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THE MULTIPLIER APPROACH TO MONEY SUPPLY PROCESS IN NIGERIA

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The standard multiplier model of the money supply process, is examined in this paper. Specifically, the hypothesis that the adjusted multiplier is independent of the policy actions of the Central Bank of Nigeria (CBN) is tested. The results reveal that the Central Bank policy actions are independent of the adjusted multiplier, indicating that the multiplier in Nigeria has been relatively stable over time. This suggests the appropriateness of using the adjusted monetary base as an indicator of the effects of the Central Bank policy actions on the money stock.

The multiplier model of the money supply process originally developed by Brunner (1961) and Brunner and Meltzer (1964), has become the standard paradigm in macroeconomics and money and banking textbooks to explain how policy actions of various countries' Central Banks influence the money stock. It has also been used in empirical analysis of money stock control and the impact of monetary policy actions on other economic variables.

The framework of monetary control presented in this paper builds on the link between liquidity supplied by the Central Bank and the deposits and credit created by banks. In particular, it builds on the distinction between the initial creation of money balances which is reflected in the CBN balance sheet in the form of currency in circulation and bank reserve deposits, and secondary money creation by the licensed banks in the form of deposits. Hence the supply of money is determined by the base money created by the CBN and the money multiplier that relates base money and narrow money or broad money.

One important feature of the multiplier model is that it decomposes movements in the money supply into the part that is due directly to Central Banks' policy actions (the adjusted monetary base) and the part that is due to changes in technology and/or the tastes and preferences of depository institutions and the public (the adjusted multiplier). In this decomposition, the adjusted multiplier is assumed to be independent of the policy actions of a Central Bank.

Under the indirect monetary control, the money supply would be expressed as the product of a money multiplier and the monetary base, with the latter as the main intermediate instrument of monetary management. For the monetary base to act as the main link to money supply, a priori expectation of the money multiplier is that

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it should be stable over time.

The multiplier depends primarily on the public's currency/deposit preferences, the reserve requirement of the CBN, and the level of excess reserves desired by banks. The derivation of the multiplier would depend on the definitions of the money supply that is adopted. The policy tool used in the multiplier analysis is the statutory cash reserve requirement ratio (CRR) normally prescribed in the Central Banks' Monetary and Credit Policy Guideline. For example, the Commercial banks were required to deposit in the head office of the Central Bank, various cash balances representing some specified proportion of their total demand deposits for the period ranging from 1980 to 1987 (see Appendix I). A weighted average of the CRR, using each category's total demand deposits as weight for that category, gives a proxy of 4.35 per cent for the prescribed CRR in that period (see Appendix II).

In order to enhance the effectiveness of the cash reserve requirement for monetary control, the base for computing this ratio was expanded from January, 1991, to include all deposit liabilities. Subsequently, the uniform reserve requirement ratio (URR), was defined as the ratio of required reserves at the CBN to total deposit liabilities, comprising demand, time and savings deposit of commercial and merchant banks.

Garfinkel and Thornton (1991) examined closely the standard multiplier model of the money supply process, specifically questioning the thesis that the adjusted monetary base multiplier is independent of the policy actions of the Federal Reserve Bank. Their results suggest that the Federal Reserve's monetary policy actions are reflected both in the adjusted monetary base and the money multiplier. That the multiplier is affected by policy actions suggests that money stock control using the multiplier model would be enhanced, by taking the effect of policy actions on the multiplier into consideration.

Following Garfinkel and Thornton (1991), this paper examines the standard multiplier model of the money supply process in the case of Nigeria, specifically, the view that the adjusted multiplier is independent of the policy actions of the Central Bank. The evidence presented in this paper that the adjusted multiplier is independent of CBN policy actions, especially in the post uniform reserve requirement period, confirms the appropriateness of using the monetary base, rather than the total reserves of banks, as an indicator of the effects of policy actions of the Central Bank on the money stock.

The objective of this paper is to show the stability or otherwise of the money multiplier model in Nigeria. By stability we mean that the adjusted multiplier is independent of the policy actions of the Central Bank.

For ease of exposition, the rest of the paper is divided into seven sections. Section two discusses the multiplier approach to money stock control and the decomposition of the money stock into the monetary base and the multiplier. The concept of the adjusted multiplier and the adjusted monetary base introduced by Garfinkel and Thornton is discussed and adapted to the Nigerian situation in section three. Section four investigates the portfolio preferences of the non-bank

public as well as the depository institutions using the ordinary regression analysis (See Doguwa, 1993). The link between reservable deposits (deposits to which reserve requirement ratio is applicable) and statutory reserves is established in section five. Section six discusses the implications of the study to the Central Bank's monetary policy, while the last section concludes the paper.

2. THE MULTIPLIER APPROACH

As a starting point for decomposing the money supply into the monetary base and the multiplier, we note that the narrow money stock, M1 for the purpose of this study, is defined as

$$M1 = C^P + TCD1 \qquad (1)$$

where, TCD1 denotes private sector demand deposits at Commercial banks and C^P denotes the currency held by the non-bank public. The monetary base MB, is simply the sum of currency C^P, and total reserves R, in the banking system:

$$MB = C^P + R \qquad (2)$$

The total reserves R, is defined as:

$$R = C^B + D_{LB} \qquad (3)$$

where C^B denotes vault cash of the banks, and D_{LB} denotes the balances of the banks at the CBN, comprising required reserves, RR, penalty deposits, PD, and excess reserves, ER.

The reserves can be affected directly by the Central Bank's sales or purchases of government debt instruments in the open market. For simplicity, Garfinkel and Thornton (1991) assumed that the Federal Reserve Bank has a simple system of statutory reserve requirements, with required reserves, RR1, given by

$$RR1 = r\,TCD1 \qquad (4)$$

where, $0 < r < 1$ and r denotes the ratio of required reserves that must be held against the private sector demand deposits, TCD1, at the commercial banks. A change in the reserve requirement ratio, r, also would constitute a monetary policy action by the monetary authority.

The total reserves in the banking system R, defined in (3) consists of two mutually exclusive and exhaustive components, namely statutory reserves RR, and other reserves OR. That is:

$$R = RR + OR \qquad (5)$$

with

$$OR = C^B + PD + ER \qquad (6)$$

For simplicity, Garfinkel and Thornton (1991) assumed in the case of the United States of America that actual reserves always equal statutory reserves, so that other reserves are identically zero. However, the assumption invoked by Garfinkel and

Thornton (1991) is not consistent with the Nigerian experience. Owing to the dearth of a variety of money market instruments, coupled with the imposition of penalty which translates into penalty deposits at the CBN, it is common to find banks in Nigeria keeping other reserves higher than necessary.

In recent years, banks build-up other reserves for purposes of meeting the Second Tier Foreign Exchange Market/Foreign Exchange Market (SFEM/FEM) bidding. Based on the Nigerian experience, equation (5) can be written as:

$$R = (r + e)\, TCD1 \qquad (7)$$

where, the ratio e denotes the ratio of other reserves that are held against TCD1 and is expected to reflect the portfolio preference and/or behaviour of the depository institutions.

The model is completed by assuming that currency is held in some proportion k, of TCD1. That is:

$$C^p = R.TCD1 \qquad (8)$$

where, the proportion k, hereafter called the k-ratio, reflects the portfolio preference of the non-bank public for currency.

From (1) we have:

$$M1 = (1 + k)\, TCD1 \qquad (9)$$

Also from (2), (7) and (8), we have:

$$MB = \{k + e + r\}\, TCD1 \qquad (10)$$

A division of (9) by (10) produces the unadjusted monetary base- multiplier representation of M1:

$$M1 = m_1\, MB \qquad (11)$$

where m_1, the money multiplier unadjusted for changes in Reserves is given by

$$m_1 = \frac{1+k}{k+e+r} \qquad (12)$$

According to this representation, a policy action which increases R by one naira, through open market purchases of government securities, increases MB by one naira and the money stock M1 by m_1 naira.

Analogous to equations (1), (5), (7), (9), (10), (11) and (12), the following equations could easily be derived for the money supply broadly defined, M2:

$$M2 = M1 + QM \qquad (13)$$

where quasi - money QM, denotes the private sector time and savings deposit at commercial and Merchant banks;

$$RR2 = r_d\, TCD1 + r_q QM \qquad (14)$$

where, r_d denotes the prescribed cash reserve ratio on demand deposits of commercial banks, r_q denotes the prescribed cash reserve ratio on QM;

$$R = \{c + r_d + r_q\, q_m\}\, TCD1 \qquad (15)$$

where, q_m denotes the ratio of QM that must be held against private sector demand deposit at commercial banks, TCD1. It should be noted that for the years January, 1976 to December, 1990, r_d equals r, while r_q is approximately zero. However, from January, 1991, r_d, r_q and r are equal;

$$M2 = (1 + k + q_m)\, TCD1 \qquad (16)$$

$$MB = \{k + e + r_d + r_q\, q_m\}\, TCD1 \qquad (17)$$

The ratio r_q assumes a zero value between January, 1976 to December 1990 in equation (17), ostensibly because QM was not part of the reservable deposits in that period; and

$$M2 = m_2 MB \qquad (18)$$

where

$$M2 = \frac{1 + K + q_m}{k + e + r_d + r_q \cdot q_m} \qquad (19)$$

3. THE ADJUSTED MULTIPLIER

In the monetary base multiplier representation, policy actions are reflected not only in monetary base, MB, through changes in R, but also in the multiplier through changes in r. With a simple adjustment of MB, however, the effects of policy actions on the money supply M1, can be isolated in one measure. This alternative measure of the monetary base, called the adjusted monetary base AMB1, reflects both changes in R and r.

