

TIME DEPOSITS IN THE BRUNNER-MELTZER MODEL OF ASSET MARKETS

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Benjamin Friedman raised on a previous occasion questions about the interpretation of the multiplier formulation in our assetmarket model of the money supply process. These questions addressed the role of time deposits in this process. This short note establishes the consistency of an equilibrium model of assetmarket interaction centered on a multiplier formulation. It states the rationale of the procedure and the nature of time deposit supply function in the process.

1. Introduction

Very early in the history of systematic speculations about money, economists recognized that, if money consists of two or more components produced under different conditions of supply, changes in the composition of the money stock affect the market for money. The usual approach has been to assume that the components of money are perfect substitutes in demand, but imperfect substitutes in supply, so analysis of changes in the composition of the money stock involves the 'supply' side.¹

In a note in this journal, Friedman and Froewiss (1977) discussed several aspects of our work on this problem. Van Loo (1981) commented on Friedman and Froewiss. In their reply Friedman and Froewiss (1981) address their final comment to us. We take this opportunity to respond.

We begin by commenting on the main issue in the exchange between Friedman and Froewiss and van Loo about the nature of the money and credit multipliers. Then, we discuss the argument put forward by Friedman and Froewiss, the role of time deposits in our model and some broader issues.

¹We have written the word supply in quotes to indicate that several years ago we decided that, to avoid confusion, it is best to give up the term money supply in favor of money-supply or, preferably, stock of money.

2. Interpretation of the multipliers

The issue in dispute is the interpretation of the multiplier functions summarizing aspects of credit and money market behavior. Since the late fifties, we have stressed that money stock, bank credit (total earning assets of banks) and interest rates are jointly determined by the interaction of the banks, the public and the central bank. See Brunner (1958, 1961a, b), Meltzer (1959) and Brunner and Meltzer (1963, 1964, 1966, 1967, 1968), for example.² The central bank controls the stock of base money in a closed economy. Commercial banks determine the optimal allocation of their total assets between reserves and earning assets and set the supply conditions for a range of liabilities. The public allocates wealth among different components to achieve its preferred portfolio. Of particular relevance, the public allocates money balances between currency and the transaction accounts at financial institutions, allocates total liabilities of financial institutions between transaction and (various types of) non-transaction accounts and allocates financial assets between deposit and non-deposit liabilities of financial institutions. The allocation patterns associated with the portfolio management of banks and the public depend on the relative yields or costs on the portfolio items involved. The actual values of the parameters are assumed to equal the desired values.

Our hypothesis treats banks and the public as responding to prevailing market conditions by adjusting actual to desired values. Any discrepancy offers an incentive to improve portfolio positions. We have always treated the public's allocation of money between currency and demand deposits as relatively little affected by open market interest rates and dominated by relative yields or costs that have comparatively little significance for either the public's demand for money or supply of earning assets to banks. An approximate separation between money demand and the division of money holdings results.

Our treatment of the banks' offer of liabilities to the public centered attention on the functional relation describing the interest rate paid by banks on time deposits. This price-setting function plays an important role in Brunner and Meltzer (1968) and is stressed in Brunner (1973). Symmetry and completeness requires a similar specification for demand deposits.

The basic idea underlying our analysis is that banks equalize the marginal revenues from earning assets with the marginal revenues from holding reserves. Also, banks equalize the marginal cost of issuing deposits of various kinds. When the marginal cost of offering (or maintaining) the stock of time

²Meltzer (1959, p. 287), Brunner (1961a), Brunner and Meltzer (1968, pp. 31-32) are explicit references to the most readily accessible journals. Brunner (1961b) and Brunner and Meltzer (1967) contain extensive discussions of the point which we have repeated many times. See also Burger (1971) and Korteweg and van Loo (1977).

deposits exceeds the marginal gain from holding lower reserves against time deposits, banks reduce the interest rate offered on time deposits.

