The currency ratio in Tanzania: an econometric analysis

Ndanshau, Michael O. A.

University of Dar es Salaam

September 2004

The Currency Ratio in Tanzania: An Econometric Analysis

Michael O.A. Ndanshau*

Abstract: This study tested some key hypotheses on the determinants of the currency ratio in Tanzania. The econometric results suggest that real income is, as theorized, negatively related to and a significant determinant of the currency ratio in Tanzania. The estimated income elasticity coefficient, found to be far less than unity, suggests there is poor substitution between currency and demand deposits in Tanzania. The results also showed that expected inflation was negatively related to the currency ratio in Tanzania. While the structural adjustment programme was found to increase and shift upward the currency ratio function in Tanzania, the liberalization of the financial sector was found to shift decrease and shift downward the currency ratio function. Most institutional variables were found to lack the expected sign and significance in explaining the currency ratio in Tanzania, probably because of inadequacy of the proxies used.

Résumé: Cette étude a vérifié certaines hypothèses clés sur les déterminants du ratio monétaire en Tanzanie. Les résultats économétriques donnent à penser que le revenu réel, tel que défini en théorie, a été négativement lié à un déterminant important du ratio monétaire en Tanzanie. Le coefficient d'élasticité du revenu estimatif, de loin inférieur à une unité, laisse entrevoir une substitution médiocre entre la monnaie et les dépôts à vue en Tanzanie. Les résultats ont également montré que l'inflation prévue a été négativement liée au ratio monétaire en Tanzanie. Bien que l'étude ait estimé que le programme d'ajustement structurel a rehaussé la fonction de ratio monétaire en Tanzanie, la libéralisation du secteur financier a fait chuter cette fonction. La plupart des variables institutionnelles n'avaient ni le signe ni la signification attendus pour expliquer le ratio monétaire en Tanzanie, probablement à cause du caractère inadapté des variables de substitution utilisées.

* Senior Lecturer and Head of Department, Department of Economics, University of Dar es Salaam, PO Box 35045, Dar es Salaam, Tanzania. Tel: +255 22 2410669/252; fax: +255 22 2410252; email: ndanshau@udsm.ac.tz

1. Introduction

What determines the currency ratio, defined as a ratio of currency to either demand deposits or money stock, has been one of the subjects of empirical interest in monetary and development economics. This is explained by the existing need to explore whether the currency ratio declines secularly as a country develops. In addition, there has been an interest to establish empirically the determinants of the currency ratio so as to shed light on the behaviour and stability of the money multiplier, which has implications for the effectiveness of monetary policy (Hess, 1977; Brunner and Meltzer, 1968). It is because of the latter concern that it has remained imperative 'to explain the behaviour of currency ratio in the context of the money supply process' (Brunner, 1965, p. 208).

This paper intends to explore empirically the determinants of the currency ratio in Tanzania. The study is motivated, first, by a dearth of empirical studies on the currency ratio in the country. Studies by Kida (1999), Ndanshau (1982) and Nsengiyumva (1977) that focus either on money supply or money demand in Tanzania do not specifically analyse determinants of the currency ratio in Tanzania. Moreover, Ndanshau (1996) and Kimei (1987) only analyse the trend of the currency ratio in Tanzania. The same shortcoming characterizes what could be considered as a very detailed study on saving in Tanzania (Nyagetera, 1997). This study, therefore, aims to fill the gaps and contribute to the literature on the currency ratio in Tanzania and other developing countries. The analysis covers a longer sample period ranging from 1967–2002; tests the mainstream hypotheses; and, additionally, it explores the influence of policy shift on the currency ratio in Tanzania during the sample period.

The rest of this paper is organized as follows. Section 2 presents an analytical framework of the study. Section 3 presents the methodology of the study. Section 4 carries the econometric results that are also compared with results from previous studies in and outside Tanzania. The main conclusion and areas for further research are presented in Section 5.

2. Analytical Framework

The basis of the diverse hypotheses and empirical tests of the behaviour of currency ratio (c) follows here from a semi-log-linear traditional money demand function that:[1]

$$c_t = \alpha_0 + \alpha_1 y_t + \alpha_2 R_t + u_t \tag{1}$$

In the equation, c_t is the currency ratio, and y is real income.

The opportunity cost of holding money balances is presented by R_t. In the equation, u_t is a stochastic error term, which is assumed to be normally distributed, have a zero mean and a constant variance. In theory, the influence of both income and the measures of the opportunity cost of currency is expected to be negative.

It is noteworthy that equation (1) has been variably refined and subjected to test in econometric studies in several developing countries (Ahmed and Ali, 1994; Dadkhah and Mookerjee, 1988; Khatkhate *et al.*, 1980). However, to use the model, specific structural and institutional differences in developing countries must be taken into account as they differ from those among advanced countries. (Park, 1973, p. 401). For the purpose of this study on Tanzania there exists several institutional and structural factors that may render equation (1) inadequate. First, during most of the sample period interest rates were regulated by the government and demand deposits have never been an interest earning asset. For this reason, interest rate is an inadequate measure of the opportunity cost of holding currency and, indeed, a superfluous variable in the currency ratio equation. The immediate candidate variable for the opportunity cost of holding money balances is expected inflation rate. Its expected increase reduces the currency ratio as the non-bank public would substitute currency in favour of physical assets.