Garfinkel and Thornton (1991) constructed this measure by calculating the hypothetical level of statutory reserves that would have been required under the reserve requirements regime in existence during a chosen base period for the current (actual) level of reservable deposits. With the chosen base period, changes in required reserves, due to changes in the stipulated reserve requirement ratio, r, are added to the monetary base. Specifically the AMB1 is given by:

$$AMB1 = MB + RAM1 \qquad (20)$$

where the reserve adjustment magnitude RAM1, is defined as:

$$RAM1 = (r_o - r)\, TCD1 \qquad (21)$$

This adjustment magnitude measures the amount of reserves released or absorbed by changes in r relative to r_o, the required reserve ratio during a chosen base period. In the base period RAM1 is zero and AMB1 equals MB. A decrease in r from its base- period level r_o, releases reserves into the banking system and thereby increases RAM1 and AMB1. Conversely, an increase in r reflects the reserve drain on the banking system by reducing RAM1 and AMB1.

From equations (10) and (20) we have:

$$AMB1 = \{k + e + r_o\}\ TCD1 \qquad (22)$$

and dividing equation (9) by equation (22) yields the following decomposition of M1:

$$M1 = m_{1adj}\, AMB1 \qquad (23)$$

where the adjusted money multiplier m_{1adj}, is given by the equation:

$$m_{1adj} = \frac{1+k}{k+e+r_0} \qquad (24)$$

Analogous to equations (20), (21), (22), (23) and (24), we have the following representation for M2:

$$AMB2 = MB + RAM2 \qquad (25)$$

$$RAM2 = (r_o - r)\ (TCD1 + QM) \qquad (26)$$

The variable QM assumes a zero value between January, 1976 to December, 1990, because it was not part of the reservable deposits in that period.

$$AMB2 = \{k + e + r_o\ (1 + q_m)\}\ TCD1 \qquad (27)$$

$$M2 = m_{2adj}\, AMB2 \qquad (28)$$

where,

$$m_{2adj} = \frac{1+k+q_m}{k+e+r_0(1+q_m)} \qquad (29)$$

The ratio q_m appearing in equation (27) and the denominator of equation (29) assumes a zero value in the period ranging from January, 1976 to December, 1990, because QM was not included in the reservable deposits during that period.

In this characterization of the money supply process, all changes in monetary policy, through changes in r are expected to be reflected in the adjusted monetary base. However, changes in the adjusted multiplier reflects only changes in the portfolio preferences of the depository institutions and the non-bank public. Thus, the multiplier is supposed to be independent of policy since it is not directly influenced by the policy actions of the Central Bank.

Figure 1 shows the plots of the M1 and M2 multipliers and the adjusted multipliers for the period February, 1976 to December, 1993, with 1993 taken as the base period. It is apparent from the figure that the multiplier unadjusted for reserve requirements ratio is slightly lower than the adjusted multiplier in the first and third periods, suggesting that reserves are released into the banking system relative to the required reserve regime in the base period.

During the base period, both the multiplier and adjusted multiplier are identical. However, in the second period the unadjusted multiplier appears to be slightly higher than the adjusted multiplier indicating a reserve drain on the depository institutions, relative to the base period. The period demarcation was roughly based

on the CBN policy changes on the prescribed cash reserve requirement ratios as shown in Appendix II.

THE PORTFOLIO PREFERENCE OF THE NON-BANK PUBLIC AND THE DEPOSITORY INSTITUTIONS

4.1 The k - ratio

Interest in the currency ratio dates back to Fisher (1911), who was concerned that the two forms of money had different income velocities. He realised that these two monies are imperfect substitutes: currency is especially useful for making small, "face-to-face" transactions, while demand deposits provide a convenient means for making large transactions.

An important part of the determination of the k-ratio is the degree of substitutability between currency and demand deposits on one hand and between each of these money assets and near money assets or quasi-money, on the other. Although the explicit rates paid on TCD1 are relatively unresponsive to changes in market interest rates, rates paid on near-money assets can very markedly with variations in other market interest rates.

The effect of these variations on the proportions of money supply held in the form of currency, of course, depends on the degree of substitutability between near-money assets and the two forms of money. If currency is a relatively poor substitute for such assets while TCD1 is a relatively good one, the ratio of currency to TCD1 will change (with changes in rates paid on such near- money assets), because of changes in TCD1. Thus, changes in interest rates, whether policy induced or not, can have an asymmetric effect on the demands for currency and TCD1, with a direct effect on the proportion k in which these alternative monies are held.

Figure 2 shows the k-ratio and the observed adjusted monetary- base multipliers from February, 1976 to December, 1993 with January, 1993 to December, 1993 being the base period. The k- ratio accounts for some of the multipliers' short-run (month-to- month) variability and for the significant shifts in its long-run trends in the fourth period. Indeed, as shown in Table 1, changes in the k-ratio alone explain just over 8 and 12 per cent of the month-to-month variability in changes in the adjusted M1 and M2 multipliers, respectively, in the fourth period when the uniform reserve requirement regime (URR), was introduced by the CBN. Indeed, the URR in the fourth period, tightened the link between the k-ratio and the adjusted multiplier by reducing or eliminating other sources of variation in the adjusted multiplier.

Figure 3 shows the k-ratio, currency outside banks and TCD1. The behaviour of these series suggests that changes in the trend of the k-ratio are associated more closely with changes in the trend of TCD1 than with changes in the trend of currency growth. For instance, the rise in the k-ratio in the late 1970's is associated with a slowing in the growth of TCD1. The decline in the k-ratio in the early

1990's and its subsequent rise are clearly associated with a sharp acceleration in the growth of TCD1 followed by a deceleration in its growth. As expected, the minimum value of the k-ratio coincided with the Nigerian currency exchange exercise of March - April, 1984.

The variability of TCD1 more closely matches the variability of the k-ratio than does the variability of currency. While the growth rates of the k-ratio and TCD1 are highly, inversely related, there is little positive association between the growth rate of the k-ratio and the growth rate of currency outside banks, in the second and fourth periods. This observation is verified in Table 2, which shows the correlations between the monthly growth rates for currency and the k-ratio and for TCD1 and the k-ratio for four periods between February, 1976 and December, 1993.

If variations in the k-ratio were simply due to shifts between currency and TCD1, its variation would be equally attributable to variations in both currency and TCD1. However, this is not the case. The growth rates of currency and the k-ratio were weakly positively correlated in the second and fourth periods, with no obvious correlations in the first and third periods. In contrast, there appeared to be a strong and consistent negative correlations between the growth rates of both TCD1 and the k- ratio during all the four periods.

The correlations reported in Table 2 clearly suggest that month- to-month variability in the k-ratio is driven largely by movements in TCD1. Consequently, both the short and long-run movements of the k-ratio are associated more with movements in TCD1 rather than currency outside banks.

The apparent importance of TCD1 in influencing the k-ratio suggests that changes in k-ratio have not occurred simply because of variation in the relative advantages and holding cost of currency and TCD1. This implies that changes in the k-ratio have not been a simple result of the public's desire to shift the composition of money supply between currency and private sector demand deposits with commercial banks.

4.2 The e - ratio

Due to the dearth of money market instruments in Nigeria, coupled with the imposition of penalties on banks for non-compliance with the provisions of the monetary policy guidelines, it is very common to find depository institutions keeping other reserves higher than necessary. In recent years banks build-up other reserves OR, for purposes of making FEM bidding. Thus, the e-ratio reflects, to a large extent, the portfolio preference of the depository institutions in Nigeria.

Figure 4 shows the e-ratio and the adjusted M1 and M2 multipliers from February, 1976 to December, 1993. The e-ratio (e1 for M1 and e2 for M2), accounts for much of the multipliers' short-run variability and for the significant shifts in its long run trends. Both e1 and e2 were equal up to December, 1990 - prior to the introduction of the uniform reserve requirement, URR. However, in the post URR period, e2 was as expected much smaller than e1.

As shown in Table 3, changes in the e-ratio alone explains over 76.1 and 56.3

per cent of the month-to-month variability in changes in the M1 and M2 adjusted multipliers in all the four periods. In fact, changes in portfolio preference of the depository institutions affect the adjusted multiplier much more significantly than the changes in the portfolio preference of the non-bank public.

Figure 5 shows the e-ratio, other reserves and reservable deposits. The behaviour of these series suggests that changes in the trend of the e-ratio are associated more closely with changes in the trend of other reserves rather than with changes in the trend of reservable deposit growth. The variability of other reserves more closely matches the variability of the e-ratio than does the variability of reservable deposits.

The above observations are verified in table 4, which shows the correlations between the monthly growth rates of other reserves and the e-ratio growth and for reservable deposits growth and the e-ratio for the periods between February, 1976 and December, 1993. If variations in the e-ratio were simply due to shifts between other reserves and reservable deposits, its variation would be equally attributable to variations in both other reserves and reservable deposits. However, this is not the case. The growth rates of other reserves and the e-ratio were consistently positively correlated in all the four periods.

In contrast, there appeared to be a weak correlation between the growth rates of both reservable deposits and the e-ratio, although most of these correlations were not significantly different from zero. Consequently, both the short and long-run movements of the e ratio are associated with movements in other reserves rather than reservable deposits.