The foregoing sketches the way in which bank's optimizing behavior can be developed to provide a stronger theoretical foundation for the competitive setting of interest rates on bank liabilities. Van Loo's characterization is a correct reading of our discussion of this issue in Brunner and Meltzer (1968, 1976) and Brunner (1973).³

The specification of the banks' and public's behavior parameters (currency ratio k , time deposit ratio t , non-deposit liability ratio n , bank reserve ratio r , the banks' borrowing ratio b and the Treasury deposit ratio g), the banks' offer of transaction and non-transaction balances, $c_T(i_A, \dots)$ and $c_N(i_A, \dots)$, and the sources and uses definition of the monetary base immediately yield the multiplicative expressions for money stock and total bank credit,

$$M = mB, \quad (1)$$

$$EA = aB. \quad (2)$$

Using the terminology of the Federal Reserve Bank of St. Louis, B may represent either the so-called source base or the monetary base (adjusted for policy changes in reserve requirements). The two multipliers are then

$$m = \frac{1+k}{den_i}, \quad a = \frac{(1+t+g)[1+n+b-r]}{den_i}, \quad i=1,2, \quad (3)$$

$$den_1 = r(1+t+g) + k \quad \text{in case } B = \text{source base,}$$

$$den_2 = (r+l)(1+t+g) + k \quad \text{in case } B = \text{monetary base,}$$

and where

l = reserve adjustment magnitude per unit of total deposits (for policy changes in the requirement ratios),

n = ratio of non-deposit-liabilities to total deposits,

g = ratio of Treasury accounts to transaction accounts,

b = ratio of banks' indebtedness to the Federal Reserve Banks to total deposits.

The appendix discusses the ratios in more detail.

In constructing the hypothesis, we have been guided by a simple but important purpose. The two multipliers separate nearly all the influence of policy from other influences operating on the money stock and earning assets

³A further step in development of the hypothesis could be taken by working out the optimization procedure. No doubt some changes in the hypothesis would result, but an analytical underpinning is not a necessary condition for a fruitful empirical hypothesis.

of banks. The monetary base fully reflects the behavior of the monetary authorities. The source base describes the complete set of activities controlled by the authorities. The authorities' actions govern the base to the last dollar. The monetary multiplier associated with the total base (including reserve adjustment) is dominated by the public's and the banks' behavior expressed by the allocation parameters and the banks' supply behavior. The role of the allocation parameters as proximate determinants of the multipliers links the multipliers with the relative yields and costs influencing the public's and banks' behavior. The dependence of k and t on c_T and c_N impounds the banks' offer functions for deposits into the multiplier expression.⁴

The descriptions presented above make the multiplier expressions partially reduced statements, as we emphasized repeatedly. The 'structural' statements occur in the form of the underlying allocation equations describing behavior of public and banks augmented by the banks' offers of deposits. (See appendix.) We agree with van Loo and disagree with Friedman and Froewiss.

3. The role of time deposits

Friedman and Froewiss (1977) concluded their discussion with the following succinct summary:

- (1) Time deposits, which are often only implicit in Brunner and Meltzer's expositions, are a crucial part of the model; without an endogenous function for the supply of time deposits, the model is internally inconsistent.
- (2) The two bank behavior equations which are explicit in the model as developed by Brunner and Meltzer (demand for earning assets and supply of demand deposits) imply, via the adding-up constraints associated with the banking system's balance sheet, a time deposit supply function in which the yield on time deposits enters with a positive sign, the opposite of what one would expect. Furthermore, all three bank sector functions include variables which should have no direct effect on bank behavior.
- (3) A suggested modification of the model, which simplifies the two explicit bank behavior equations, rationalizes the model's bank behavior sector without interfering with the model's equilibrium or comparative statics properties.

We emphasized from the very beginning and in subsequent work [Meltzer (1969), Brunner (1973, 1974, 1976)] the role of non-transaction accounts.

⁴Optimal allocation to currency and reserves is analyzed in Hess (1971) and Frost (1971). As emphasized in the text and the appendix, k does not depend on the rate of interest.

More recently, in Brunner and Meltzer (1976) we elaborated in substantial detail the rationale for going beyond the two asset world of Hicks or Metzler. We argued, there and elsewhere, that standard analysis ignores important events and significant effects of policy actions. And, we explained at length the role of time deposits in an analysis addressing observable events centered around 'intermediation' or 'disintermediation'.