Second, government regulation of the financial sector; coupled with poor transport and communication infrastructure during the 1967–90 period, created little or no incentive for financial widening, deepening and lengthening (Kimei, 1987). As a result, a dual financial system prevailed: a largely urban-biased formal financial sector and an informal financial sector that, by and large, catered for the under-banked rural areas (Ndanshau, 1996; Hyuha *et al.*, 1993). The liberalization of the financial sector started in 1991 led to both financial innovation and increase in the number of players in the formal financial sector. The number of local and foreign commercial banks licensed by the Bank of Tanzania (BoT) increased from two in 1991 to 19 in 2002. This, coupled with the financial products innovated, is likely to have increased preference of bank deposits over currency, which is the main medium of exchange in the informal financial sector. In this regard, the impact of financial sector reform on the currency ratio is expected to be negative.

Third, the Government of Tanzania promulgated the Arusha Declaration in 1967. The *Ujamaa* and Self-Reliance policy in the declaration led to nationalization of the 'commanding heights' of the economy, among others, in manufacturing, finance, trade and agricultural sectors. Nationalization policy led to growth of public sector enterprises (PEs) and employment. In 1967 there were 73 PEs with 26,645 employees; and,

while the number of PEs had increased to over 425 in 1992 (Moshi, 1995), employment in PEs had increased to 176,635 workers in 1994.[2] In relation, the wage bill of the PEs' employees, largely paid in cash, rose from Tshs. 162.7 million in 1967 to Tshs. 69,947 million in 1994 (Tanzania, various; see Table 1).[3] Also, the share of deposits of PEs in total commercial banks' deposits increased from 10.2 per cent in 1967 to 44.4 per cent in 1992 and fell to about 4.5 per cent in 2002 due to implementation of divestiture since 1993.[4] Thus, the developments in the public sector is expected to bear a significant but, seemingly, indeterminate influence on the currency ratio in Tanzania.[5]

Fourth, the sample period for this study has been characterized by high and multiple tax rates, regulation of commodity and foreign exchange prices, income compression and growth of informal sector economic activities. High and multiple taxes encourage tax evasion and corruption, both of which are better served by currency, especially high denomination currency. Moreover, price ceilings set by the government in the commodity and foreign exchange markets, coupled with scarcities that prompted rationing, provided a river bed for the growth of black markets during the 1970s and the early 1980s (Maliyamkono and Bagachwa, 1990). The exchange rate premium increased from an average of 33.8 per cent in 1968–70 to an average of 319.5 in 1983–85 (Table 1). Furthermore, income compression and development of a severe unemployment problem since the 1970s led to a growth of informal sector economic activities, solely dependent on cash (currency) as the principal medium of exchange (Ndanshau and Mvungi, 2002; Tanzania Revenue Authority, 2001). Ndanshau (2002) shows that the proportion of the Tshs. 100 notes in total currency in circulation increased from an average of 44.8 per cent in 1968–70 to about 86 per cent in 1983–85. The issue of notes of Tshs. 200 and later Tshs. 5,000 and Tshs. 10,000 reduced the share of Tshs. 100 notes and subsequently coins. Notes of Tshs. 5,000 and Tshs. 10,000 accounted for about 62 per cent and about 76 per cent of the total notes in circulation in 1995–97 and 1998–2000, respectively. In this respect, the growth of the unobserved economy is expected to bear a positive influence on the behaviour of the currency ratio in Tanzania. Exchange rate premium is used in the analysis as a proxy measure for the unobserved economy in Tanzania.

The basic models for estimation that modifies equation (1) to capture the afore-mentioned developments in Tanzania are as follows:

$$c_t = \alpha_0 + \alpha_1 y_t + \alpha_2 \pi_t^e + u_t \tag{1a}$$

Table 1: Three years average of some financial and macroeconomic indicators in Tanzania

Period	Share of PEs' deposits	Exchange rate premium	Real interest rate	Real GDP growth	M2/GDP ratio	Bank branches	Inflation
1968–70	24.4	33.8	0.2	4.3	20.7	36.3	3.3
1971–73	24.2	101.1	−3.9	4.7	23.9	40.7	7.6
1974–76	27.8	133.5	−13.5	4.9	23.6	74.3	17.5
1977–79	28.8	104.4	−5.7	1.6	28.2	97.7	10.4
1980–82	22.6	241.9	−21.7	1.0	34.5	107.0	27.8
1983–85	31.7	319.5	−24.2	1.9	29.1	124.7	32.5
1986–88	37.6	141.0	−13.7	3.6	13.4	155.0	31.4
1989–91	41.3	58.3	−5.6	4.7	14.9	190.3	31.6
1992–94	36.5	20.0	−3.1	3.6	16.2	193.0	26.7
1995–97	11.6	10.8	−9.5	4.2	14.8	169.3	21.8
1998–00	7.9	−2.7	−1.6	4.6	13.9	171.3	8.9
2001–02	4.5	5.6	−1.2	5.9	15.7	180.5	4.7

Source: Various official publications.

