50
-.0982	3.51	-.0963	2.95	-.0612	1.99
-.1713	4.06	-.2100	4.42	-.1596	3.77
.0164	15.52	.0166	16.91	.0167	16.49
.0152	28.00	.0151	28.87	.0150	26.86
.0024	6.67	.0020	6.39	.0022	6.64

* Denotes value imposed

ø Not used in this model

TABLE 6.1 (cont.)

MODEL 1		MODEL 2		MODEL 3	
Estimate	t-ratio	Estimate	t-ratio	Estimate	t-ratio
-.1949	4.24	-.0950	6.23	-.1429	2.88
-.3010	3.41	-.30*		-.2749	2.95
-.0959	2.87	∅		-.1082	3.09
-.0216	.90	∅		∅	
.1555	2.38	∅		∅	
.2*		.2*		.2*	
2.0*		2.0*		2.0*	
-.4807	4.21	-.9076	4.91	-.9140	4.83
-1.0589	5.03	-1.1780	4.72	-1.1746	5.12
.5*		.5*		.5*	
.2676	1.01	.3138	1.28	.2703	1.11
.0143	.57	.0240	.98	.0222	.91
-.7762	2.89	-.7486	3.17	-.7118	3.01
.2932	3.92	.2240	2.02	.2207	1.99
.0495	4.96	.0631	7.31	.0536	6.30
.2783	4.83	.2842	4.98	.2554	4.61
-.0102	.49	-.0572	1.72	-.0526	1.60
.7474	2.66	1.0248	3.85	.8879	3.22
.3593	4.83	.4298	5.89	.3526	4.77
.1687	3.35	.1750	3.10	.1429	2.28
-.4148	3.11	-.3905	2.81	-.3802	2.89
.5665	5.18	.7225	4.41	.7201	3.91
-.2043	3.15	-.3453	2.03	-.3513	1.84
1.6981	14.37	1.7545	9.87	1.7950	8.86
.5808	5.16	.0415	3.04	.0363	2.65
-.3022	4.43	-.0198	1.36	-.0208	1.42
2.0931	9.84	-.0548	2.51	-.0609	2.66
.0057	.62	.0661	8.29	.0657	8.31
.1978	7.83	.1802	7.84	.1860	8.08
-.2151	3.45	-.1358	2.26	-.1405	2.37

* Denotes value imposed

∅ Not used in this model

TABLE 6.1 (cont.)

	MODEL 1 Estimate	MODEL 1 t-ratio	MODEL 2 Estimate	MODEL 2 t-ratio	MODEL 3 Estimate	MODEL 3 t-ratio
1	.1500	2.88	.1545	3.23	.1332	2.73
2	-.0077	1.26	-.0080	1.36	.1332	1.06
3	.0327	5.56	.0331	5.93	.0324	5.84
4	-.0491	3.92	-.0511	4.13	-.0438	3.55
5	1.2390	2.43	.6989	1.37	.7457	1.48
6	.2934	5.27	.3559	6.01	.3169	5.48
7	.1032	10.96	.1015	10.47	.1011	10.57
8	-.0294	5.59	-.0219	5.93	-.0226	5.22
9	-.0294	.16	-.0364	.20	-.0567	.31
0	-.0936	3.50	-.0872	3.38	-.0822	3.28
1	.0981	12.65	.0966	12.41	.0956	12.31
2	.0678	15.10	.0655	14.40	.0651	14.38

* Denotes value imposed

ø Not used in this model

and the work of Kouri and Porter [58].

The estimated real and nominal steady state growth rates are not substantially altered in the three models estimated as shown in Table 6.2.

TABLE 6.2

REAL AND NOMINAL STEADY STATE GROWTH RATES

	Model 1	Model 2	Model 3
Real growth rate	.0164 (15.5)	.0166 (16.9)	.0167 (16.5)
Nominal growth rate	.0152 (28.0)	.0151 (28.9)	.0150 (26.9)

These stable estimates suggest that the differences between the models are likely to be more in short run dynamics rather than long-run behaviour.

The most simple change was that made to the expenditure tax equation (equation 16). This involved excluding the adjustment term $\alpha_{18}(\log \hat{T}_{22} - \log T_2)$ and redefining $\hat{T}_{21}$ to be $\hat{T}_2$ where

$$\log \hat{T}_2 = T_{02} + \log t_2 \; P.d$$

The new estimates of the expenditure tax adjustment were .2992(3.0) and .2969(3.0) from Models 2 and 3 respectively. The similarity between these two estimates suggests that the change between these two models has had little impact on the tax sector.

One area where the modelling changes have produced differences between all three models is the influence of money throughout the model. Disequilibrium in real money balances enters the equations for expenditure, prices and wages. For Models 2 and 3 it also enters the net capital inflow equation.

Table 6.3 sets out the impact coefficients of this disequilibrium term in expenditure, prices and wages.