The banking system's consolidated statement

$$a - m = \tau + \rho - 1,$$

where τ is the ratio of non-transaction accounts (time deposits) to the monetary base and ρ the ratio of all remaining liabilities (and all capital accounts) to the base, makes clear that the specification of one of the four magnitudes is dependent on the others. The relation also shows that the relative movements of the asset and monetary multipliers are closely related to the public's allocation patterns involving transaction and non-transaction accounts.

The relation can be used to explore the substantial difference in the interest sensitivity of the two multiplier expressions and to comment on the 'implausibility' of the derivatives of a and m with respect to i_t , the interest rate offered on time deposits. An increase in i_t occurring independently of the market rate, i_A on assets, yields,

$$\varepsilon(a, i_t) = \varepsilon(a, t) \cdot \varepsilon(t, i_t) > 0,$$

$$\varepsilon(m, i_t) = \varepsilon(m, t) \cdot \varepsilon(t, i_t) < 0,$$

where $\varepsilon(\)$ denotes a partial elasticity.

The elasticities of a and m with respect to i_t are a product of the multipliers' elasticities with respect to the time deposit ratio and the latter's elasticity with respect to i_t .⁵ Lower transaction costs or increased competition raises i_t relative to i_A ; banks bid more aggressively for time deposits and (other non-transaction accounts), and the public reallocates financial assets. The result of the market's full adjustment, expressed by the multipliers as a summary expression, is an increase in a and a fall in m . With unchanged transaction costs and degree of competition, any change in i_t is associated with movements of i_A . The two expressions

$$\varepsilon(a, i_A) = \varepsilon(a, r) \cdot \varepsilon(r, i_A) + \varepsilon(a, t) [\varepsilon(t, i_A) + \varepsilon(t, i_t) \cdot \varepsilon(i_t, i_A)],$$

$$\varepsilon(m, i_A) = \varepsilon(m, r) \cdot \varepsilon(r, i_A) + \varepsilon(m, t) [\varepsilon(t, i_A) + \varepsilon(t, i_t) \cdot \varepsilon(i_t, i_A)]$$

⁵Our discussion here follows the extensive discussion of the relative responses of m and a to interest rates in Brunner and Meltzer (1968).

show the interest elasticities of the two multipliers modified by the response of banks' allocation to reserves and offer of time deposits (and other non-transaction accounts). (We disregard the response of the supply of transaction accounts.) The first component shows the effect of interest rates on the reserve ratio. The second component shows the effect of interest rates on the public's allocation and the banks' offer of time deposits. The mixture of public and banks' characteristics in the two expressions make it clear that a and m have the properties of a reduced form. With the properties

$$\varepsilon(r, i) < 0 < \varepsilon(t, i_t), \quad \varepsilon(i_t, i_A) > 0$$

the bracketed expression is positive whenever prevailing competitive levels produce $\varepsilon(i_t, i_A) \sim 1$. At comparatively low levels of competition, with $\varepsilon(i_t, i_A)$ nearer zero than unity, the bracketed expression turns negative. The comparative interest sensitivity of the two multipliers thus depends on the prevailing degree of competition between financial institutions expressed by $\varepsilon(i_t, i_A)$.

4. Other technical issues

Friedman and Froewiss (1981) argue that it is 'impossible in general to identify the signs of the derivatives' of the multiplier functions if a and m are (partial) reduced forms. This statement may mean that it is often difficult to determine the signs of reduced form derivatives using only information about the signs of 'structural' derivatives. There is no compelling reason to restrict analysis in this way. To obtain hypotheses with definite empirical content, order constraints often must be imposed on combinations of structural derivatives.

In our hypothesis the most important constraints restrict the comparative responses of the public's demand for money and supply of earning assets to banks, not the properties of the allocation functions in the multiplier expressions. For the multipliers, we require only that the elasticity $\varepsilon(t, i_A)$ of the time deposit ratio with respect to the market rate of interest be numerically less than the elasticity $\varepsilon(t, i_t)$ of t with respect to the conditions under which banks offer time deposits. The determinacy of the signs of the multiplier expressions has no bearing on the issue discussed by Friedman and Froewiss. It simply means that the class of empirical hypotheses is not an empty set.