and

$$c_t = \alpha_0 + \alpha_1 y_t + \alpha_2 \pi_t^e + \alpha_3 Br_t + \alpha_4 dP_t + \alpha_5 tr_t + \alpha_6 er_t^* + u_t \qquad (2)$$

where π^e is the expected inflation rate which is expected to exert a negative influence on the currency ratio. The proxy measure for financial development (*Br*), which is the number of branches of the commercial banks, is expected to be negative signed.[6] The measure of parastatal sector development (*dP*) in Tanzania is expected to bear a negative influence on the currency ratio. The influence of tax rate (*tr*) on the currency ratio is expected to be positive, as also maintained, among others, by Tanzi (1983). The coefficient of the foreign exchange premium (*er**) is expected to be positive signed. The premise here is that development of parallel foreign exchange markets increased demand for currency and, therefore, the currency ratio in the country.

It is worth noting, however, that both expected inflation (π^e) and the exchange rate premium (*er**) are not observable. Following Maddala (1992), the following distributed lag model of expectations was used:

$$er_{t+1}^* - \lambda er_t^* = (1 - \lambda) er_t \qquad (3)$$

where λ is the coefficient of adjustment with values that lie between zero and unity. Expression (3) can be restated as:

$$er^*_{t+1} = \sum_{i=0}^{1-\lambda} \lambda^{ier_{t-1}} \tag{4}$$

As noted by Maddala (1992), expression (4) involves an infinite series which is not observable such that it is imperative to treat separately the observable and the non-observable components by starting from the following infinite series:

$$\sum_{i=0}^{t-1} er(1-\lambda)\lambda^{ier_{t-1}} + \sum_{i=0}^{1-\lambda} \lambda^{ier_{t-1}} \tag{5}$$

Let the observable part of the series be denoted by $z_{1t}\lambda$ and the unobservable part be z_{2t}. Each of the expected variables is:

$$er^*_{t+1} = z_{1t} + cz_{2t} \tag{6}$$

where c is treated as an unknown parameter.

By substituting (6) in (2), the equation for estimation is:

$$\begin{aligned} c_t = {} & \beta_0 + \beta_1 y_t + \beta_2 z_t \pi_t + c' z_2 \pi_t \\ & + \beta_3 Br_t + \beta_4 dP + \beta_5 tr_t + \beta_6 z_{1t} er + c' z_2 er_t + u_t \end{aligned} \tag{7}$$

where c' is βc.

Equations (1) and (7) have been estimated with and without modelling of policy shift (by dummy variables) for economic reforms (*ER*) in mid-1986 and financial sector liberalization (*FR*) in 1991. While the *ER* takes values of zero for the 1967–86 period and unity for the 1987–2002 period, the *FR* takes values of zero during the 1967–91 period and unity for the 1992–2000 period. Both policy shift variables are expected to be negative.

3. The Variables and Data Sources

The currency ratio is measured either as the ratio of currency (*CC*) held by the non-bank public to either the demand (checkable) deposits (*DD*) or the narrow money (*M1*), which is the sum of currency (*CC*) and checkable deposits (*DD*) of the non-bank public. Like in most of the previous studies, the ratio of currency to demand deposits is used in this study.[7] The real income used in the analysis is nominal gross domestic product (GDP) deflated by the national consumer price index (NCPI).[8]

The ratio of the total tax revenues to the nominal GDP is used as a proxy for tax rates. Deposits of the parastatal enterprises (PEs) are measured as a ratio of the total deposits of the commercial banks. The other variables are as already defined.

The undeseasonalized annual time-series data for both currency, deposits of commercial banks, and deposits of PEs are from various *Quarterly Economic Bulletins* and *Economic and Operation Report*s of the Bank of Tanzania. The data for GDP, tax revenues, NCPI and population are from the *International Financial Statistics Year Book* of the International Monetary Fund (IMF).[9] Adaptive expectation hypothesis has been used to obtain the expected values of the exchange rate premium and inflation rate. It is worth noting, however, that for the 1967–92 period, the exchange rate premium is measured as the difference between the official and parallel market rates. For the 1993–2002 period, the parallel market rate was assumed to equal the average bureau de change rate reported by BoT in that the data for the former were not available. The data for the official and bureau de change rates were obtained from BoT publications; and, the data for the parallel market exchange rate during the 1967–92 period were obtained from Mwinyimvua (1996). The data for bank branches are from various annual reports of the commercial banks in Tanzania.

The data used in the analysis are reasonably reliable for most of the variables. The only concern is on the measurement and data for the GDP and the tax rates. The GDP data in Tanzania include a substantial proportion of subsistence (non-monetary) income ignored here because of non-availability of its data for the entire sample period.[10] This is explained by various deficiencies in the national accounts of Tanzania (Msokwa, 2002). As regards tax rates, the ideal measure, as noted by Cagan (1958, p. 322), would be 'the marginal rate levied on the average level of income for which taxes are not withheld, permitting currency to be used to aid evasion'. The average tax rate has been used because data for that seemingly ideal measure of tax rates is not available in Tanzania. It is in this respect that possible failure of the average tax rate to capture the expected influence of tax rates on currency ratio in Tanzania may result, and even so due to the existence in the country of substantial non-taxed informal economic activities. Hence low tax compliance and tax evasion in the formal sector (Mpango, 1996; Osoro, 1995).