TABLE 6.3

ROLE OF MONEY DISEQUILIBRIUM IN THE THREE MODELS

Equation	Model 1	Model 2	Model 3
Expenditure	-.2489 (6.0)	-.1877 (4.8)	-.2501 (6.5)
Prices	-.0982 (3.5)	-.0963 (3.0)	-.0612 (2.0)
Wages	-.1713 (4.1)	-.2100 (4.4)	-.1596 (3.8)

Money has more influence relative to Model 1 in Model 3 compared to Model 2 for private expenditure. Yet this tendency is reversed for both prices and wages. These changes would be largely due to the alterations made to the specification of the formulation for demand money balances. The three alternatives were

Model 1:

$$\log \hat{m} = m_O + \log y - .30 \log r - .10 \log r_w - .02\ QE + .16 \log EP^{w}/P$$

Model 2:

$$\log \hat{m} = m_O + \log y - .30 \log r$$

Model 3:

$$\log \hat{m} = m_O + \log y - .27 \log r - .11 \log r_w$$

Models 2 and 3 also differed from Model 1 in the specification of the net capital inflow equation. In Models 2 and 3 the net capital flow equation was made a function of the differential between the demand for money and the supply of money.

This differential is the fundamental cause of capital flows set out in the monetary theory of the balance of payments. Capital flows are also made a function of interest differentials and exchange rate expectations which are also essential ingredients to the Kouri and Porter analysis.

An across equation speed of adjustment restriction is still imposed between the bonds and the net capital inflow equation. This is that both bonds and net capital inflow respond to disequilibrium at the same speed. If this restriction is dropped many of the models parameter estimates take on unrealistic values. These constrained speeds of adjustment are .1192 (8.5), .0772 (6.5), and .0698 (6.1) for Models 1, 2 and 3 respectively.

The estimates for Models 2 and 3 are substantially below that of Model 1 - the estimates of Models 2 and 3 are significantly different from that of Model 1. But the different specification of log $\hat{m}$ in Model 3 compared to Model 2 means that α_{13} is substantially lower, while not significantly different in Model 3 compared to Model 2. These two estimates imply speeds of adjustment of 8.39, 12.95, and 14.33 quarters respectively.

These few examples and by further considering the estimates in Table 6.1 it can be seen that changes, even relatively small changes in the money supply process can lead to significant alterations in parameter estimates not only in the immediate area where the change was made but also throughout the rest of the model. This is particularly important for monetary theorists who evaluate their hypotheses on the significance of money in explaining behaviour elsewhere in the economy - for example in expenditure, prices and wages. The imposition of portfolio constraints or their absence can lead to important changes as can be seen between Models 2 and 3.

Also, even though all three models were specified within the formation table framework to modelling the money supply process different endogenous modelling of components of that framework can lead to significant changes in dynamic behaviour. This was shown by the formulation of the net capital inflow equation.

(6.3) Conclusions

This thesis has had several objectives. The first objective was to show that the standard criticisms that are often levelled at the money multiplier - monetary base framework can be overcome.

These criticisms related to the standard procedure of making the monetary base exogenous and to the lack of portfolio balance theory in the parameters that make up the multiplier. Chapters II and III looked at the identities that underlied this approach to the money supply process, while Chapter IV dealt with the endogenous behaviour of the monetary base and the components of the money multiplier. Section (4.4) specifically derived the portfolio consistency conditions for this framework and the similarity between these constraints and those derived in Chapter I for the Tobin Model can now easily be seen.

These chapters, I think, have demonstrated conclusively that the standard criticisms of the money multiplier - monetary base framework are very myopic.

Chapter V set out the traditional - particularly for Australia - approach to modelling the money supply process. This approach is usually termed the formation table approach. Chapter V also discussed the specific criticisms of the money multiplier - monetary base framework in the Australian context. The most important specific criticism of this approach for the Australian context related to the choice of an intermediate target by the authorities. Critics have argued that if the intermediate target is the interest rate (as in the Australian context) then this framework is inappropriate. Purvis [79] for example, evaluates the value of the monetary base concept for Australia on two criteria: firstly, the indicator value of the concept; and secondly, the use of monetary base as a measure of liquidity. Again Chapter V showed that these criteria are inappropriate to evaluate the concept.

Chapter V also met the second objective of this study. That was, that if one has a basic model of behaviour then this can be incorporated into either of the two approaches to modelling the money supply process. This was again demonstrated in Chapter VI.

The empirical chapter, Chapter VI, was intended to show that the imposition of any or all of the possible portfolio restrictions (within either type of framework) can have important implications for the monetary sector of a model and for the model as a whole. This chapter also demonstrated that within a basic framework for modelling the money supply process it is possible for there to be differences in opinion on how particular elements should be modelled. For example, should advances be supply or demand determined, should net capital inflow be modelled as part of a general portfolio adjustment process or as a hybrid equation within the monetary approach to the balance of payments framework.