5. THE LINK BETWEEN RESERVABLE DEPOSITS AND REQUIRED RESERVES

Movements in the adjusted multiplier appear to be determined primarily by movements in the e-ratio and to some extent the k-ratio. The movements in the k-ratio, in turn, appear to be determined primarily by changes in reservable deposits. The question that remains is, "what determines the stock of reservable deposits outstanding?" The model of the money supply presented earlier, appeared to provide a simple answer:- the stock of reservable deposit is influenced largely by the amount of required reserves prescribed by the CBN, through the cash reserve ratio. This link arises in the model because the stock of required reserves are assumed to be held only to meet the statutory cash reserve requirement ratio prescribed by the CBN.

The strength of the relationship between the monthly growth rates of reservable deposits and required reserves is illustrated in Table 5. This table shows the results of a simple linear regression of reservable deposit monthly growth rates on the monthly growth rates of required reserves for several periods between February, 1976 and December, 1993. The regression estimates in the table are however intended to be illustrative and should not be interpreted as alternative models for the money supply process.

In all cases, except the post URR period, there appeared to be a statistically significant relationship between the monthly growth rates of reservable deposits and required reserves. The strength of the relationship, as measured by the adjusted R-squared in the period February, 1976 to December, 1978, suggests that the growth rates of required reserves accounted for over 99.9 per cent of the monthly growth rates of reservable deposits. However, the strength of this relationship declined drastically in subsequent periods, with the post URR period showing no significant relationship between the two growth rates.

6. IMPLICATIONS FOR MONETARY POLICY

6.1 Effects of Policy Action on the Multiplier

The regression analysis of the monthly growth rates of the statutory reserves on the adjusted multiplier presented in Table 6, suggests that except for the first and second periods, policy actions could not exert any significant effect on the M1 and M2 multipliers, respectively. The analysis suggests that policy actions have no significant effect on the multipliers in the 1990s, when the uniform reserve requirement regime, URR was introduced. Changes in statutory reserves accounted for 29.6 and 9.9 per cent of the variation in the M1 and M2 adjusted multipliers, in the first and second period, respectively (see Tables 6a and 6b). However, during the URR regime, it appeared that the two adjusted multipliers were independent of policy actions.

The realization that the two adjusted multipliers are independent of CBN policy actions suggests that the adjusted monetary base might be the best indicator of policy actions on the money stock. The adjusted monetary base is designed to reflect all policy actions - changes in the monetary base through changes in R and changes in the multiplier through changes in r; however, except for the second and post-URR periods, the adjusted monetary base does not fully capture the effects of these actions on both M1 and M2 (See Table 6).

6.2 The Key Feature of the Money Multiplier

One of the important features of the multiplier model is that it decomposes movements in the money supply into the part that is due directly to CBN policy actions (the adjusted monetary base) and the part that is due to changes in the portfolio preference of the depository institutions (the money multiplier).

The regression analysis of the monthly growth rates of money supply on the adjusted monetary base and adjusted multiplier is presented in Table 7. The analysis presented in this table revealed some interesting results. Apart from the first and second periods when changes in the portfolio preference of the depository institutions accounted for just over 32.5 and 17.5 per cent of the movements in M1 and M2, respectively, the changes in the portfolio preference of the depository institutions (as reflected in the adjusted multiplier), have no impact on the movements in the money stock. Rather, changes in the Central Bank policy actions

(as reflected in the adjusted monetary base) have increasingly accounted for most of the variations in the money stock.

6.3 The Adjusted Monetary Base as an Indicator of Policy Actions on the Money Stock

Except in the first and second periods, the adjusted monetary base has adequately captured the effects of policy actions on M1 and M2, respectively. Indeed as shown in Table 7, changes in money stock, M2 are now more closely linked to changes in the adjusted monetary base followed by changes in adjusted multipliers and total reserves, in that order.

The poor performance of total reserves as an indicator of monetary policy could be fathomed from the following brief component analysis of total reserves, R. Required reserves in Nigeria are frozen and unchangeable in the current month. Similarly, penalty deposit which is a component of total reserves, cannot be changed in the current period by using the instruments of indirect monetary control. Vault cash is determined behaviourally by the demand for it, by the licensed banks. In short the only component of total reserves the CBN can influence and potentially control is excess reserves. Consequently, it may not be possible to achieve a total reserve target within a current month by manipulating excess reserves, given the values of other components of total reserves.

It now appears that the cash reserve requirement ratio on all reservable deposits would have to be substantially increased in order to effectively control the money stock, through RR and subsequently AMB. Prescribing a higher ratio would make the control of money stock more effective under the indirect monetary control framework.

7. SUMMARY AND CONCLUSIONS

This paper has examined closely the standard multiplier model of the money supply process, specifically, the view that the adjusted multiplier is independent of the policy actions of the Central Bank of Nigeria. The paper found that the CBN's monetary policy actions, reflected in the prescribed reserve requirement ratios, were independent of the adjusted money multipliers for both M1 and M2. In other words, the paper has shown that these two adjusted multipliers in Nigeria are relatively stable over time.

The independence of the multipliers from the policy actions has important implications for the multiplier approach to money stock control. By taking this approach, the target level of M1 or M2 could be achieved by forecasting the M1 or M2 adjusted multiplier and then supplying the amount of the adjusted monetary base necessary to hit the desired M1 or M2 target. However, forecasting the monthly adjusted multiplier is certainly beyond the scope of this study. However, Balbach (1981), Hafer et al (1983) and Johannes and Rasche (1979, 1987) provided an excellent discussion of the multiplier approach to money stock control. They have also reviewed alternative methods that have been used to forecast the multiplier.

Apart from the first and second periods when changes in the M1 and M2 adjusted multipliers accounted for just over 32.5 and 17.5 per cent of the movements in M1 and M2, respectively, the changes in these multipliers have no impact on the movements in the money stock. Rather, changes in the adjusted monetary base have increasingly accounted for most of the variations in the money stock.

The realization that the two adjusted multipliers are independent of CBN policy actions suggests that the adjusted monetary base might be the best indicator of policy actions on the money stock. The adjusted monetary base is designed to reflect all policy action - changes in the monetary base through changes in R and changes in the multiplier through changes in r; however, except in the first and third periods, the adjusted monetary base has adequately captured the effects of policy actions on both M1 and M2. Indeed, changes in money stock, M2 are now more closely linked to changes in the adjusted monetary base followed by changes in adjusted multipliers and total reserves, in that order.

In all cases, except the post uniform reserve requirement period, there appeared to be a statistically significant relationship between the movements of reservable deposits and movements of required reserves. Consequently, for the CBN to effectively control the money stock, the adoption of the URR appears to be in the right direction. However, for the URR to be effective, the statutory cash reserve ratio should be revised upwards, with a view to strengthening the relationship between movements in required reserved and reservable deposits, especially with the adoption of OMO as an indirect control instrument.

Table 1a: **Regression estimates of movements in the M1 adjusted multiplier gm_{1adj} on movements in the currency ratio, gk: $gm_{1adj} = a + b\,gk$**

Period	a	b	SEE	D.W	Adj R^2
1976:2–1978:12	0.015 (1.33)	–0.597* (3.00)	0.066	1.65	0.191
1979:1–1987:12	0.001 (0.21)	0.059 (0.92)	0.052	2.47	0.000
1988:1–1990:12	0.003 (0.33)	–0.258 (1.42)	0.054	2.45	0.028
1991:1-1993:12	0.001 (0.13)	–0.276 (2.19)	0.044	2.59	0.098

* Indicates statistical significance at the 1 per cent level. Absolute values of t-statistic are in parenthesis.

Table 1b: **Regression estimates of movements in th eM2adjusted multiplier gm_{2adj}, on movements in the currency ratio, gk: $gm_{2adj} = a + b\ gk$**

Period	a	b	SEE	D.W	Adj R^2
1976:2–1978:12	0.012 (1.04)	–0.138 (0.66)	0.069	1.77	0.000
1979:1–1987:12	0.004 (0.71)	0.034 (0.44)	0.062	2.54	0.000
1988:1–1990:12	0.000 (0 04)	–0 311 (1.46)	0.064	2.46	0.031
1991:1-1993:12	–7.774 (0 00)	–0.421 (2 48)	0.059	2 36	0.128

* Indicates statistical significance at the 1 per cent level. Absolute values of t-statistic are in parentheses.

Table 2: **Spearman's rank correlation between the monthly growth rates of the k – ratio and the monthly growth rates of Currency and TCD1.**

Period	k-ratio & Currency	k-ratio & TCD1
1976:2–1978:12	–0 112	–0.928*
1979·1–1987:12	0 467*	–0 737*
1988:1–1990:12	0 424	–0.736*
1991:1-1993:12	0.634*	–0.703*

* Indicates statistical significance at the 1 per cent level.

Table 3a: **Regression estimates of movements in the M1 adjusted multiplier gm_{1adj}, on movements in other reserve ratio gel: $gm_{1adj} = a + b\ gel$**

Period	a	b	SEE	D.W	Adj R^2
1976:2–1978:12	0.008 (1.67)	–0 340* (14.10)	0 028	2 03	0.853
1979.1–1987:12	0 007* (2 71)	–0 179* (18.49)	0.025	1.91	0.761
1988:1–1990:12	0.006 (1 60)	–0 168* (12.66)	0 023	2 08	0.820
1991.1-1993·12	0 005 (1 89)	–0 214* (16.72)	0 015	1.95	0.888

* Indicates statistical significance at the 1 per cent level. Absolute values of t-statistic are in parentheses.