The model has been estimated by using the ordinary least squares (OLS) method, even though the augmented Dickey–Fuller (ADF) method indicates an existence of unit root in the data used.[11] The preference of the OLS method over the now fashionable modern time-series analysis approaches, including cointegration and error correction models (ECM), has been motivated by insufficiency of data points. The modern

approaches would have required incredible and heroic interpolation of data for just too many variables. This would have rendered inefficient most of the parameter estimates hence distorting inference from the results. Instead, exploratory data analysis (EDA) has been used to test for normality in data distribution, which is a key requirement for best unbiased OLS estimators (Murkherjee *et al*., 1998). The EDA results showed that only the exchange rate premium was significantly different from the mean (Table 2). In this respect, almost all the variables were reasonably symmetric, that is, the mean was not significantly different from the median. However, the skewness-kurtosis test, namely, the Jarque–Bera test statistic at the 5 per cent test level shows that almost all the variables were not normally distributed.[12] Notable, however, is that transformation by a log operator significantly corrected for the skewness and kurtosis in the data used (Table 2).

4. Econometric Results

Regression results presented in Table 3 were preceded by several pre-tests. The explanatory power of equation 1 (equation 1a) was poor when nominal rather than real income was used.[13]

A search procedure that was applied to the inflation rate over the interval 0.1 to 0.9, while controlling for the exchange rate premium at its actual level, showed that the residual sum of squares (RSS) was minimized when λ was 0.5. By controlling the estimated regression with the expected inflation rate at RSS (0.5), the search procedure for the exchange rate premium failed to produce minimum RSS lower than RSS (0.5). For this reason, the actual rather than the expected exchange rate premium was used. In the pre-test regressions, serial correlation was detected in the basic model. This was circumvented by using the Markov first-order autoregressive scheme (Gujarati, 1995).

The regression results (equation 1a) for the basic model (1a) that excludes policy and institutional variables shows that 74 per cent of currency ratio behaviour was explained by the variables in the estimated function (Table 3). The F-statistic is also high (21.6) and statistically significant, indicating a good fit and a good explanatory power of the estimated function. In the estimated basic model, the income elasticity bears the expected negative sign but is far lower than unity and is not statistically significant at the conventional test levels. This finding suggests a very inelastic demand for currency, a characteristic in Tanzania and most other developing countries. Moreover, the low substitution between currency and demand deposit implied by the estimated income elasticity coefficient is also explained by low income, low development of

Table 2: Summary statistics for skewness and normality tests of the variables used

Statistic	*CR*	*y*	R_s	π^e	*br*	*dP*	*tr*	*er*
Mean	0.5	2496582	10.5	0.9	120.9	0.3	12.1	103.9
Median	0.5	2248887	7.25	0.9	120	0.3	12.3	66.76
Std. Dev.	0	780359.3	8.2	0.3	57.05	0.1	3.51	110.7
Skewness	0.9	0.03	0.97	0.6	−0.22	0	0.1	1.76
Kurtosis	4.4	1.42	2.33	2.4	1.69	2.6	2.1	6.75
Var. Coeff.		0.31	0.78	0.33	0.47	0.33	0.29	1.06
X_U	0.8	3651182	26	1.6	203	0.5	19.6	517.9
X_L	0.4	1317583	3.5	0.6	33	0	5.8	0.57
Jarque–Bera	7.3	3.6	5.96	2.4	2.67	0.3	1.2	37.45
In log linear								
Mean	−0.66	14.68	2.07	−0.1	4.65	0.23	2.45	3.95
Median	−0.66	14.63	1.98	−0.1	4.78	0.23	2.51	4.2
Std.Dev.	0.16	0.33	0.74	0.27	0.61	0.09	0.31	1.44
Skewness	0.35	−0.22	0.47	0.2	−0.8	−0.16	−0.4	−0.94
Kurtosis	3.11	1.65	1.75	1.95	2.22	2.5	2.25	4
Var. Coeff.	−0.24	0.02	0.36	−2.7	0.13	0.39	0.13	0.36
X_U	−0.21	15.11	3.26	0.44	5.31	0.41	2.97	6.25
X_L	−0.94	14.09	1.25	−0.52	3.5	0.05	1.76	−0.56
Jarque–Bera	0.7	2.85	3.46	1.81	4.27	0.49	1.64	6.43

Notes: CR = currency ratio; y = real GDP; R_s = nominal interest on passbook deposits; π^e = expected inflation rate; br = number of bank branches; tr = tax rate; er = exchange rate premium; and dP = share of PEs in total deposits of the commercial banks.
Source: The data set used.

banking culture and the predominance of currency based black market and informal economic transactions during most of the sample period. These factors explain poor use of depository services, particularly the demand deposits, that are not generally accepted as a medium of exchange and do not carry a return in the form of an interest rate as in developed countries. In this regard, the results suggest that currency in Tanzania is a 'necessary good', or conversely, that deposits were 'inferior'.