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APPENDIX 1 DECOMPOSITION OF BASE AND MULTIPLIER

In Chapter II an expression for the adjusted base[1] was derived as

$$
\begin{aligned}
B^{a1} &= GFE + GSRB + RBATGLGD + RBLABDOA + NCRB \\
&\quad + [C - RBCR - RBOL] + RBLOLRF - [TLF + FDLF] - RBLOLRF \\
&= GFE + GSRB + RBATGLGD + RBLABDOA + NCRB \\
&\quad + [C - RBCR - RBOL] - [TLF + FDLF] \qquad \ldots(2.21)
\end{aligned}
$$

Therefore

$$
\begin{aligned}
\frac{dB^{a1}}{B^{a1}_{-1}} &= \left(\frac{GFE_{-1}}{B^{a1}_{-1}}\right) \cdot \frac{dGFE}{GFE_{-1}} + \left(\frac{GSRB_{-1}}{B^{a1}_{-1}}\right) \cdot \frac{dGSRB}{GSRB_{-1}} \\
&\quad + \left(\frac{RBATGLGD_{-1}}{B^{a1}_{-1}}\right) \cdot \frac{dRBATGLGD}{RBATGLGD_{-1}} \\
&\quad + \left(\frac{RBLABDOA_{-1}}{B^{a1}_{-1}}\right) \cdot \frac{dRBLABDOA}{RBLABDOA_{-1}} + \left(\frac{NCRB_{-1}}{B^{a1}_{-1}}\right) \cdot \frac{dNCRM}{NCRB_{-1}} \\
&\quad + \left(\frac{[COIN - RBCR - RBOL]_{-1}}{B^{a1}_{-1}}\right) \frac{d[COIN - RBCR - RBOL]}{[COIN - RBCR - RBOL]_{-1}} \\
&\quad - \left(\frac{[TLF + FDLF]_{-1}}{B^{a1}_{-1}}\right) \cdot \frac{d[TLF + FDLF]}{[TLF + FDLF]_{-1}} + w' \qquad \ldots(3.76)
\end{aligned}
$$

---

1. B^{a1} and ma1 are chosen for analysis in this section for a number of reasons. Firstly, the series for B^{a2} is cut short due to the ceasing of publication of the only crude series for net foreign assets of banks by the Reserve Bank in the Statistical Bulletin in 1974. Secondly, there is still unresolved controversy about whether the base should be adjusted for B^r, that is changes in reserve requirements caused by changes in required reserve ratios. This has been done at the expense of not using the very important concept of net stock of monetary reserves (NSWR). However, reference will be made to results from these other series where appropriate.

This equation shows the impact of a percentage increase in one of the proximate parameters on the growth of the monetary base.

The money multiplier (ma1) was given as

$$\text{ma1} = \frac{[1 + c + f + p - (g + b)(1 + f)]}{[c + p(r + .5\bar{m} - (\lambda_{GSRB} + \lambda_{LSGSRB}))}$$

$$+ (\alpha_0 + e - \alpha + w(s + \delta))(1 + f)] \; (e - \alpha_1 - \alpha_2)$$

$$+ w(s + \delta) \qquad \ldots(3.56)$$

$$= \{\frac{X}{Y}\}$$

Therefore

$$\frac{d\text{ma1}}{\text{ma1}_{-1}} = \frac{d\{\frac{X}{Y}\}}{\frac{X}{Y}_{-1}} + w'' \qquad \ldots(3.77)$$

$$= \left[\frac{Y[\Sigma_i \frac{\delta_x}{\delta_i} di] - X[\Sigma_1 \frac{\delta_y}{\delta_1} d1]}{Y^2}\right] \frac{[Y]}{[X]_{-1}} + w'' \qquad \ldots(3.78)$$

$$= \frac{(Y_{-1})}{(Y)} \frac{(1)}{(X_{-1})} \; [\Sigma_i i_{-1} \frac{\delta_y}{\delta_i} \frac{d_i}{i_{-1}}]$$

$$\left(\frac{X}{X_{-1}}\right)\left(\frac{Y}{Y^2}{}_{-1}\right) \; [\Sigma_1 1_{-1} \frac{\delta_y}{1\delta_1} \frac{d1}{1_{-1}}] + w'' \qquad \ldots(3.79)$$

where i refers to each parameter in X, and 1 refers to each parameter in Y, and w'' is an error term due to the discrete approximation to the continuous time case.

$$\Sigma i_{-1} \frac{\delta_y}{\delta_i} \frac{i}{i_{-1}} = c_{-1} \frac{dc}{c_{-1}} + f_{-1}[1 - (g + b)] \frac{df}{f_{-1}}$$

$$+ p_{-1} \frac{dp}{p_{-1}} - g_{-1}(1 + f)\frac{dg}{g_{-1}} - b_{-1}(1 + f)\frac{db}{b_{-1}} \quad \ldots(3.80)$$

$$\Sigma 1_{-1} \frac{\delta_y}{\delta_1} \frac{d_1}{1_{-1}} = c_{-1} \frac{dc}{c_{-1}} + p_{-1}(r + \theta\bar{m} - (\lambda_{GSSB} + \lambda_{LSGSSB}))\frac{dp}{p_{-1}}$$

$$+ r_{-1}p\frac{dr}{r_{-1}} + \theta_{-1}p\bar{m}\frac{d\theta}{\theta_{-1}} + \bar{m}_{-1}p\theta\frac{d\bar{m}}{\bar{m}_{-1}}$$