Table 3b: **Regression estimates of movements in the M2 adjusted multiplier gm_{2adj}, on movements in other reserve ratio gel: $gm_{2adj} = a + b$ gel**

Period	a	b	SEE	D.W	Adj R^2
1976:2–1978:12	0.005 (1.12)	–0.291* (13.32)	0.025	1.92	0.838
1979:1–1987:12	0.009* (2.69)	–0.170* (11.78)	0.038	1.99	0.563
1988:1–1990:12	0.003 (0.46)	–0.169* (7.69)	0.039	1.97	0.625
1991:1-1993:12	0.003 (0.50)	-0.147* (8.11)	0.032	1.84	0.649

* Indicates statistical significance at the 1 per cent level. Absolute values of t-statistic are in parenthesis.

Table 4: **Spearman's rank correlation between the monthly growth rates of the e-ratio and the monthly growth rates of Other Reserves and reservable deposits.**

Period	e-ratio & Other Reserves	e-ratio & Reservable Deposits
1976:2–1978:12	0.935*	–0.382
1979:1–1987:12	0.979*	–0.270*
1988:1–1990:12	0.985*	–0.021
1991:1-1993:12	0.960* 0.979*	0.005 :M1 –0.119 :M2

* Indicates statistical significance at the 1 per cent level. \1 The ratio el equals e2 in the first three periods.

Table 5a: **Regression estimates of the growth rate of M1 reservable deposit, gTCD1 on the growth rate of Required Reserves, gRR1: gTCD1 = a + b gRR1**

Period	a	b	SEE	D.W	Adj R^2
1976:2–1978:12	0.000 (1.79)	1.000* (49.98)	0.001	2.22	0.999
1979:1–1987:12	0.011 (2.47)	0.438* (7.48)	0.042	1.68	0.339
1988:1–1990:12	0.009 (0.93)	0.265* (3.12)	0.048	1.65	0.199
1991:1-1993:12	0.037* (5.34)	–0.006 (0.19)	0.041	2.29	0.000

Table 5b: **Regression estimates of the growth rate of M2 reservable deposits, gRDM2 on the growth rate of Required Reserves, gRDM2 = a + b gRR2**

Period	a	b	SEE	D W	Adj R^2
1991:1-1993 12	0 084 (1 35)	0 084 (0 22)	0 346	1 05	0 000

Table 6a: **Regression estimates of the growth rate of the required reserves, gRR1 on the growth rates of M1-adjusted multiplier, gm_{1adj} and adjusted monetary base, gAMB1: (i) gRR1 = a + b gm_{1adj} (ii) gRR1 = a + c gAMB1**

Period	a	b	c	SEE	D W	Adj R^2
1976:2–1978.12	0 015 (1 75)	0 487* (3 91)	–	0.053	1 91	0 296
	0.023 (2.11)	–	–0.048 (0.27)	0.064	2 13	0 000
1979:1–1987:12	0 005 (0.83)	–0.228 (1.77)	–	0.069	1 61	0 020
	0.000 (0 05)	–	0.448* (4.56)	0.063	1.52	0 183
1988:1–1990:12	0 039* (2.45)	–0.046 (0.16)	–	0 094	1,23	0.000
	0.033 (1.87)		0.328 (1.18)	0.092	1 12	0 011
1991:1-1993:12	0.044 (1.42)	1.722 (2.44)	–	0.191	1 49	0.1250
	0.078 (1.98)	–	–0.866 (1 54)	0.200	1.58	0 038

* Indicates statistical significance at the 1 per level. Absolute values of t-statistic are in parentheses.

Table 6b: **Regression estimates of the growth rate of the required reserves, gRR2 on the growth rates of M2-adjusted multiplier, gm_{2adj} and adjusted monetary base, gAMB2: (i) gRR2 = a + b gm_{2adj} (ii) gRR2 = a + c gAMB2**

Period	a	b	c	SEE	D W	Adj R^2
1976:2–1978:12	0.018 (1.87)	0.346 (2.10)	--	0.060	2.03	0.091
	0.023 (2.11)	–	–0.048 (0.27)	0.064	2.13	0.000
1979:1–1987:12	0.006 (1.12)	–0.400* (3.58)	–	0.066	1.53	0.099
	0.000 (0.05)	-	0.448* (4.56)	0.063	1.52	0.183
1988:1–1990.12	0.039 (2.51)	0.151 (0.63)	--	0.094	1,31	0.000
	0.033 (1.87)	-	0.327 (1.16)	0.092	1.12	0.011
1991:1-1993·12	0.061 (2.47)	0.985 (2.38)	–	0.147	1.93	0.128
	0.100* (3.17)	–	–1.037 (2.64)	0.144	1.95	0.147

*indicates statistical significance at the 1 per level. Absolute values of t-statistic are in parentheses.

Table 7a: **Regression estimates of the movements of money supply gM1 on the movements of adjusted monetary base gAMB1, Total reserves gR, and M1-adjusted multiplier, gm_{1adj}: (i) gM1 = a + b gAMB1, (ii) gM1 = a + c gR and (iii) gM1 = a + d gm_{1adj}**

Period	a	b	c	d	SEE	D.W	Adj R^2
1976:2–1978:12	0.02* (3.21)	–0.18 (0.29)	–	–	0.04	1.84	0.000
	0.02* (3.23)	–	–0.03 (0.27)	–	0.04	1.89	0.000
	0.02* (3.11)	–	–	0.32* (4.17)	0.03	1.72	0.325
1979:1–1987:12	0.01 (2 28)	0.37* (8.93)	-	–	0.03	2.32	0.424
	0.01* (2.72)	–	0.04 (2.59)	–	0.03	2.13	0.051
	0.01* (3.08)	–	–	–0.07 (0.99)	0.04	2.15	0.000
1988:1–1990:12	0.02 (2.53)	0.24 (2.27)	–	–	0.03	1,76	0.106
	0.02 (3.38)	–	0.00 (0.14)	–	0.04	1.49	0.000
	0.02* (3.52)	–	–	0.04 (1.67)	0.04	1.53	0.049
1991:1-1993:12	0.03* (5.81)	0.31* (4.52)	–	–	0.02	2.66	0.357
	0.04* (6.82)	–	0.03 (1.24)	–	0.03	2.59	0.0.15
	0.04* (7.33)	–	–	–0.08 (0.70)	0.03	2.55	0.000

* Indicates statistical significance at the 1 per cent level. Absolute values of t-statistic are in parentheses.

Table 7b: **Regression estimates of the movements of money supply gM2 on the movements of adjusted monetary base gAMB2, Total reserves gR, and M2 adjusted multiplier gm_{2adj}: (i) gM2 = a + b gAMB2, (ii) gM2 = a + c gR and (iii) gM2 = a + d gm_{2adj}**

Period	a	b	c	d	SEE	D-W	Adj R^2
1978:12	[illegible]	[illegible] (0.23)	–	–	0.02	2.00	[illegible]
	[illegible]	[illegible]	[illegible]	–	0.02	2.01	[illegible]
	[illegible]	–	–	0.02* (3.97)	0.02	2.31	0.000
[illegible]	[illegible]	–	–	–	[illegible]	2.01	0.358
	[illegible]	–	–	–	0.02	1.96	0.089
	[illegible]	–	–	0.23* (2.90)	0.03	1.47	0.175
1988:1–1990:12	0.02 (2.65)	0.05 (0.53)	–	–	0.03	1,39	0.000
	0.02* (3.69)	–	0.01 (0.34)	–	0.03	1.33	0.000
	0.01* (6.43)	–	–	–0.09 (2.29)	0.02	1.91	0.038
1991:1–1993:12	0.03* (7.26)	0.14* (3.62)	–	–	0.02	2.20	0.143
	0.03* (6.93)	–	0.03 (1.24)	–	0.02	2.35	0.015
	0.02* (4.25)	–	–	–0.13 (2.14)	0.02	2.01	0.096

* indicates statistical significance at the 1 per cent level. Absolute values of t-statistic are in parentheses.

APPENDIX I

Prescribed cash reserve ratios for the period: 1980 - 1987

Category of Bank	TCD (₦ millions)	Cash reserve ratio (per cent)
A	₦300 or more	5.0
B	₦100 - ₦300	4.0
C	₦30 - ₦100	3.0
D	Less than ₦30	2.0

APPENDIX II

CBN policy changes on cash reserve requirement ratio (1976 - 1993)

Period	Number of Months	Cash reserve ratio (weighted) (per cent)
1976:1 - 1978:12	36	11.0
1979:1 - 1987:12	108	4.35 - 5.41
1988:1 - 1990:12	36	6.35 - 8.32
1991:1 - 1993:12 1/	36	3.0 - 6.0

1/ Uniform reserve requirement URR, defined as the statutory cash deposits which the depository institutions must keep with CBN against all deposit liabilities (demand, time and savings), in compliance with the prescribed reserve requirement ratio, was introduced in the period.