The regression results show that the estimated coefficient of the expected inflation ($z1P5$) bears the expected negative sign but is not statistically significant. However, the unobserved part of the expected bears the expected negative sign and is statistically significant at the 5 per cent test level. Given a lack of generalized use of demand deposits in Tanzania as a means of payment and settling debts, the results suggest substitution of currency in favour of physical assets, hence the inverse between the expected inflation and the currency ratio. The significance of the usually ignored unobserved expected inflation ($z2P5$) appears to capture the effect on currency ratio that arose from suppressed inflation that arose from price controls prior to economic reforms.

Table 3: Regression results for equation (1), with policy shifts, 1967–2002

	Equation a	Equation b	Equation c	Equation d
Constant	1.953	5.334	1.177	5.545
	(3.571)	(2.866)***	(3.726)	(2.858)***
ln *y*	−0.199	−0.395	−0.122	−0.409
	(0.120)	(0.201)***	(0.260)	(0.200)**
ln *z*1*P*5	−0.017	−0.086	−0.001	−0.084
	(0.076)	(0.049)***	(0.089)	(0.051)
ln *z*2*P*5	−0.036	−0.032	−0.041	−0.030
	(0.014)**	(0.012)**	(0.018)**	(0.013)**
ER		0.274		0.278
		(0.120)**		(0.120)**
FR			−0.124	−0.031
			(0.158)	(0.120)
ρ	0.563	0.244	−0.651	0.217
	(0.163)*	(0.191)	(0.155)*	(0.194)
R^2	0.74	0.76	0.75	0.76
s.e.r.	0.14	0.14	0.14	0.14
DW-stat.	2.34	2.04	2.42	2.03
F-stat.	21.58*	18.41*	17.01*	14.86*

Notes: ln stands for log operator; *y* is real income; *z*1*P*5 and *z*2*P*5 are values of the expected of inflation; ρ is the autocorrelation coefficient; and *ER* and *FR* are, respectively, dummy variables for economic and financial sector reforms.
Figures in parentheses are standard errors.
* is test at 1% level, ** is test at 5% level and *** is test at 10% level.

The inclusion of the policy shift variables, namely, economic reforms (*ER*) in 1986 and financial sector liberalization (*FR*) in 1991, reduced slightly the explanatory power of the basic model (Table 3, equation b). Moreover, inclusion of the variable for economic reforms increased three-fold the size of the income elasticity coefficient that also became statistically significant at the 10 per cent test level. This finding suggests that economic reforms impacted positively on the substitution between currency and deposits. Second, the constant term in equation (b) is also larger, suggesting that economic reforms shifted upward the currency ratio function. Furthermore, inclusion in the basic model of a dummy variable for the liberalization of the financial (*FR*) lowered slightly the constant term and the income elasticity coefficient (equation c); and, both coefficients remained statistically insignificant as in the estimated basic model (equation a). When both policy shift variables are included in the basic model (equation d) both constant term and the income elasticity coefficient increased substantially and all turned out to be significant at least at the 10 per cent test level. The results for policy shift variables suggest that while the economic reforms implemented in Tanzania shifted upward the currency ratio function, the liberalization of the financial sector shifted downward the currency ratio function.

Overall, however, the results (equation d) suggest that the more broad-based economic reforms (*ER*) were statistically significant and crowded or overwhelmed the insignificant effect of the financial sector liberalization (*FR*) on the currency ratio.

Regression results for equation (7), with and without the policy shift dummies, are presented in Table 4. The results show that all the income elasticity coefficients estimated with and without the institutional and policy shift dummies are statistically significant at the 5 per cent test level. The coefficient of the income elasticity is consistently negative signed, as expected. Notable, however, is that the inclusion in regression of either or both institutional and policy shift variables rendered positive the coefficient of expected inflation ($z1P5$). This result was unexpected and unexplainable. It is worth noting that in Table 4 (equation a) the coefficient of the unobserved part of expected inflation (z2P5) is

Table 4: Regression results for equation (7) with institutional and policy shifts, 1967–2002

	Equation a	Equation b	Equation c	Equation d
Constant	6.477	6.885	6.685	7.121
	(1.907)	(1.898)*	(1.910)*	(1.894)*
ln *y*	−0.348	−0.366	−0.346	−0.365
	(0.136)**	(0.134)**	(0.135)**	(0.133)**
ln *z1P5*	0.079	0.085	0.078	0.084
	(0.053)	(0.052)	(0.053)	(0.052)
ln *z2P5*	−0.073	−0.066	−0.081	−0.074
	(0.016)*	(0.016)*	(0.017)*	(0.017)*
ln *er*	−0.054	−0.047	−0.067	−0.061
	(0.027)**	(0.027)***	(0.029)**	(0.029)**
ln *tr*	−0.255	−0.121	−0.229	−0.089
	(0.137)	(0.165)	(0.139)	(0.166)
ln *dP*	0.104	0.073	0.118	0.086
	(0.074)	(0.076)	(0.075)	(0.076)
ln *br*	−0.597	−0.589	−0.633	−0.627
	(0.162)*	(0.159)*	(0.165)*	(0.161)*
ER		0.163		0.169
		(0.116)		(0.115)
FR			−0.098	−0.104
			(0.090)	(0.088)
R^2	0.86	0.87	0.87	0.88
s.e.r.	0.11	0.1	0.11	0.11
DW-stat.	2.12	2.32	2.18	2.4
F-stat.	24.96*	22.85*	22.15*	20.78*

