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An Analytical-Schematic Presentation of the Franc Area Monetary System[1] in Central Africa

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Five countries in Central Africa (Cameroon, the Central African Republic, Chad, the People's Republic of the Congo, and Gabon) are members of a common central bank, the Banque des Etats de l'Afrique Centrale (BEAC), and share a common currency as well as pool their reserves.[2] The present note proposes a schematic presentation of the monetary system of these countries which could facilitate an analysis of monetary developments. Basically, the paper analyzes interactions between four sectors--the Government, the nonbank private sector, deposit money banks and other financial institutions, and the Central Bank. However, for purposes of analysis here, fiscal operations of the Government, as reflected in its transactions with the banking system, are considered as autonomously determined.[3] The private nonbank sector's relationship with the banking sector is traced through its demand for money. The behavior of commercial banks is analyzed by working with certain balance sheet identities and various legal constraints imposed on their operations. Then, money supply is determined by focusing attention on the creation of 'base money' by the Central Bank and on the money multiplier. For illustrative purposes, monetary and credit developments in one member country of the BEAC, Chad, are analyzed in the final section.

The model, as well as the results as applied to Chad, should be taken as a preliminary attempt to formalize the monetary system of the area. As data become available for more countries, it is hoped to elaborate the model further and to extend it to other countries. In particular, the mechanism through which the equality is brought about between the demand for and supply of money needs to be explored. In this paper, as will become clear later, the presumption is made that it is the supply of money which adjusts itself to the demand for money.

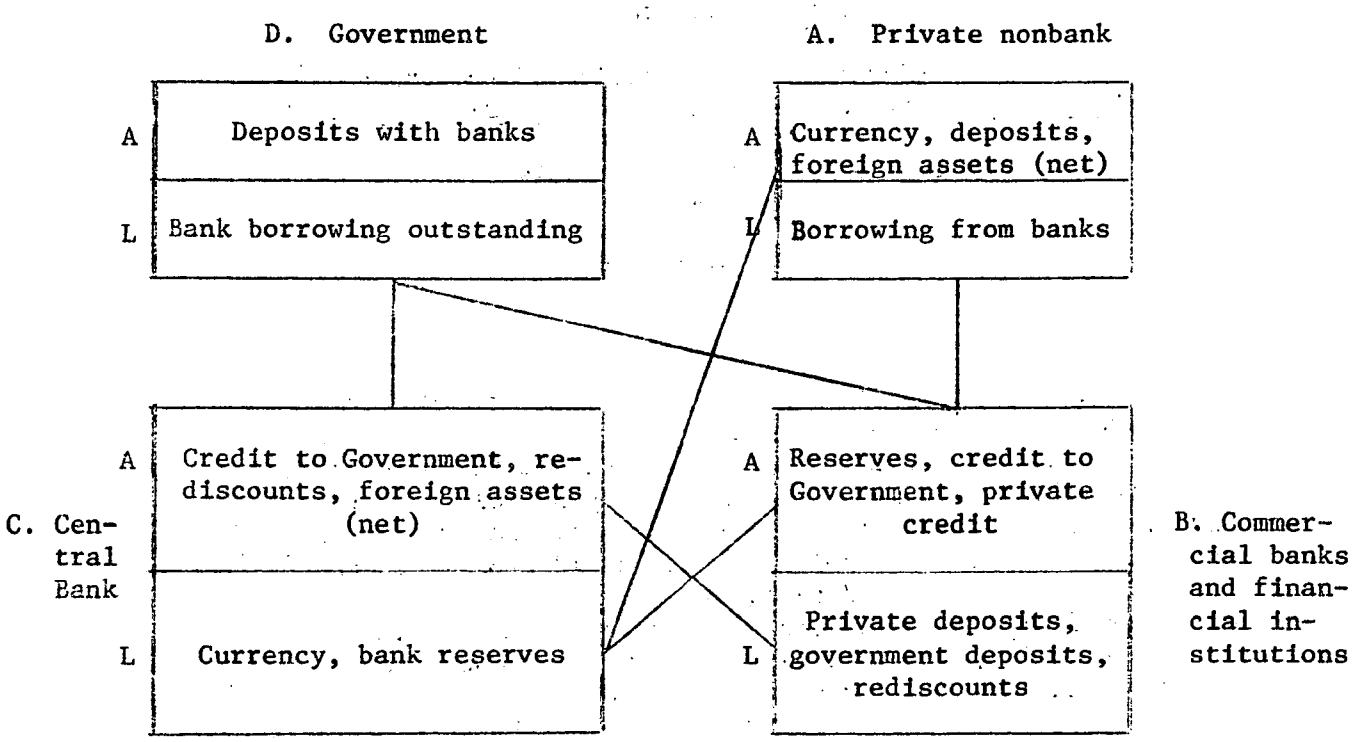
1/ For a fuller description of the system, see SM/74/187, pp. 67-78.