$$- \lambda_{GSSB_{-1}} p \frac{d\lambda_{GSSB}}{\lambda_{GSSB_{-1}}} - \lambda_{GSSB_{-1}} p \frac{d\lambda_{LSGSSB}}{\lambda_{LSGSSB_{-1}}}$$

$$+ f_{-1}(\alpha_0 + e - \alpha + w(s + \delta))\frac{df}{f_{-1}}$$

$$+ e_{-1}(1 + f)\frac{de}{e_{-1}} - \alpha_{1-1}(1 + f)\frac{d\alpha_1}{\alpha_{1-1}}$$

$$- \alpha_{2-1}(1 + f)\frac{d\alpha_2}{\alpha_{2-1}} + w_{-1}(s + \delta)(1 + f)\frac{dw}{w_{-1}}$$

$$+ s_{-1} w(1 + f)\frac{ds}{s_{-1}} + {}_{-1} w(1 + f)\frac{d\delta}{\delta_{-1}} \quad \ldots(3.81)$$

$$\frac{dma1}{ma1_{-1}} = \frac{dc}{c_{-1}}\left[c_{-1}\left(\frac{Y}{Y}-1 \cdot \frac{1}{X_{-1}}\ \frac{Y_1}{Y^2}\right)\right]$$

$$+\frac{df}{f_{-1}}\left[f_{-1}\left((1-(g+b))\frac{Y}{Y}-1\ \frac{1}{X_{-1}} - \frac{X}{X_{-1}}\ \frac{Y}{Y^2}1(e-\alpha_1-\alpha_2+w(s+\delta))\right)\right]$$

$$+\frac{d1}{p_{-1}}\left[p_{-1}\left(\frac{Y}{Y}-1\ \frac{1}{X_{-1}} - \frac{XY}{X_{-1}Y^2}-1(r+\theta\bar{m}-(\lambda_{GSSB}+\lambda_{LSGSSB}))\right)\right]$$

$$-\frac{dg}{g_{-1}}\left[g_{-1}(1+f)\frac{Y}{Y}-1\frac{1}{X_{-1}}\right] - \frac{db}{b_{-1}}\left[b_{-1}(1+f)\frac{Y}{Y}-1\ \frac{1}{X_{-1}}\right]$$

$$-\frac{dr}{r_{-1}}\left[r_{-1}\left(p\frac{Y}{Y^2}-1\frac{X}{X_{-1}}\right)\right] - \frac{d\theta}{\theta_{-1}}\left[\theta_{-1}\left(p\bar{m}\ \frac{Y}{Y^2}-1\frac{X}{X_{-1}}\right)\right]$$

$$-\frac{d\bar{m}}{\bar{m}_{-1}}\left[\bar{m}_{-1}\left(p\theta\ \frac{Y}{Y^2}-1\ \frac{X}{X_{-1}}\right)\right] + \frac{d\lambda_{GSSB}}{\lambda_{GSSB_{-1}}}\left[\lambda_{GSSB_{-1}}\left(p\frac{Y}{Y^2}-1 \cdot \frac{X}{X_{-1}}\right)\right]$$

$$+\frac{d\lambda_{LSGSSB}}{\lambda_{LSGSSB_{-1}}}\left[\lambda_{LSGSSB_{-1}}\left(p\frac{Y}{Y^2}-1\ \frac{X}{X_{-1}}\right)\right]$$

$$-\frac{d_e}{e_{-1}}\left[e_{-1}(1+f)\frac{Y}{Y^2}-1\ \frac{X}{X_{-1}}\right] + \frac{d\alpha_1}{\alpha^1_{-1}}\left[\alpha^1_{-1}(1+f).\frac{Y}{Y^2}-1\frac{X}{X_{-1}}\right]$$

$$+\frac{d\alpha_2}{\alpha^2_{-1}}\left[\alpha^2_{-1}(1+f)\frac{Y}{Y^2}-1\ \frac{X}{X_{-1}}\right] - \frac{d_w}{w_{-1}}\left[w_{-1}(s+\delta)(1+f)\frac{Y}{Y^2}-1\frac{X}{X_{-1}}\right]$$

$$- \frac{d_\delta}{\delta_{-1}} \left[\delta^{\delta}{}_{-1} w(1 + f) \frac{Y}{Y^2}{}_{-1} \frac{X}{X_{-1}} \right]$$

$$= \frac{d_c}{c_{-1}} \left[c_{-1} \frac{Y}{X_{-1}}{}_{-1} \left(\frac{1}{Y} - \frac{X}{Y} \frac{1}{Y} \right) \right] = \frac{d_c}{c_{-1}} \quad c_{-1} \frac{1}{ma1_{-1}} \frac{1}{Y}(1 - ma1)$$

$$+ \frac{d_f}{f_{-1}} \left[f_{-1} \left[(1 - (g + b)) \frac{1}{ma1_{-1}} \cdot \frac{1}{Y} \right. \right.$$

$$\left. \left. - (e - \alpha_1 - \alpha_2 + w(s + \delta)) \frac{1}{ma1_{-1}} \frac{1}{Y}(ma1) \right] \right] \qquad \ldots(3.82)$$