Notes: ln stands for log operator; *y* is real income; *z1P5* and *z2P5* are values of the expected inflation; *br* is branches of commercial banks; *tr* is tax rate; *dP* is share of deposits of PEs in commercial banks; *er* is exchange rate premium; and *ER* and *FR* are, respectively, dummy variables for economic and financial sector reforms.
Figures in parentheses are standard errors.
* is test at 1% level, ** is test at 5% level and *** is test at 10% level.

consistently negative signed and statistically significant as obtained in the previous results (Table 3). In Table 4, the estimated elasticity coefficients of the exchange rate premium (*er*) are statistically significant at least at the 10 per cent test level but all are wrong signed. Similarly, the estimated coefficient of the tax rate (*tr*) is wrong signed and statistically insignificant. The wrong signs of the exchange rate premium and tax rate could possibly be attributed to the inadequacy of the proxies measures used for the two variables. The result also shows that the share of the deposits of PEs (*dP*) in total deposits of the commercial banks bear unexpected positive signs; and the estimated coefficients are not statistically significant. As expected, the measure of financial sector development, proxied by the number of bank branches (*br*), bears the expected negative signs and all are statistically significant at the 1 per cent test level.

The results presented in Table 4 show that the inclusion in estimation of structural variables (*ER* and *FR*) improved the explanatory power of the model. The R^2 and the F-statistics increased and the standard error of regression (s.e.r.) decreased, if compared to the results presented in Table 3. However, the results in Table 4 show that the estimated coefficients of *ER* and *FR* are statistically insignificant, and, while the coefficients for *ER* bears unexpectedly positive sign, that for *FR* is negative as expected. The positive rather than negative signed coefficient of *ER* appears to underscore the increase in demand for currency for pent-up demand for goods and services that became more readily available after the adoption of economic reforms.[14] Moreover, as in the results presented in Table 3, while the inclusion in regression of a dummy for economic reforms shifted upward the currency ratio function, inclusion of a dummy variable for financial sector liberalization reduced the income elasticity coefficient and shifted downward the currency ratio function. In sum, however, the influence of economic reforms on the currency ratio overwhelmed that of financial sector liberalization. The latter may not be unexpected because financial deepening, measured by the ratio of broad money (M2) to the GDP, decreased by almost a half after the adoption of economic reform in Tanzania (Table 1).

In general, the negative and significant influence of income on the currency ratio established by this study is consistent with theory and similar to that obtained by some of the previous studies in developing countries (Dadkhah and Mookerjee, 1988; Khatkhate *et al.*, 1980).[15] Other studies, however, have established a positive relationship between the currency ratio and income, for example, in India (Ahmed and Ali, 1994; Kharadia, 1983). This study's estimated income elasticity coefficients are low, thus suggesting poor substitutability between currency and deposits, a not uncommon characteristic in countries with

underdeveloped formal financial markets. Moreover, as in this study, a study on India established a negative influence of inflation on the currency demand (Ahmed and Ali, 1994). Also, like this study on Tanzania, Kharadia (1983) finds a significant negative influence of spread of banking, and even financial deepening and development, on the currency ratio in India. The wrong signs of the proxy for underground economy and the tax rates suggest that the proxies used were poor. Furthermore, negative influence on the currency ratio of financial sector reform is, though not statistically significant, similar to that found in the study by King and Levine (1993) that covers Argentina, Chile, Indonesia, Korea and the Philippines.

5. Conclusion

The purpose of this paper was to carry out an econometric analysis of some key hypotheses on determinants of the currency ratio in Tanzania. The analysis was based on undeseasonalized annual time series data for the 1967–2002 period. The results show that real income is, as theorized, negatively related to and a significant determinant of the currency ratio in Tanzania. The estimated income elasticity coefficient, found to be far less than unity, suggests poor substitution between currency and demand deposits in Tanzania. If the state of financial system and economic development in Tanzania is considered, the poor substitution between currency is not unfounded because currency dominates in both formal and informal sector transactions in Tanzania. The findings of the study do, by and large, show that inflation exerted a negative influence on the currency ratio in Tanzania. This finding of the basic model suggests that the non-bank public sector substituted currency in favour of physical assets during the period of the study. The findings also suggest that economic reforms increased the currency ratio and the liberalization of the financial sector reduced the currency ratio. Moreover, financial sector development, measured by the number of bank branches, was found to exert the expected significant negative influence on the currency ratio in Tanzania.

The major policy implications that follow from the results are twofold. First, attainment of price stability would help reduce demand for currency in favour of bank deposits. Second, there is still a need for financial lengthening and deepening that would help reduce the currency in circulation in favour of bank deposits. This could be augmented by policy measures that target to provide access to financial services by operators in the informal sector.

Like other empirical studies, the findings of this study are indicative rather than conclusive. When more current data are available, econometric analysis could further be used to examine the behaviour and determinants of both currency and demand deposits and simulate the results to establish if the behaviour of the currency ratio differs significantly from that obtained by this study. This is one potential area for future research. The other is the study of the effect of institutional change and transformation, particularly financial innovation, on the behaviour of the currency ratio. Estimation of the modern econometric methods could also be applied to, first, validate the results of this study; and, second, establish any superiority of the modern techniques over the traditional method used here.