REFERENCES

1. Balbach, A.B. (1981). How Controllable is Money Growth? *Federal Reserve Bank of St. Louis*, pp 3 - 12.
2. Brunner, K. (1961). A Schema for the Supply Theory of Money. *International Economic Review*, pp 79 - 109.
3. Brunner, K and Meltzer, A.H. (1964). Some Further Investigations of Demand and Supply Function for Money. *Journal of Political Economy*, pp 1 - 37.
4. Cagan, P. (1958). The Demand for Currency relative to the total Money Supply. *Journal of Political Economy*, pp 303 - 328.
5. Doguwa, S.I. (1993). *Regression Analysis and Box- Jenkins Models - A supplement.* Text of a Lecture delivered during the Research Methodology Course for Economist and Assistant Economist, at the CBN Training Centre, Satellite Town, Lagos.
6. Fisher, I. (1911). *The Purchasing Power of Money* (Augustus M. Kelly, 1911).
7. Garfinkel, M. R. and Thornton, D.L. (1991). The Multiplier Approach to the Money Supply Process: A Precautionary Note. *Federal Reserve Bank of St. Louis*, pp 47 - 63.
8. Hafer, R.W., Hein, S.E. and Kool, C.J.M. (1983). Forecasting the Money Multiplier: Implications for Money Stock Control and Economic Activity. *Federal Reserve Bank of St. Louis*, pp 23 - 33.
9. Hess, A.C. (1971). An Explanation of the Short-run Fluctuations in the Ratio of Currency to Demand Deposits. *Journal of Money, Credit and Banking*, pp 666 - 679.

10. Johannes, J.M. and Rasche, R. H. (1979). Predicting the Money Multiplier. *Journal of Monetary Economics*, pp 301 - 325.

11. Johannes, J.M. and Rasche, R.H. (1987). *Controlling the Growth of Money Aggregates*, (Kluwer Academic, 1987).

12. Research Department (1979) *Twenty years of Central Banking in Nigeria*. Ibadan University Press.

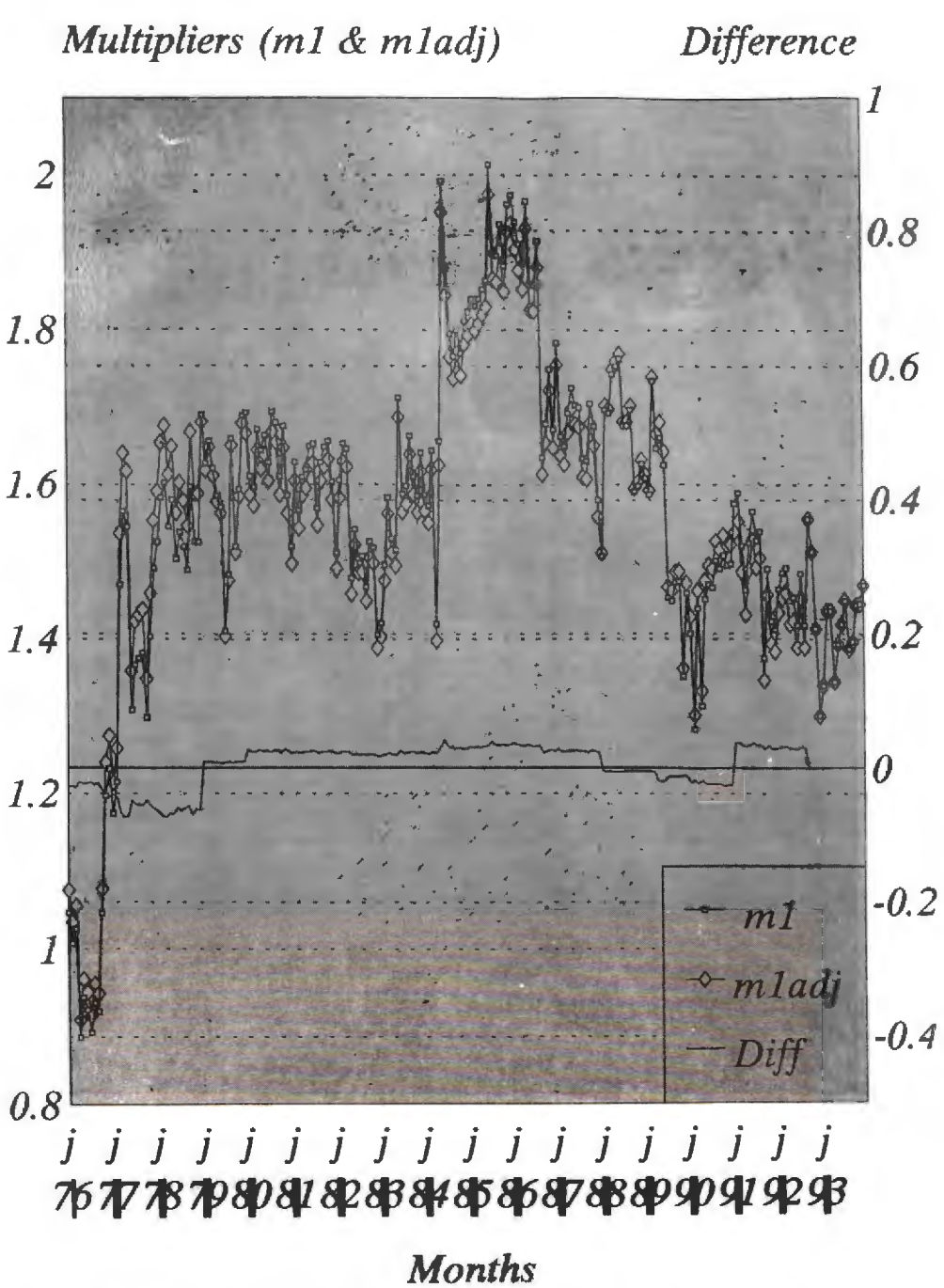

Fig. 1a: The adjusted and unadjusted M1 multipliers between January, 1976 and December, 1993.

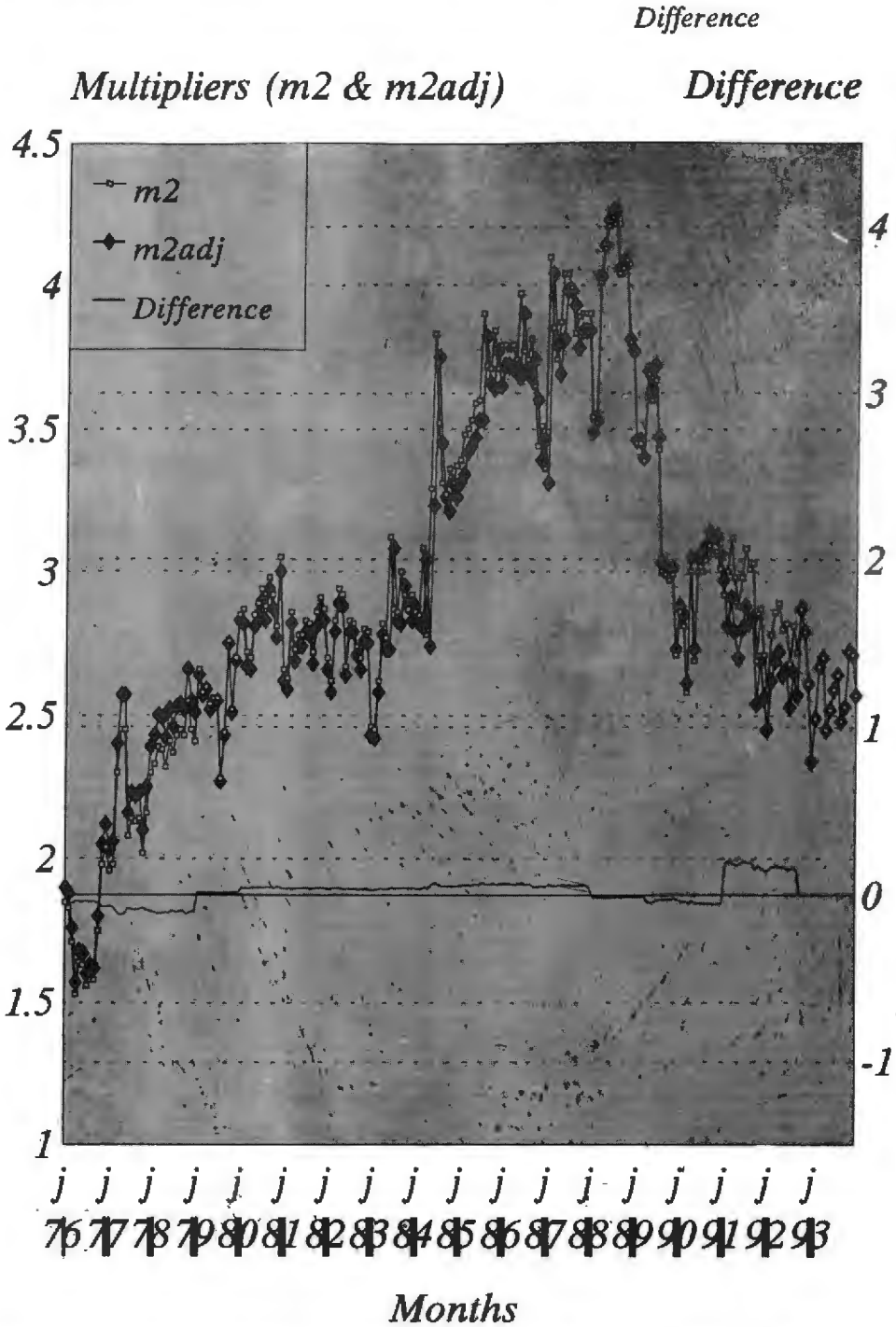

Fig. 1b: The adjusted and unadjusted M2 multiplier between January, 1976 and December, 1993.