Friedman and Froewiss in their reply to van Loo claim that if our equations represent 'the interaction of both sides of their respective markets, then the σ -function [asset supply] would be identical with the a function [the asset multiplier] multiplied by B (which is exogenous), and the L function [money demand] would be identical to the m function [the monetary

multiplier] multiplied by B' . The quoted passage reveals some confusion. In the appendix, we show that our usual analysis, starting from the public's and the banks' allocation patterns, yields two independent market equations. One equation describes the credit market and one equation the money market. The two equations are not analytic (i.e., not identities in the economists' usage). The credit market juxtaposes $a(\dots)B$ with the public's asset supply $\sigma(\dots)$. The expression $a(\dots)B$ is a partially reduced expression derived from the underlying allocation and offer decisions of the public and the banks. The σ -function is a 'structural' equation. It is logically impossible for $a(\dots)B$ and $\sigma(\dots)$ to be 'identical expressions', or stated more correctly, for the equation relating the two to be an analytic statement. The same comment applies to the money market.

Friedman and Froewiss question the occurrence of some of the variables that enter as arguments in the multiplier functions. Their interpretation of $m(\dots)$ and $a(\dots)$ as structural supply functions precludes the occurrence of several variables. The appendix demonstrates that the variables at issue affect the allocation ratios that enter the multiplier expressions. Furthermore the Friedman-Froewiss interpretation yields a hypothesis difficult to reconcile with the data for the early 1930's when the multiplier expressions were dominated by the movement of the currency ratio and the reserve ratio.

Our use of descriptive terms apparently misled Friedman and Froewiss about the logical nature of the statements under consideration. An ascription like the 'desired stock of money' refers to any magnitude of M satisfying the money demand function and also to the reduced form solution of M derived from the whole system. The ascription does not differentiate between the two interpretations. The same comment applies to the 'banks' desired portfolio'. The values of earning assets and reserves emerging from the equilibrium system describe the banks' preferred position.

5. Equilibrium theory, old and new views

We take the opportunity provided by this exchange to comment on a broader set of issues related to the use of multiplier analysis of the stocks of money and bank credit. Multiplier analysis is, at times, described as an 'old view' or as a 'mechanical' treatment that is inconsistent with modern equilibrium analysis. We believe these claims are false.

The formulas describing the multiplication of reserve injections developed in the twenties and thirties were, indeed, 'mechanical' in a very specific sense. The parameters and allocation ratios in the formulas were often treated as constants, divorced from the choice theoretic framework and modern economic analysis. Careful statements of this approach, the best of which is perhaps in the textbook by Shaw (1950), recognized that the assumption of constant allocation ratios was, at best, a useful first step.

A principal problem with the 'old view' is the absence of any interaction between the asset markets and the determination of the stocks of money and credit. This failure of the 'old view' is not inherent. The subtle economic analysis of monetary history, by Milton Friedman and Anna Schwartz, relied on a multiplier approach but considered, also, the response of the allocation ratios to relative prices, costs, uncertainty and other determinants of economic behavior. Our own work, for the past twenty years, and the work of Frost (1971), Hess (1971), Korteweg-van Loo (1977) and others shows that the multiplier approach is not incompatible with equilibrium analysis and the 'new view'.

Our decision to develop an equilibrium analysis of the money stock based on the multipliers was motivated by our interest in moving beyond a 'forest of Jacobians' with little content. We chose an approach, often neglected by economists, between the highly formal and general statements that characterize large parts of economic analysis and the detail that characterizes econometric models of the financial sector. The multiplier approach provided a framework that was extended to analyze the responses of market rates, money stock and earning assets to their underlying determinants and to develop substantial empirical content *before* any econometric testing or estimating was done. The approach offers opportunities for examining a wide range of issues about institutional arrangements and deriving reliable conclusions about the effects of such arrangements.