2/ We are grateful to Mr. Niranjan Arya for computational assistance and to other colleagues for various helpful comments.

3/ 'Government' includes Treasury operations while the banking system excludes the Postal Checking System (CPP).

The relationship between the various sectors may be summarized in the following diagram, which excludes minor items:

Chart 1. The Central African Franc Area Monetary System



A. Private nonbank

The private sector's relationship with the banking sector may be traced through its holdings of money, further divided into currency, demand deposits and time deposits. Thus[1/]

$$MO_d = f\ (Y_r,\ P)^{2/} \qquad (1)$$

$$MO_d = COB + DD + TD \qquad (1\text{-a})$$

$$COB = c\ MO_d \qquad (2)$$

$$TD = t\ DD \qquad (3)$$

1/ See Appendix for the explanation of symbols.
2/ The demand for money function, as specified here, is a simplified function in nominal terms, and would need a more detailed investigation. The importance of institutional factors would also need to be researched.

From 1 and 2, we have

$$DD + TD = (1 - c)\ MO_d \tag{4}$$

From 3 and 4, we obtain

$$DD = \frac{1 - c}{1 + t} MO_d \tag{5}$$

and

$$TD = \frac{t}{1 + t} (1 - c)\ MO_d \tag{6}$$

Apart from the demand for money functions (equation 1), there are two behavioral ratios in the above system describing the private nonbank sector: viz., the ratio of currency to money (c) and the ratio of time deposits to demand deposits (t). Pending further analysis as to factors affecting these ratios, it is assumed here that currency and time deposits bear a fixed relationship to money and to demand deposits, respectively. In general, the relevant determinants would be the money rate of interest on deposits and structural factors such as the degree of monetization, payment habits and the nature and extent of financial intermediation.

B. Commercial banks and financial institutions

Commercial banks and financial institutions in the area operate within certain liquidity and credit restrictions as laid down in the statutes of the Central Bank and other banking legislation. In the case of the BEAC, banks must satisfy the following constraints:

1. They must maintain a minimum liquidity ratio of 75 per cent,[1/]

2. They must lend to the Government a minimum of 10 per cent of their total deposit liabilities,

3. Their nonrediscountable credit must not exceed the sum of 25 per cent of demand deposit and 50 per cent of time deposit liabilities,

4. They must cover with their own funds at least 7 per cent of their rediscountable assets and 10 per cent of their nonrediscountable assets,

5. In addition, the Central Bank also limits the banks' recourse to its rediscount facilities by prescribing credit ceilings.

1/ This ratio may vary somewhat between individual countries. The ratio is between liquid assets, defined as comprising reserves and rediscountable credit, and short-term liabilities, comprising demand and time deposits and rediscounts from the Central Bank.

For purposes of analysis, it may be assumed that the banks' liabilities (mainly in the form of deposits) are determined exogenously by the behavior of the nonbank private sector, by the fiscal operations of the Government, as well as by the operations of the central bank, so the asset distribution of deposit money banks may be analyzed within the framework of profit-maximization. This may be done as a problem in linear programming as follows:

Maximize

$$\text{Profits: } \pi = i_1 CPSB_1 + i_2 CPSB_2 + i_3 CGB + i_4 FAB + 0.0\ BR - i_5 RD \tag{7}$$

Subject to:

$$BR + CPSB_1 + CGB \geq 0.75\ (\overline{DD} + \overline{GDB} + \overline{TD} + RD) \tag{8}$$

$$CGB \geq 0.10\ (\overline{DD} + \overline{GDB} + \overline{TD}) \tag{9}$$

$$CPSB_2 \leq 0.25\ \overline{DD} + 0.50\ \overline{TD} \tag{10}$$

$$0.07\ CPSB_1 + 0.10\ CPSB_2 \leq \overline{CA} \tag{11}$$

$$RD \geq \overline{RD} \tag{12}$$

$$CPSB_1 \geq RD \tag{13}$$

$$CPSB_1 + CPSB_2 + CGB + FAB + BR = \overline{DD} + \overline{TD} + RD + \overline{GDB} + FLB + \overline{CA} \tag{14}$$

and all the variables ≥ 0.