Notes

1. Garcia and Park (1979) estimated the following function for currency ratio:

   $$m_{it} = a_{i0} + a_{i1} \ln y_t + a_{i2} \ln RTD_t + a_{i3} \ln RTB_t + a_{i4} m_{it-1} + e_{it}$$

   The regression results showed that the measure of income and interest rate had the expected positive and negative signs.

2. By 1970 the public sector accounted for 58 per cent of total employment. By 1984 the share of public sector in total employment had increased to 74 per cent. See United Republic of Tanzania (2000), p. 2.

3. By 2000 over 200 PEs had been privatized, liquidated or put under performance management contracts.

4. No data are available to show the fall in the number of employees and their salaries and wage bill after the privatization of the PEs because since 1993 the National Bureau of Statistics (NBS) in Tanzania has not been producing data on these developments in the parastatal sector.

5. Bagachwa and Naho (1995) and Isachsen *et al.* (1982) single out a positive influence of the increase of the PEs' wage on the increase on the demand for currency in Tanzania.

6. Other possible proxy measures include, among other things, the currency-money ratio (a dependent variable in the analysis of this study), the ratio of domestic credit to gross national product, the ratio of assets of all financial institutions to GNP, the ratio of total non-bank financial assets to total financial assets, ratio of total private non-bank financial assets to total private assets, illiteracy rates,

and a measure of urbanization. These proxy variables have not been used or tried in the analysis mainly because of data problems.

7. Pre-test results indicated that the ratio of currency to the *M1* only reduced the intercept and explanatory power of the model.

8. Results from pre-tests also showed that both nominal income in level and in per capita terms produced very inferior results. Moreover, pre-test results showed that the use in regression of either real per capita or real national income did not affect significantly the explanatory power of the model.

9. The national accounts data published by NBS in Tanzania could not be used as they were characterized by serious breaks and inconsistencies – all attributed to perpetual updates to make them more telling. Notably, however, both the IMF and World Bank carry more reliable data for the GDP but obtained from the NBS.

10. The data for the non-monetary GDP is only available for 1967–82 and 1991–2000.

11. The results have not been reported here. Nachega (2001, p. 8) also notes that 'the ADF test has a very low power in the presence of a structural break, as under such circumstances it is biassed toward the non-rejection of a unit root'.

12. Mukherjee *et al*. (1998) note, however, that the test is good for the sample size of more than 1,000 data points. It may not, therefore, be a good test for the normality assumption with respect to the data points used here.

13. Nominal and real per capita were also tried in estimation to 'assuage some of the criticisms levelled against the use of nominal measure of income 'that its use infers a form of money illusion and use of real income mitigates the effect of simultaneous bias from omitted supply-side variables. See Dadkhah and Mookerjee (1988, p. 363). The results for nominal per capita income and also income in level were found to be very poor.

14. Elsewhere, this phenomenon is presented by what is referred to as the Mitchell–Hawtrey effect. See Bagachwa and Naho (1995, p. 1389). Chandavarkar (1997) also notes that commercialization increases demand for money, that in Tanzania is essentially demand for currency.

15. See Dadkhah and Mookerjee (1988) for a survey of the studies on developed countries.

References

Ahmed, Q.M. and S.M. Ali (1994), 'The Behaviour of the Currency Deposit Ratio in Pakistan 1950–86: A Comment', *The Indian Economic Journal*, Vol. 44, No. 1, pp. 120–25.

Bagachwa, M.S.D. and A. Naho (1995), 'Estimating the Second Economy in Tanzania', *World Development*, Vol. 23, No. 8, pp. 1387–99.

Bank of Tanzania (various), *Economic Bulletin*, Quarterly. Bank of Tanzania, Dar es Salaam.

Bank of Tanzania (various), *Economic and Operations Report*. Bank of Tanzania, Dar es Salaam.

Brunner, K. (1965), 'Institutions Policy and Monetary Analysis', *The Journal of Political Economy*, Vol. 73, pp. 197–218.

Brunner, K. and A.H. Meltzer (1968), 'Liquidity Traps for Money, Bank Credit, and Interest Rates', *Journal of Political Economy*, Vol. 76, pp. 1–37.

Cagan, P. (1958), 'The Demand for Currency Relative to the Total Money Supply', *The Journal of Political Economy*, Vol. 66, pp. 303–28.

Chandavarkar, A.G. (1977), 'Monetization of Developing Economies', *IMF Staff Papers*, No. 24, pp. 665–721.

Dadkhah, K.M. and R. Mookerjee (1988), 'The Behaviour of the Currency Deposit Ratio in India, 1970–1982', *The Journal of Developing Areas*, 22, pp. 359–72.

Garcia, G. and S. Pak (1979), 'The Ratio of Currency to Demand Deposits in the United States', *Journal of Finance*, Vol. 34, pp. 703–15.

Gujarati, D. (1995), *Basic Econometrics*. 3rd Edition. McGraw-Hill, New York.