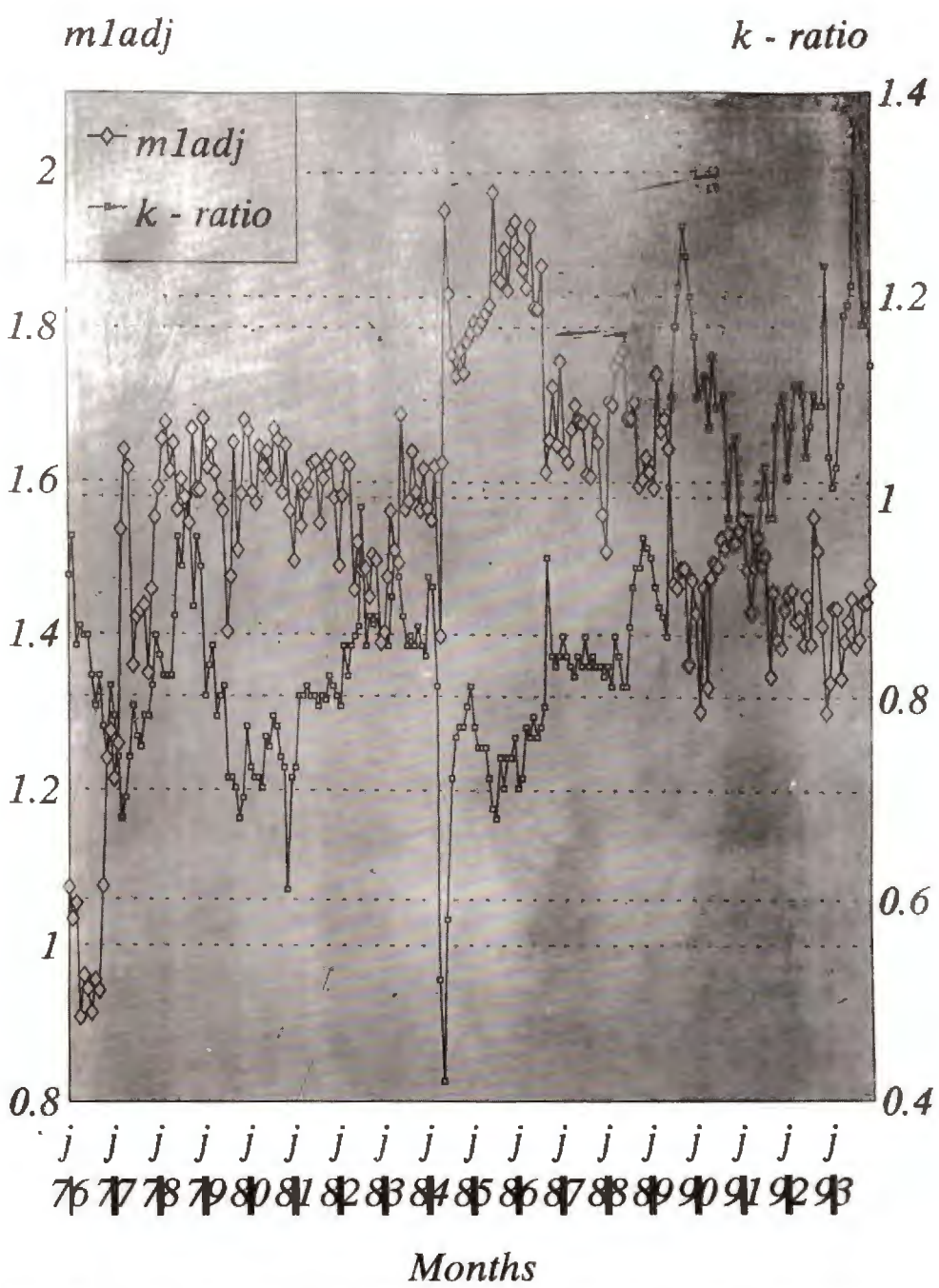

Fig. 2a: The k-ratio and the adjusted M1 multiplier between January, 1976 and December, 1993.

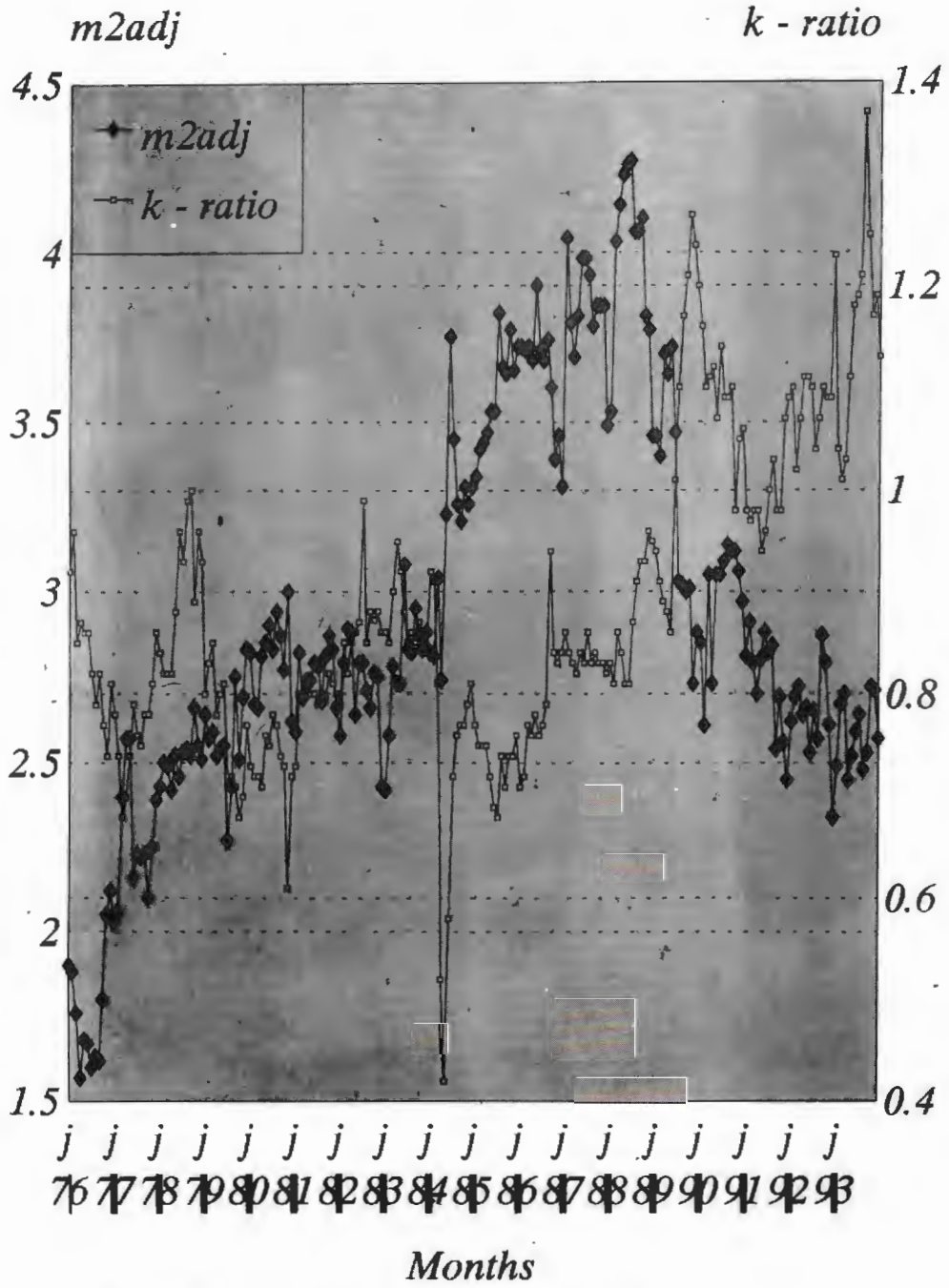

Fig. 2b: The k-ratio and the adjusted M2 multiplier between January, 1976 and December, 1993.