$$= \frac{d_f}{f_{-1}} \left[f_{-1} \frac{1}{ma1_{-1} Y} \quad 1 - (g + b) - (e - \alpha_1 - \alpha_2 + w(s + \delta))ma1 \right]$$

$$+ \frac{d_p}{p_{-1}} \left[p_{-1} \frac{1}{ma1_{-1} Y} \left[1 - ma1(r + \theta\bar{m} - \{ \lambda_{GSSB} + \lambda_{LSGSSB} \}) \right] \right]$$

$$- \frac{d_g}{g_{-1}} \left[g_{-1} \frac{1}{ma1_{-1} Y}(1 + f) \right] - \frac{d_b}{b_{-1}} \left[b_{-1} \frac{1 \; 6}{ma1_{-1} Y} \; (1 + f \right]$$

$$- \frac{d_r}{r_{-1}} \left[r_{-1} \frac{ma1P}{ma1_{-1} Y} \right] - \frac{d_\theta}{\theta_{-1}} \left[\theta_{-1} \frac{p\bar{m} \; ma1}{ma1_{-1} Y} \right] - \frac{d_{\bar{m}}}{\bar{m}_{-1}} \left[\bar{m}_{-1} \left(\frac{p\theta \; ma1}{ma1_{-1} Y} \right) \right]$$

$$+ \frac{d\lambda_{GSSB}}{\lambda_{GSSB_{-1}}} \left[\lambda_{GSSB_{-1}} \frac{pma1}{ma1_{-1} Y} \right] + \frac{d\lambda_{LSGSSB}}{\lambda_{LSGSSB_{-1}}} \left[\lambda_{LSGSSB} \left(\frac{pma1}{ma1_{-1} Y} \right) \right]$$

$$- \frac{d_e}{e_{-1}} \left[e_{-1} \frac{(1 + f)ma1}{ma1_{-1} Y} \right] + \frac{d\alpha_1}{\alpha^{\alpha}{}_{-1}} \left[\alpha^{1}{}_{-1} \frac{(1 + f)ma1}{ma1_{-1} Y} \right]$$

$$+ \frac{d\alpha_2}{\alpha 2_{-1}}\left[\alpha^2_{-1} \frac{(1+f)ma1}{ma1_{-1}Y}\right] - \frac{d_w}{w_{-1}}\left[w_{-1}\frac{(s+\delta)(1+f)ma1}{ma1_{-1}Y}\right]$$

$$- \frac{d_s}{s_{-1}}\left[s_{-1}\frac{w(1+f)ma1}{ma1_{-1}Y}\right] - \frac{d_\delta}{\delta_{-1}}\left[\delta_{-1}\frac{w(1+f)ma1}{ma1_{-1}Y}\right]$$

$$= \frac{d_c}{c_{-1}}\left[\frac{c_{-1}}{ma1_{-1}}\frac{1}{Y}(1 - ma1)\right]$$

$$+ \frac{d_f}{f_{-1}}\left[\frac{f_{-1}}{ma1_{-1}}\left[\frac{1}{Y}\quad 1 - (g+b) - (e - \alpha_1 - \alpha_2 + w(s+\delta))ma1\right]\right]$$

$$+ \frac{d_p}{p_{-1}}\left[\frac{p_{-1}}{ma1_{-1}}\frac{1}{Y}\left[1 - (r + \theta\bar{m} - (\lambda_{GSSB} + \lambda_{LSGSSB}))ma1\right]\right]$$

$$- \frac{d_g}{g_{-1}}\left[\frac{g_{-1}}{ma1_{-1}}\frac{1}{Y}\left[1+f\right]\right] - \frac{d_b}{b_{-1}}\left[\frac{b_{-1}}{ma1_{-1}}\frac{1}{Y}[1+f]\right]$$

$$- \frac{d_r}{r_{-1}}\left[\frac{r_{-1}}{ma1_{-1}}\frac{1}{Y}\,p.ma1\right] - \frac{d_\theta}{\theta_{-1}}\left[\frac{\theta_{-1}}{ma1_{-1}}\frac{1}{Y}\,p\bar{m}.ma1\right]$$

$$- \frac{d_{\bar{m}}}{\bar{m}_{-1}}\left[\frac{\bar{m}_{-1}}{ma1_{-1}}\frac{1}{Y}\,p\theta.ma1\right] + \frac{d\lambda_{GSSB}}{\lambda_{GSSB_{-1}}}\left[\frac{\lambda_{GSSB_{-1}}}{ma1_{-1}}\frac{1}{Y}\,p.ma1\right]$$

$$+ \frac{d\lambda_{LSGSSB}}{\lambda_{LSGSSB_{-1}}}\left[\frac{\lambda_{LSGSSB_{-1}}}{ma1_{-1}}\frac{1}{Y}\,p.ma1\right] - \frac{d_e}{e_{-1}}\left[\frac{e_{-1}}{ma1_{-1}}\frac{1}{Y}(1+f)ma1\right]$$