Hess, A.C. (1977), 'An Explanation of Short-run Fluctuations in the Ratio of Currency to Demand Deposits', *Journal of Money, Credit and Banking*, Vol. 3, pp. 666–79.

Hyuha, M., M.O.A. Ndanshau and J.P. Kipokola (1993), 'Scope, Structure and Policy Implications of Informal Financial Markets in Tanzania', African Economic Research Consortium (AERC) Research Paper No. 18.

International Monetary Fund (various), *International Financial Statistics Year Book*. IMF, Washington DC.

Isachsen, A.J., J.T. Koveland and S. Strøm (1982), 'The Hidden Economy in Norway', in V. Tanzi (ed.), *The Underground Economy in the United States and Abroad*. Lexington Books, Lexington, MA, pp. 209–31.

Kharadia, V.C. (1983), 'The Behaviour of the Currency-Demand Deposits Ratio in India, its Effects on Money Supply and Implications for Monetary Policy', *The Indian Economic Journal*, Vol. 31, pp. 89–106.

Khatkhate, D.R., V.G. Galbis and D.P. Villanueva (1980), 'A Money Multiplier Model for a Developing Economy: The Venezuelan Case', in W. L. Coats Jr and D. R. Khatkhate (eds.), *Money and Monetary Policy in Less Developed Countries: A Survey of Issues and Evidence*. Pergamon Press, New York, pp. 335–45.

Kida, T.M. (1999), 'Money Supply Process in Tanzania: Policy Implications', unpublished MA Dissertation, University of Dar es Salaam.

Kimei, C.S. (1987), *Tanzania's Financial Experience in the Post War Period*. ACTA Universitat Upsaliasis, Uppsalla.

King, R.G. and R. Levine (1993), 'Finance, Entrepreneurship and Growth: Theory and Evidence', *Journal of Monetary Economics*, Vol. 35, pp. 513–42.

Maddala, G.S. (1992), *Introduction to Econometrics*. Macmillan Publishing Company, New York.

Maliyamkono, T.L. and M.S.D. Bagachwa (1990), *The Second Economy in Tanzania*. James Curry Ltd, London.

Moshi, H.P.B. (1995), 'Parastatal Sector Reforms and Private Sector Development in Tanzania', in L.A. Msambichata, A.A.L. Kilinds and G. Mjema (eds.), *Beyond Structural Adjustment Programmes in Tanzania*, Economic Research Bureau, Dar es Salaam, pp. 171–90.

Mpango, P.I.N. (1996), 'Evasion of Import Duties: An Economic Analysis of the Case of Tanzania', unpublished PhD thesis, University of Dar es Salaam.

Msokwa, Z.E. (2002), 'How Accurate Are Tanzania's Gross Domestic Product (GDP) Figures?', Paper presented to Department of Economics Seminar (DES), University of Dar es Salaam, April.

Mukherjee, C., H. White and M. Wuyts (1998), *Econometrics and Data Analysis for Developing Countries*. Routledge, London.

Mwinyimvua, H. (1996), 'The Impact of Macroeconomic Policies on the Level of Taxation in Developing Countries: The Case of Tanzania', unpublished PhD thesis, University of Dar es Salaam.

Nachega, J. (2001), 'A Cointegration Analysis of Broad Money Demand in Cameroon', IMF Working Paper, WP/01/26, March.

Ndanshau, M.O.A. (1982), 'An Analysis of the Links between Output, Capital Formation, and Money in Tanzania, 1966–1980', unpubublished MA thesis, University of Dar-es-Salaam.

Ndanshau, M.O.A. (1996), 'Behaviour of the Income Velocity in Tanzania, 1967–1994', African Economic Research Consortium (AERC) Research Paper, No. 50.

Ndanshau, M.O.A. (2002), 'Evolution of the Currency Ratio in Tanzania: An Eclectic Account', Department of Economics Seminar (DES) Paper, University of Dar es Salaam, mimeo.

Ndanshau, M.O.A. and A.A.K. Mvungi (2002), 'The Kongo Street Culture: Creation of Wealth and Employment through Petty-trade', final report submitted to REPOA (Research on Poverty Alleviation), Dar es Salaam, February.

Nsengiyumva, F. (1977), 'Determinants of Tanzanian Money Supply, 1966–1976', unpublished MA Dissertation, University of Dar es Salaam.

Nyagetera, B.M. (1997), 'Financial Repression in Tanzania: Its Impact on Savings, Investment, Credit and Growth', unpublished PhD thesis, University of Dar es Salaam.

Osoro, N.E. (1995), 'Tax Reforms in Tanzania: Motivations, Directions and Implication', AERC Research Paper, No. 38, October.

Park, Y.C. (1973), 'The Role of Money in Stabilization Policy in Developing Countries', *IMF Staff Papers*, 20, pp. 379–418.

Tanzania Revenue Authority (2001), 'Informal Sector Taxation', paper presented at the National Workshop for the Informal Sector Roadmap, 28–29 November, Dar es Salaam.

Tanzi, V. (1983), 'The Underground Economy in the United States: Annual Estimates, 1930–80', *IMF Staff Papers*, No. 30, pp. 283–305.

United Republic of Tanzania (2000), *National Employment Policy*. Dar es Salaam, mimeo.