We continue to believe that our approach offers a better solution to the practical problems associated with the rational execution of policies to control the stock of money. We are pleased to note that during the past decade some central banks outside the U.S. have adopted variants of this approach, have succeeded in controlling money and have contributed to the development of methods to implement the approach more effectively. We see no reason to adopt a 'non-multipliers approach' until there is some evidence that the alternative yields the same range of unambiguous propositions with a smaller set of constraints or a larger range of non-trivial propositions with few additional constraints.

Appendix: Description of the system

$$C = k(u_T, u_c, \dots)D, \quad (\text{A.1})$$

allocation of money balances between currency C and transaction accounts D where u_T and u_c denote the costs of holding or using transaction accounts and currency.

$$T = t(c_T, c_N, \dots)D, \quad (\text{A.2})$$

allocation of deposit accounts between transaction and non-transaction accounts. The arguments refer to the yields offered by the financial intermediaries to the account holders.

$$N = n(c_T, c_N, i_A, \dots)(D + T + GD), \quad (\text{A.3})$$

allocation of liabilities between deposit and non deposit liabilities.

$$R = r(i_A, \dots)(D + T + GD), \quad (\text{A.4})$$

allocation of assets between reserves and earning assets.

$$A = b(i_A, \dots)(D + T + GD), \quad (\text{A.5})$$

allocation of total reserves between unborrowed and borrowed reserves.

$$\begin{aligned} c_T &= c_T(i_A, \dots), \\ c_N &= c_N(i_A, \dots), \end{aligned} \quad (\text{A.6})$$

banks' offers of transaction specified conditions c_T and c_N and non-transaction liabilities at

$$R + EA = D + T + GD + A + N, \quad (\text{A.7})$$

the banks' consolidated statement.

$$GD = gD, \quad (\text{A.8})$$

allocation of Treasury deposits GD ; g is an exogenous parameter.

$$M = L(i_A, \dots), \quad (\text{A.9})$$

the public's demand for money.

$$EA = \sigma(i_A, \dots), \quad (\text{A.10})$$

the public's supply of assets to banks.

$$M = C + D, \quad (\text{A.11})$$

definition of money stock.

$$\text{The uses side of the source base is } B = C + R \quad (\text{A.12a})$$

To obtain the monetary base the reserve adjustment magnitude must be added to the right-hand side.

The sources side of the source base B = Federal Reserve Credit + gold stock + a combination of remaining items from the consolidated statement of the Treasury monetary account and the Federal Reserve Banks. (A.12b)

Notation: B = base, R = bank reserves, i.e., base money held by the consolidated banking system, C = currency held by the public, D = transaction accounts, T = non-transaction accounts in form of time deposits, A = bank liabilities to Federal Reserve Banks, N = banks' non-deposit liabilities, M = money stock, EA = banks' total earning assets.

Eqs. (A.1), (A.2), (A.4), (A.6), (A.8), (A.11) and (A.12a) yield the multiplier expression for the money stock, i.e., $M = m(\dots)B$, where m depends via the proximate parameters on all the arguments in the k , t and r -function. Eqs. (A.1)–(A.8) and (A.12a) yield the multiplier expression for earning assets, i.e., $EA = a(\dots)B$, where a depends via the proximate determinants k , t , r , n , b on all the arguments controlling these allocation parameters.

The system can be collapsed into four independent equations with σ denoting the public's asset supply function and L its money demand function.

$$EA = a(\dots)B, \quad (\text{A.13a})$$

$$EA = \sigma(\dots), \quad (\text{A.13b})$$

$$M = m(\dots)B, \quad (\text{A.14a})$$

$$M = L(\dots). \quad (\text{A.14b})$$

The four independent equations incorporate the public's and the banks' optimizing behavior. Eqs. (A.13a) and (A.13b) determine our credit market equation

$$a(\dots)B = \sigma(\dots),$$

and eqs. (A.14a) and (A.14b) imply our money market equation

$$m(\dots)B = L(\dots).$$

These are two independent equations describing the interaction of asset markets.

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