$$+ \frac{d\alpha_1}{\alpha 1_{-1}}\left[\frac{\alpha 1_{-1}}{ma1_{-1}}\frac{1}{Y}(1+f)ma1\right] + \frac{d\alpha_2}{\alpha 2_{-1}}\left[\frac{\alpha 2_{-1}}{ma1_{-1}}\frac{1}{Y}(1+f)ma1\right]$$

$$+ \frac{d_w}{w_{-1}}\left[\frac{w_{-1}}{ma1_{-1}}\frac{1}{Y}(s+\delta)(1+f)ma1\right] - \frac{d_s}{s_{-1}}\left[\frac{s_{-1}}{ma1_{-1}}\frac{1}{Y}\,w(1+f)ma1\right]$$

$$- \frac{d_\delta}{\delta_{-1}}\left[\frac{\delta_{-1}}{ma1_{-1}}\frac{1}{Y}\,w(1+f)ma1\right] \qquad \ldots(3.83)$$

APPENDIX 2 DATA: DEFINITIONS AND SOURCES

In this section, the sources from which raw data are obtained are set out; and the construction of variables used to estimate the three versions of the Model is described. In the case of raw data, the notation used is the same as that in RBA1, where applicable.

1. Raw data

ADVSB	loans, advances and bills discounted by All Savings Banks, average of weekly figures for third month in quarter, $m. [13]; "All Savings Banks, Selected Assets".
ADVTB	loans, advances and bills discounted by All Trading Banks, average of weekly figures for third month in quarter, $m. [13]; "All Trading Banks, Selected Assets".
C	personal consumption expenditure on goods and services, $m. at 1966/67 prices. [6], [4]; "Table 2 - Expenditure on Gross Domestic Product at Average 1966/67 Prices".
DEPN$	depreciation allowances, private capital stock, $m. [1]; "Table 18 - Depreciation Allowances, by Industry and Form of Organisation". Items: Companies and Unincorporated Enterprises. The series is interpolated from annual figures using the method described in part 4 of this appendix.
DEPNG$	depreciation of public capital stock, $m. [1]; Table 18 - "Depreciation Allowances, by Industry and Form of Organisation". Item: Public Enterprises. The series is interpolated as for DEPN$.
ER	exchange rate, $US/A, Market value of $1A on the last day of the quarter. Note; in September 1974 Australia adopted a trade weighted exchange rate. International Department, Reserve Bank of Australia.
FR	official holdings of gold and foreign reserves, end of quarter, $m. [13]; "International Liquidity".

FRV	adjustment for the effects of exchange rate changes on official holdings of gold and foreign reserves. Research Department, Reserve Bank of Australia.
GDP	gross domestic product (at market prices), $m. at 1966/67 prices. [6], [4]; "Table 2 - Expenditure on Gross Domestic Product at Average 1966/67 Prices".
GDP$	gross domestic product (at market prices), $m. [6], [4]; from "Table 1 - Domestic Production Account".
GEC	government final consumption expenditure, $m. at 1966/67 prices. [6], [4]; "Table 2 - Expenditure on Gross Domestic Product at Average 1966/67 Prices".
GEC$	government final consumption expenditure, $m. [6], [4]; "Table 1 - Domestic Production Account".
GEK	government (public) gross fixed capital expenditure, $m. at 1966/67 prices. [6], [4]; "Table 2 - Expenditure on Gross Domestic Product at Average 1966/67 Prices".
GNO	face value of non-official holdings of Australian Government securities and Treasury notes, end of quarter, $m. [13]; from Table - "Government Securities classified by Holder". "Total Holdings" less the sum of 'Reserve Bank' and 'Public Authorities (excl. Finance)'.
GSS	face value of the holdings of Australian Government securities by Savings Banks, average of weekly figures in third month of quarter, $m. [13]; "Savings Banks, Selected Assets".
GST	face value of the holdings of Australian Government securities by All Trading Banks, average of weekly figures in third month of quarter, $m. [13]; "All Trading Banks, Selected Assets".
IC	construction investment; gross private fixed capital expenditure on other building and construction, $m at 1966/67 prices. [6], [4]; "Table 7 - Gross Fixed Capital Expenditure and Increase in Stocks at Average 1966/67 Prices".
ID	dwelling investment; gross private fixed capital expenditure on dwellings, $m. at 1966/67 prices. [6], [4]; as for IC.

IE — equipment investment; the 'all other' component of gross private fixed capital expenditure, \$m. at 1966/67 prices.
[6], [4]; as for IC.

M_3 — volume of money, average of weekly figures in third month of quarter, \$m.
[1]; "Volume of Money".

MM — imports of goods and services, \$m. at 1966/67 prices.
[6], [4]; "Table 2 - Expenditure on Gross Domestic Product at Average 1966/67 Prices".

MM\$ — imports of goods and services, \$m.
[6], [4]; "Table 1 - Domestic Production Account".

NDEF — defence employment, permanent defence forces in Australia and overseas, last month of quarter figures, thousands; [2] "Table 1 - Civilian employees and defence forces: Australia". (Category: Defence Forces)

NE — employment, non-farm civilian employees, last month of quarter figures, thousands.
[5], [2]; "Table 2 - Civilian Employees: States and Territories". (Category: Persons)
Note: This series is only published from 1966(3). The series from 1958(3) to 1966(2) is obtained from Commonwealth Treasury. There is a minor break in the series after 1971(2); trainee teachers are excluded from the definition.