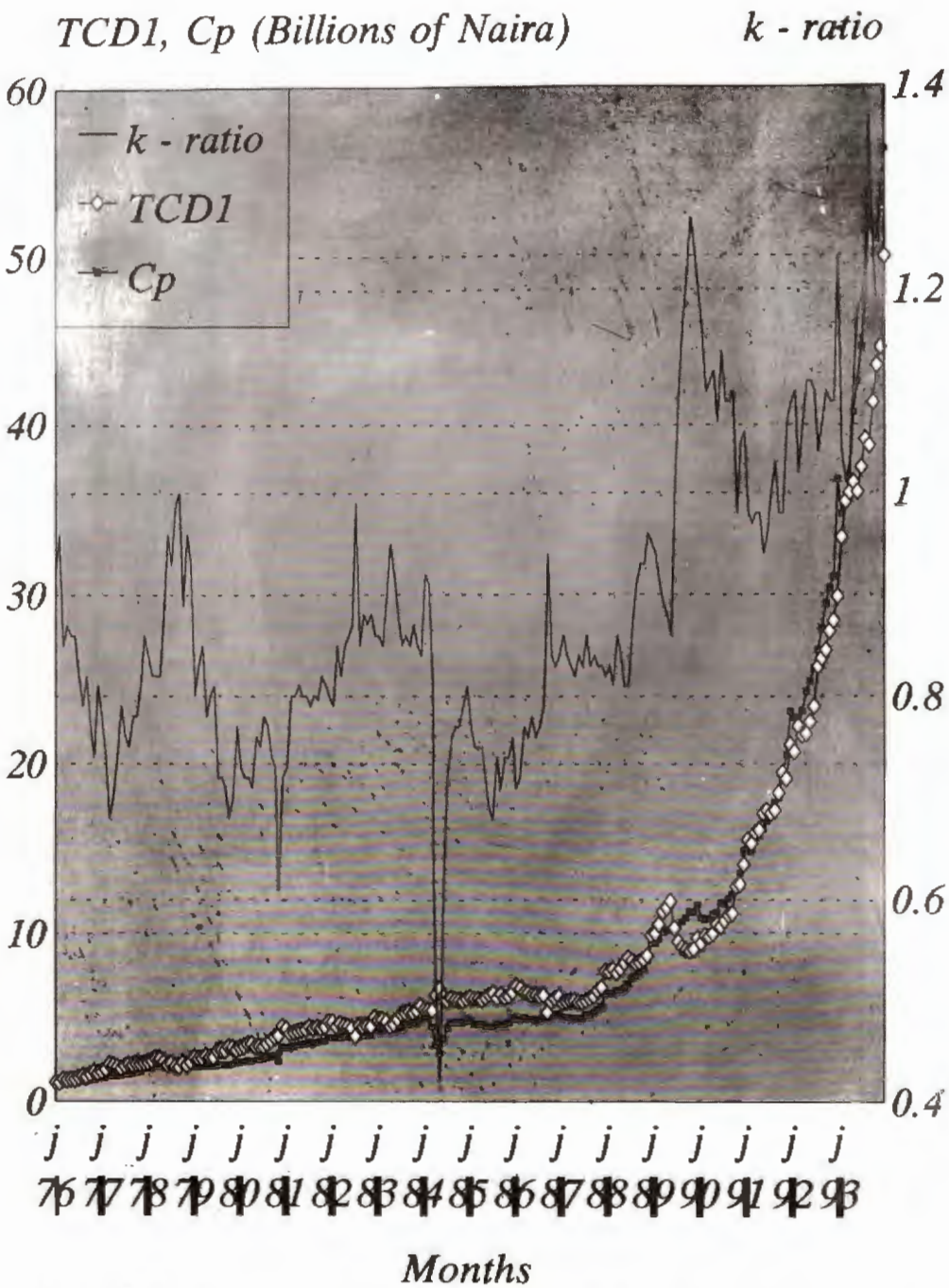

Fig. 3 The k-ratio, currency with non-bank public and private sector demand deposits at commercial banks between January, 1976 and December, 1993.

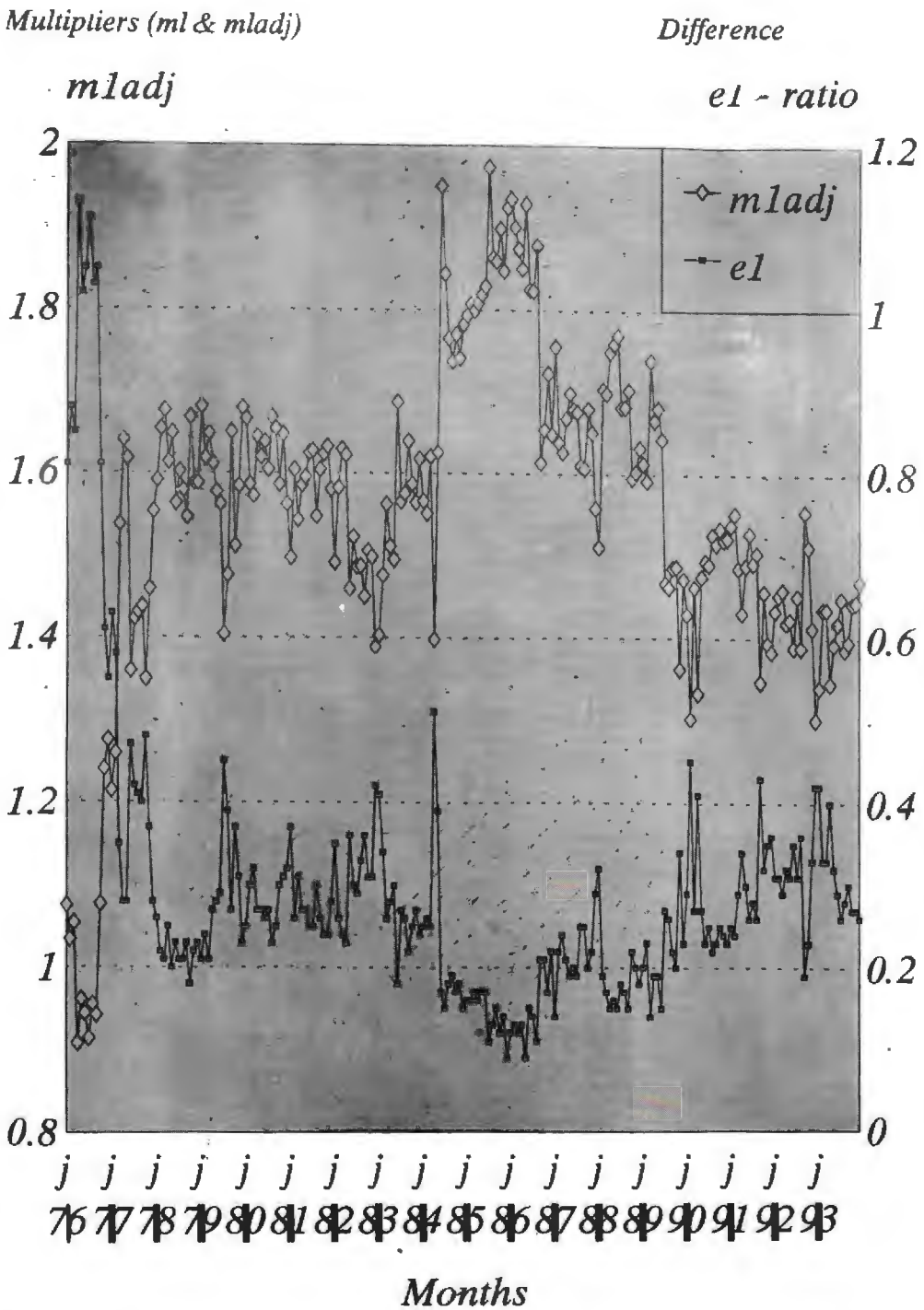

Fig. 4a: The e-ratio and the adjusted M1 multiplier between January, 1976 and December, 1993.

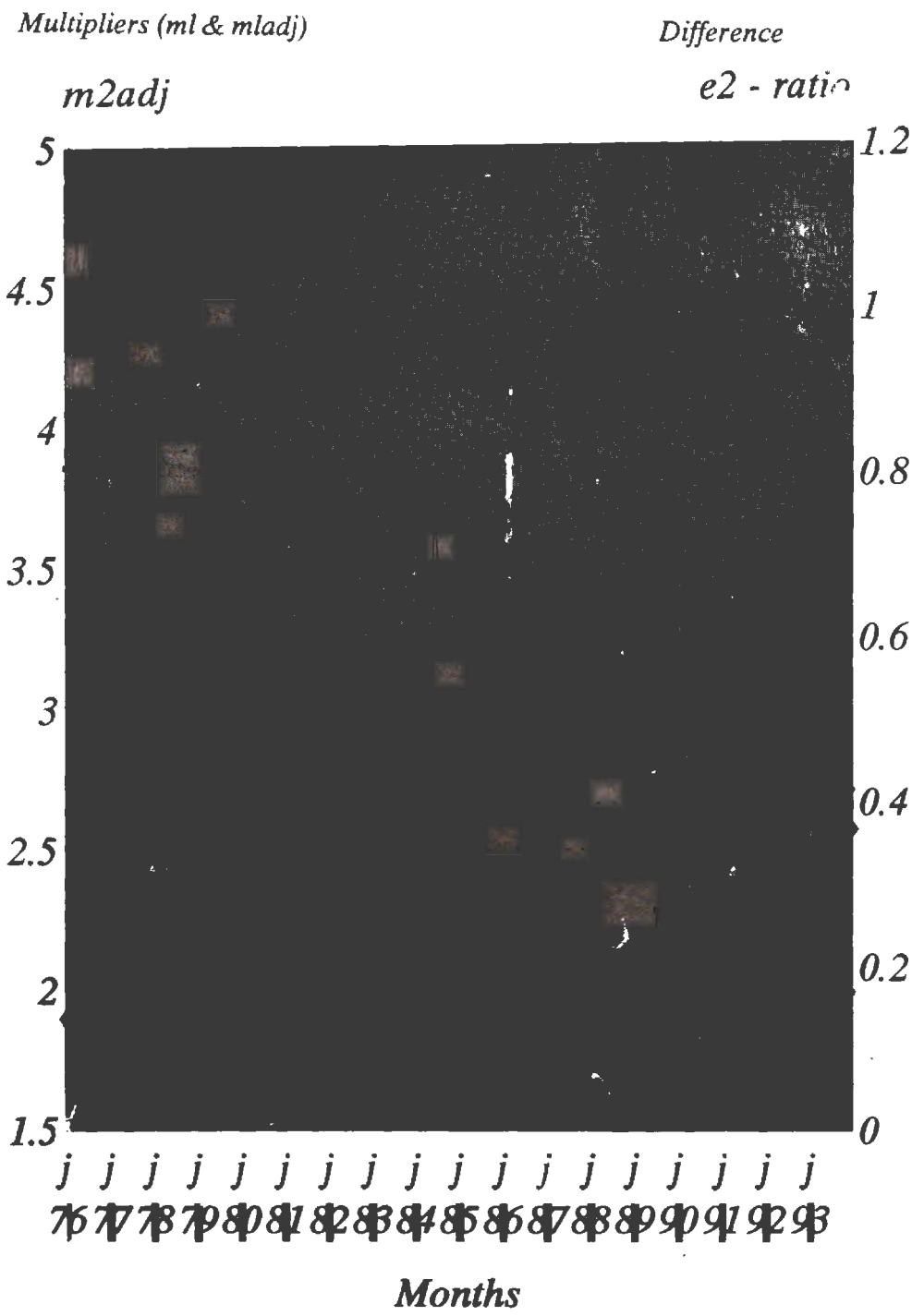

Fig. 4b: The e-ratio and the adjusted M2 multiplier between January, 1976 and December, 1993.