Exogeneous variables in the above equations are marked with a bar over them. It should be noted that equation 14 is the balance-sheet identity. The right-hand side of this equation represents the liability side with total deposits as well as capital accounts determined exogenously for the commercial banks. The left-hand side of the equation gives the asset distribution which, together with rediscounts from the central bank (RD), are to be determined with the objective of profit-maximization.

The nature of the objective function to be maximized (equation 7) should be noted. The usual maximizing function generally includes in the arguments not only the rate of return but also the variance (uncertainty) of return on the portfolio. The objective function assumes away the aspect of uncertainty because of an absence of information on the behavior of banks under conditions of uncertainty, and also because, in the case of the countries being considered, uncertainty of returns is probably of minor significance in the choice of portfolio.

The next step in the analysis would be to compare such a derived optimal portfolio with the actual portfolio of banks in order to ascertain the reasons for their departure from the optimal behavior. This should give the analyst some insight into the banks' behavioral relationships. The model should also help in tracing banks' optimal reactions to exogenous (policy) changes such as a change in the rediscount ceiling.

C. The Central Bank

The accounts of the Central Bank may be summarized in the form of the balance-sheet identity as follows:

$$(FAC - FLC) + (CGC - GDC) + RD = COB + BR \tag{15}$$

Recalling that

$$COB = cMO,$$

and assuming that

$$MO_d = MO_s \text{ (see below)},$$

and that deposit money banks of their own accord customarily maintain reserves in accordance with the relation

$$BR = r[(1 - c)MO + GDB] \tag{16}$$

then, from equations 2, 15 and 16, we obtain

$$MO_s = \frac{[(FAC - FLC) + (CGC - GDC) + RD - rGDB]}{c + r(1 - c)} \tag{17}$$

$$= \frac{BM}{c + r(1 - c)} \tag{18}$$

where BM (equal to the numerator in equation 17) is the base money and $\frac{1}{c + r(1 - c)}$ becomes the money-multiplier.

Equation 17 focuses on factors influencing changes in money supply and which may be divided into 'behavioral' and 'nonbehavioral' and into 'autonomous' and 'policy-induced'.1/ Within an integrated model, in equilibrium MO_s, as determined by equation 17, will be the same as MO_d in equation 1 above (which is subdivided into demand deposits, time deposits and currency with the nonbank sector as in Section A above). The derived equilibrium values of DD, TD as well as government deposits are then fed into the commercial banks' profit-maximization behavior model (equations 7-14).

1/ cf. Rattan J. Bhatia, "Factors Influencing Changes in Money Supply in BCEAO Countries", IMF Staff Papers, July 1971.

An illustration--Chad

As an illustration, the above model was applied to Chad, one of the five member countries of the BEAC.

a. Private nonbanks

The three behavioral equations were determined on the basis of least square regressions covering the period from the first quarter of 1967 through the third quarter of 1973 and were as follows:

$$MO_d = -6.47 + 0.54\ Y_r + 0.11\ P^{1/} \qquad R^2 = 0.98 \quad (1')$$

$$(-6.38) \quad (3.78) \quad (12.87)$$

$$COB = -0.23 + 0.67\ MO^{2/} \qquad R^2 = 0.85 \quad (2')$$

$$(-0.26) \quad (6.46)$$

$$TD = -0.36 + 0.31\ DD^{2/} \qquad R^2 = 0.20 \quad (3')$$

$$(-0.77) \quad (1.66)$$

According to the statistical results, the demand for money function is satisfactorily explained by the specified arguments 'real income', Y_r, and 'price level', P. The public's 'demand' for currency also appears to be related in a stable way with its money holdings. However, the ratio of demand deposits to time deposits needs further examination.[3/]

b. Commercial banks

The relevant data for purposes of solving the maximization problem in equations 7-14 were available for nine different dates during the period 1968-73. Table I gives the actual and calculated values for $CPSB_1$, $CPSB_2$ and RD.

An interesting finding is that, given the specified constraints and the relative interest rates on different assets and the rediscount rate, the postulated profit maximization behavior would induce banks to use fully the permitted rediscount ceilings (i.e., calculated RD always equals the prescribed ceiling $\overline{RD}$). In fact, however, actual RD has been consistently

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1/ Data used refer to an urban index of consumer prices.

2/ COB and TD were regressed on MO and DD respectively, instead of being calculated as average ratios, primarily to demonstrate whether a stable relationship existed between the variables.

3/ Were it not for the fact that TD and DD appear with different coefficients in the constraint in equation 10 above, TD and DD could have been combined, thus eliminating the need to determine TD separately through equation 3.