NF — farm employment, thousands; [3] "Table 2 - Civilian Population 15 years of age and over by Employment Status".
Note: This series is only available from 1964(1). Earlier figures are obtained from the regression (1964(1)-1974(4)).

$$NF = 435 - .04S1 - 10.01S2 - 4.98S3 - 2.37t + .022NE$$

NU — unemployment; persons registered for employment with the Commonwealth Employment Service, last month of quarter figures, thousands.
[5], [2]; from "Table 11 - Registered Unemployed", (item: total unemployed, persons, original; Australia). Revised definition of Unemployed series from 1973(3). A revision in the definition of school leavers involved a decrease of approximately 1,000. (Old series still used.)

PW(US) — world price series, index, 1963 = 1.0. U.S. implicit price deflator. [12]

QA dummy variable for requests by the Reserve Bank to All Trading Banks about advances outstanding, assuming a lag of one quarter in response of advances to a request.

QA = 1 in 1961(1) - 1961(2); = 0 otherwise

QE dummy variable for expectations of a change in the exchange rate.

QE = $-(0.9)^i$ i=1 in 1972(4); = $-(0.5)^i$ i=1 in 1973(3); = $(0.5)^i$ i = 1 in 1974(3); and i = 2, 3, 4 in the preceding three quarters in each case

QER dummy variable for the timing of exchange rate changes.

QER = -1 in 1972(4) and 1973(3); = 1 in 1974(3); = 0 otherwise

QF dummy variable for the imposition of direct controls on capital inflow.

QF = 1 in 1973(1) - 1974(3); = 0 otherwise

QS dummy variable for credit squeeze.

QS = 1 in 1961(1); and = 2 in 1973(3); = 0 otherwise

QUS dummy variable for devaluation of the $US in 1973(1)

QUS = 1 in 1973(1); = 0 otherwise

RCHD rate of sales tax on household durables, percentage. Series supplied by Australian Treasury.

RCMV rate of sales tax on purchases of motor vehicles, percentage.
[4]; there are six sales tax schedules.

$$RCMV = \sum_j u_j R_j \qquad j = 2,\ 3,\ 4$$

$$u_2 = .1787 \qquad u_3 = .5293 \qquad u_4 = .2920$$

where

R_j is the rate for the jth schedule

u_j is the average proportion of the total sales value of household durables taxed under each of the relevant schedules.

When a rate changes, that quarter's observation is derived by weighting the two rates depending on the number of days each had its effect in that quarter. For further details see [11].

RCND — rate of sales tax on non-durables, percentage. [4];

$$RCND = \sum_j u_j R_j \qquad j = 2, \text{ general rate}$$

$u_2 = .0496 \qquad u_{GR} = .9504$

For an explanation of the above, treatment of rate changes and references, see RCMV.

RCS — statutory tax rate on taxable company profits, ratio. [8], [9].

REA — representative PAYE tax rate. Research Department, Reserve Bank of Australia.

RGM — theoretical yield on Australian Government securities with ten year term to maturity, (non-rebateable bonds), percentage. [13]; "Interest Rates and Security Yields".

RW(US) — world interest rate, percentage. U.S. Government security yield on long dated bonds (ten years or more), monthly average. [13].

TXC — indirect taxes: customs duty, $m. [4]; "Table 20 - Taxes, Fees, Fines, etc."

TXP — indirect taxes: payroll tax (net), $m. [4]; "Table 20 - Taxes, Fees, Fines, etc."

TXS — indirect taxes: sales tax, $m. [4]; "Table 20 - Taxes, Fees, Fines, etc."

TYCP — company income tax payments, $m. [4]; "Table 20 - Taxes, Fees, Fines, etc." An adjustment is made to the series for 1974 to account for temporary changes in the seasonal pattern of payments.

TYHPNP — personal income tax payments by non-PAYE taxpayers, $m. [4]; "Table 20 - Taxes, Fees, Fines, etc.". The item is "Income Taxes - Persons - Other".

TYHPP — personal income tax payments by PAYE taxpayers, $m. [4]; "Table 20 - Taxes, Fees, Fines, etc." The item is "Income Taxes - Persons - Net Tax Instalments".

W_A — minimum weekly wage rates (adult males), $. (Data obtained from ABS by Activity Section, Research Department.) Monthly figures available. Quarterly observations are weighted averages of monthly figures with weights in the ratio 1.2.2.1.