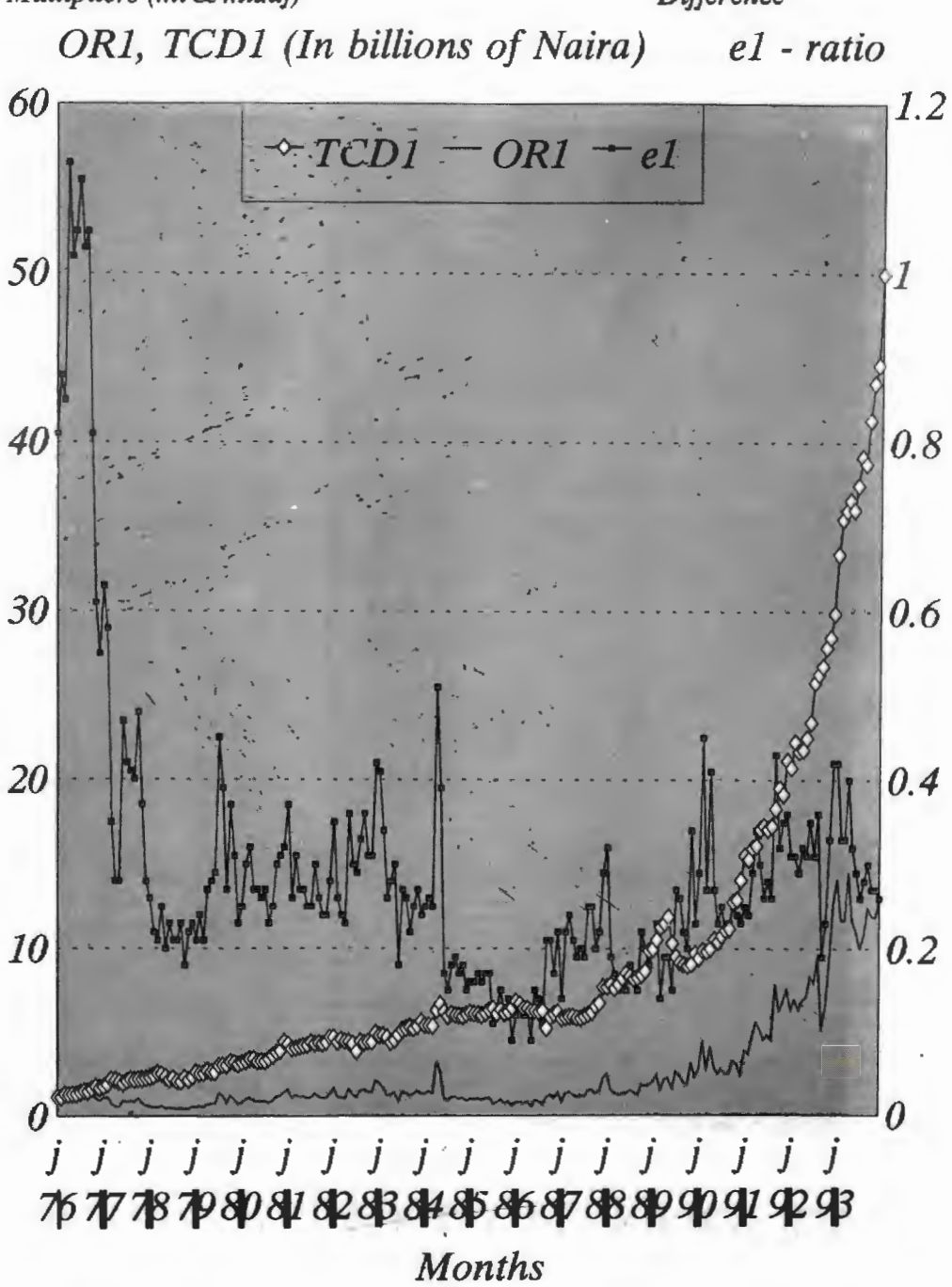

Fig. 5a: The el-ratio, other reserves OR1 and private sector demand deposits at commercial banks between January, 1976 and December, 1993.

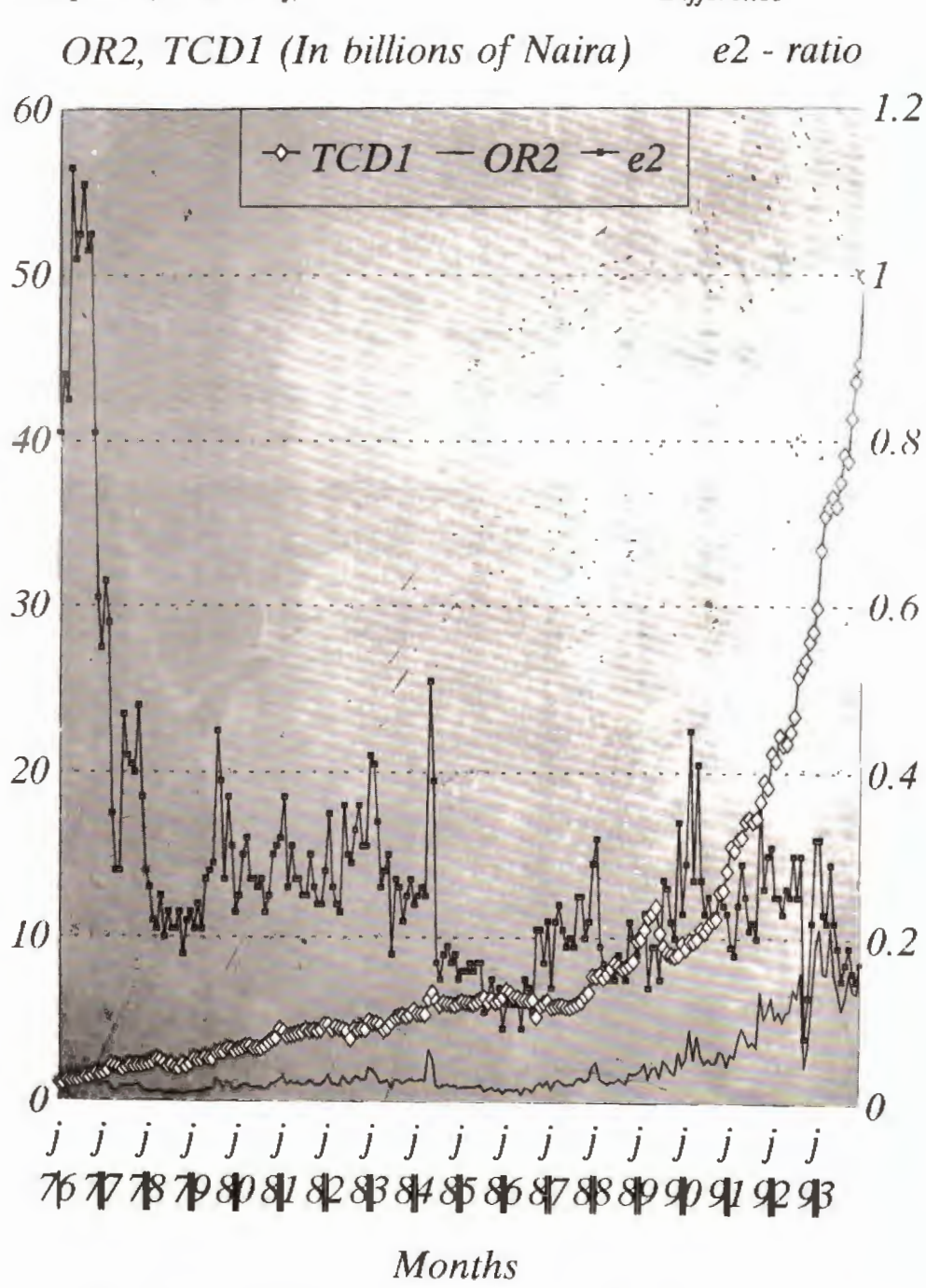

Fig. 5 b: The e2-ratio, other reserves, OR2, and private sector demand deposits at commercial banks between January, 1976 and December, 1993.