Table 1. Chad: Commercial Banks' Assets Portfolio, 1968-73

(End period; in billions of CFA francs)

	1968	1969	1970	1971	1972				1973
					March	June	Sept.	Dec.	June
$CPSB_1$									
Calculated	9.17	11.09	10.43	7.30	10.35	10.36	10.51	10.37	11.96
Actual	8.64	9.98	9.10	7.89	9.93	9.94	8.34	8.08	10.90
$CPSB_2$									
Calculated	0.71	0.87	1.11	1.01	1.00	0.94	0.95	0.82	1.53
Actual	1.49	1.52	1.26	1.32	1.18	1.19	1.02	1.14	1.08
RD									
Calculated	5.25	6.39	5.49	3.13	6.44	6.38	6.38	6.33	7.28
Actual	4.88	5.74	4.19	3.73	5.53	5.55	4.79	4.18	4.86
$\overline{RD}$	5.25	6.39	5.49	3.13	6.44	6.38	6.38	6.33	7.28
Percentage deviation									
$CPSB_1$	6.1	11.1	14.6	-7.4	4.2	4.2	26.0	28.3	9.7
$CPSB_2$	-52.3	-42.8	-11.9	-23.5	-18.0	-21.0	-6.9	-28.1	-41.6
$CPSB_1 + CPSB_2$	-2.4	4.0	11.4	9.8	2.2	1.5	10.7	21.4	12.6

below the maximum, $\overline{RD}$ suggesting that the Central Bank's ceilings have not been the constraining factor on credit expansion. Either the monetary authorities have exercised other means of keeping actual rediscounts below the rediscount ceilings, or the demand for credit has been below the supply levels predicted by the maximization equation. In general, the banking authorities do not refuse seasonal credit which is the bulk of the credit demand in countries like Chad. It would appear, therefore, that actual credit expansion in that country at least was limited by the demand for, rather than the supply of, credit.1/

The calculated discountable and rediscountable credit ($CPSB_1$ and $CPSB_2$) also deviate from the actuals; in general calculated $CPSB_1$ is higher, and calculated $CPSB_2$ lower, than the respective actuals. This may be a reflection of the assumption made here that all 'long-term' credit was nonrediscountable and, therefore, included under $CPSB_2$. The average deviation is considerably reduced if we compare the totals of calculated and actual credit.

C. The Central Bank

The determination of the money multiplier is dependent upon the two behavioral ratios, c and r. From equation (1') above, c may be taken to equal 0.67.2/ The reserve ratio, on the other hand, has fluctuated between 0.02 and 0.09. However, given the small size of r, such fluctuations do not affect significantly the value of the money multiplier.3/ Thus r could be assumed to equal its average ratio during the period, i.e., .05 of total deposits. In the case of Chad, the money multiplier would be 1.46 [=1÷(0.67+0.05 (1-0.67))].

1/ The largest percentage deviation was during the second half of 1972 when the drought conditions severely reduced crops and the demand for credit.

2/ The constant term in equation 2' is not statistically significant.

3/ With c as 0.67, and r as 0.02 or 0.09, the value of money multiplier will be 1.48 or 1.43, respectively.

APPENDIX NOTATIONS

MO_d	=	Demand for money
COB	=	currency outside banks
DD	=	demand deposits
TD	=	time deposits
c	=	ratio of currency to money
t	=	ratio of demand deposits to time deposits
i_T	=	interest rate on time deposits
$CPSB_1$	=	rediscountable credit
i_1	=	interest on rediscountable credit
$CPSB_2$	=	nonrediscountable credit
i_2	=	interest rate on nonrediscountable credit
CGB	=	commercial bank credit to Government
i_3	=	interest on CGB
FAB	=	commercial banks' holdings of foreign assets
i_4	=	interest on FAB
BR	=	bank reserves
RD	=	commercial banks' rediscounts with the Central Bank
i_5	=	interest rate on RD
GDB	=	government deposits with commercial banks
FLB	=	commercial banks' foreign liabilities
CA	=	commercial banks' capital accounts including other items (net)
FAC	=	Central Bank's foreign assets
FLC	=	Central Bank's foreign liabilities
CGC	=	government borrowing from the Central Bank

APPENDIX NOTATIONS (contd.)

GDC	=	government deposits with the Central Bank
r	=	reserve ratio of commercial banks with respect to deposits
MO_s	=	supply of money
BM	=	base money
P	=	price index
Y_r	=	real income