WE	average weekly earnings per employed male unit, index. [5], [7]; "Table 16 - Average Weekly Earnings for Employed Male Unit". The figure in this table is given in dollars. To convert to an index based on 1966/67 = 1.00, divide by 61.90 (the average figure for the four quarters of the fiscal year 1966/67). This series is only published after 1961(3). Data from 1958(3) to 1961(2) are estimated using data from an earlier definition of WE. There is a break in the series after 1971(2). Trainee teachers were excluded from the result (the series is roughly 30 cents higher).
X	exports of goods and services, \$m. at 1966/67 prices. [6], [4]; "Table 2 - Expenditure on Gross Domestic Product at Average 1966/67 Prices".
X\$	exports of goods and services, \$m. [6], [4]; "Table 1 - Domestic Production Account".
XW(US\$)	world exports, \$USm. at 1970 prices. [10]; Table: "World Trade: Exports".
YCB	cash benefits to persons from general government, \$m. [4]; from "Table 14 - Households (including Unincorporated Enterprises) Income and Outlay Account".

<u>Sources of Data</u>

[1] Australian Statistician, <u>Australian National Accounts</u>, Canberra, Australian Bureau of Statistics, annually.

[2] Australian Statistician, <u>Employment and Unemployment</u>, Canberra, Australian Bureau of Statistics, monthly.

[3] Australian Statistician, <u>Labour Force</u>, Canberra, Australian Bureau of Statistics, monthly.

[4] Australian Statistician, <u>Quarterly Estimates of National Income and Expenditure</u>, Canberra, Australian Bureau of Statistics, quarterly.

[5] Australian Statistician, <u>Seasonally Adjusted Indicators</u>, Canberra, Australian Bureau of Statistics, annually.

[6] Australian Statistician, <u>Supplement to Quarterly Estimates of National Income and Expenditure</u>, Canberra, Australian Bureau of Statistics, annually.

[7] Australian Statistician, <u>Wage Rates and Earnings</u>, Canberra, Australian Bureau of Statistics, monthly.

[8] Commissioner of Taxation, <u>Annual Report of the Commissioner of Taxation</u>, Canberra, Commissioner of Taxation, annually.

[9] Commissioner of Taxation, Taxation Statistics, Canberra, Commissioner of Taxation, annually.

[10] International Monetary Fund, International Financial Statistics, Washington, D.C., I.M.F., monthly.

[11] Mackrell, N.C., Sales Tax Rates for 'Other Durables', 'Non-Durables' and 'Motor Vehicles', mimeographed, Reserve Bank of Australia, December 1971.

[12] O.E.C.D., Main Economic Indicators, Paris, O.E.C.D., monthly.

[13] Reserve Bank of Australia, Statistical Bulletin, Sydney, Reserve Bank of Australia, monthly.

2. Construction of variables

$d = C + ID$

$k = DlnK$

$x = X$

$i = MM$

$y = (GDP\$ - DEPN\$ - DEPNG\$)/P$

$P = GDP\$/GDP$

$P_g = (GEC\$ + GEK\$)/(GEC + GEK)$

$P_x = X\$/X$

$W = WE$

$N = L + NU$

$L = NE + NF + NDEF$

$B = GNO - GSS - GST$

$DF = DR - P_x.x + P_i.i$

F is cumulated from a base stock 2945.0 in 1958(2)

$A = ADVSB + ADVTB$

$T_1 = TYHPP + TYHPNP + TYCP$

T_2 = TXP + TXC + TXS

R = FR - FRV

M = M3

Dv = y + i - DK - d - x - g

v is cumulated from a base stock 2957.0 in 1958(2)

r = RGM/100

E = ^{1}/ER

DK = IC + IE - DEPN$/P

K is cumulated from a base stock 11095.0 in 1958(2)

P_w = PW(US)/1.0795

1.0795 is the average 1966/67 value of PW(US)

P_i = (MM$/MM)/E

r_w = RW(US)/100

g = GEC + GEK

c = YCB/P

t_1 = 0.5[REA + RCS]

t_2 = .334(RCHD + RCMV + RCND)

t_3 = TXC/MM$

W_A = (WA/43.24)/P

43.24 is the average 1966/67 value of WA

t = time

3. Interpolation procedure

The quadratic interpolation formulae used to calculate quarterly depreciation data from annual observations of depreciation allowances were obtained as follows:

If x_{t-1}, x_t, x_{t+1} are three successive annual observations of a continuous flow variable $x(t)$, the quadratic function passing through the three points is such that -

$$\int_0^1 (as^2 + bs + c)\, ds = x_{t-1}$$

$$\int_1^2 (as^2 + bs + c)\, ds - x_t$$

Integrating and solving for a, b, c gives

$$a = 0.5\, x_{t-1} - 1.0\, x_t + 0.5\, x_{t-1}$$

$$b = -2.0\, x_{t-1} + 3.0\, x_t - 1.0\, x_{t+1}$$

$$c = 1.8333\, x_{t-1} - 1.1666\, x_t + 0.3333\, x_{t+1}$$

The first two quarterly figures within any year can be interpolated by

$$\int_{1.0}^{1.25} (as^2 + bs + c)\, ds = 0.0548\, x_{t-1} + 0.2343\, x_t - 0.0390\, x_{t+1}$$

$$\int_{1.25}^{1.50} (as^2 + bs + c)\, ds = 0.0077\, x_{t-1} + 0.2657\, x_t - 0.0235\, x_{t+1}$$

and corresponding formulae give the third and fourth quarter interpolated figures.