Determinants of Excess Liquidity in Tanzanian Commercial Banks

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Abstract

Among the current concerns of policymakers, economists, and analysts in Tanzania is that banks are awash with liquidity despite the high private sector credit demand. On one hand, excess liquidity constrains banks' productivity/efficiency; while on the other hand, it strangles the share of credit allocated to the private sector therefore upsetting economic growth. To determine the causes of excess liquidity, autoregressive distributed lag model is employed in this study. The findings suggest that high cost of funds, credit risks, volatility of deposit holders' cash preference, and the rate of required reserves perpetuated accumulation of excess liquidity in commercial banks in Tanzania. The main empirical findings and conclusions have important policy implications on price stability, risks minimisation, proper supervision and optimal liquidity management by the commercial banks.

1.0 Introduction

There are salient features that characterise banks in developing economies and Tanzania is not an exception. These features are pertinent to depressed financial sector settings which are a manifestation of the low level of economic and social developments, as well as unsound institutional and legal frameworks establishing banks and other financial institutions in developing countries. In developing economies banks face market risks that engender fear especially about lending and investment in domestic financial assets. Risk

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vulnerability of the Tanzanian banks which was examined through stress test looking at: credit risk, interest rate risk, exchange risk, and risk of the change in interest spreads, suggest that banks are generally resilient to shocks (IMF-World Bank, 2003). The major risk area that is identified in Tanzanian banks is interest rate risk. One of the stylised facts about credit risk in Tanzanian banks is that banks are not so much exposed to sectoral risks but are exposed to the risk of concentration of credit on some few individual borrowers. The failure of the biggest five borrowers, for example, would deprive a bank of more than 60 percent of its assets. The study also found that one of the outstanding features of financial sector in Tanzania is the high degree of liquidity.

When a bank holds reserves over and above the level sufficient to finance its statutory required minimum reserves, deposit outflows and short-term maturing obligations, it is reckoned as holding excess liquidity. When free reserves are large, banks supposedly have surplus reserves and are eager to make loans and lower interest rates. When free reserves are small, banks are supposedly under pressure to pay off their indebtedness and will consequently restrict credit and raise interest rates[1] (Frost, 1971).

Among the current concerns of policymakers and economists/researchers in Tanzania is the fact that the banking system is awash with liquidity notwithstanding the private sector high demand for credit finance. For a developing country with its enterprises craving for working capital, underutilisation of the meagre available financial resources is a crucial economic problem. The piling up of excess reserves signals either inefficiency in

[1] Under normal circumstances, it is theorised that if reserves of one bank increase, then the bank would raise lending up to the amount of its excess reserves. The amount lent out could create an equal sum of deposits hence converting excess reserves into deposits. With regards to the banking system as a whole, this tendency would cause banks' loss of excess reserves (converted into deposits) due to involved movements of those reserves in the form of deposits from one bank to another. Eventually, banks excess reserves would be cleared.

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intermediation process or a presence of some factors which induce banks to hold more than necessary amount of reserves. This study therefore seeks to investigate the factors which cause banks to undertake overwhelming accumulation of excess liquidity.

Section 2 discusses theoretical framework while Section 3 describes analytical model of banks' demand for excess reserves. Empirical analysis is provided in Section 4 whereas Section 5 concludes and highlights some policy implications arising from the findings.

2.0 Theoretical Framework

Traditional theory of liquidity preference pioneered by Keynes (1930, 1936) in the *Treatise on Money* and the *General Theory* is profoundly marked by uncertainty that economic agents feel in what is by definition an uncertain environment. Banks liquidity preference brings together elements of monetary and financial theory developed by Keynes. His liquidity preference theory identifies two functions of a bank as financial intermediation and money creation.

There is a trade-off between assets return and the degree of risk aversion. Markowitz (1952, 1959) formulates the theory of optimal portfolio selection in the context of trade-offs between risk and return. He has an idea of portfolio diversification as a method of reducing risks. Tobin (1958) adds money to Markowitz's model to argue that agents would diversify their savings/investments between a risk free asset (money) and a *single* portfolio of risky assets. In the context of bank's investments therefore, holding huge amount of liquidity would imply that it is trading off enormous risks related to the existing vulnerable investment avenues. According to Larsen (1951), liquidity preference of banks is affected by the public expectations formation. To analyse banks demand for liquidity, volatility of depositors' cash preference should thus be taken into consideration. Note that

post Keynesian renewed interest on liquidity preference derives from the generalisation of liquidity preference theory to banks (Dymski, 1988).

Mishkin (2001) explains that banks keep excess reserves as an insurance against the costs associated with deposit outflows. He argues that the higher the costs associated with deposits outflow, the more the excess reserves banks want to hold. Thus literally, banks keep excess liquidity for a range of reasons. Among the widely cited reasons for accumulation of excess liquidity in banks are: susceptibility to required reserves deficiency penalty; market risks vulnerability; and liquidity deficiency costs, ranging from interest on borrowed funds to the possible bankruptcy ordinance action. Yet other reasons include the tremendous deposit inflows that banks cannot allocate to earning assets in full due to their limited operational capacity, macroeconomic shocks in the real sector, and inadequate firms absorption capacity for loanable resources available. Because of these reasons banks trade off some pretty gains from earning assets for low-return excess liquidity to hedge against that types of risk.

The first thorough empirical study of banks' demand for free reserves was undertaken by Meigs (1962). He explains that the rate at which a bank adjusts its free reserves to the desired level is a function of the gap between the desired free reserves and the actual value. A different approach to banks portfolio dynamics is studied by Morrison (1966). Morrison's work is the first empirical study on bank's demand for excess reserves in both banks' panic and non-panic periods. In his study he concludes that excess reserves are held as a buffer to avoid asset transaction costs emanating from unforeseen, transitory deposit shocks. Accumulation of excess reserves in the U.S. banking system in the 1930s has been studied recently to ascertain what exactly happened. Explanation for excess reserves during the 1930s is categorised into two main views. The first explains accretion

of excess reserves as desired (Friedman et al., 1963; Ramos, 1996; Calomiris and Wilson, 1996). This strand of argument considers accumulation of excess reserves as protective liquidity. The second view pinpoints accumulation of excess reserves as undesired phenomenon attributed to exogenous economic factors (Bernanke, 1983, 1995; Ferderer and Zalewski, 1994). There is an indication in the literature that market liquidity may vary during periods of stress relative to normal situations, leading to greater asset price volatility during the former and so disrupting liquidity targets (Cohen and Shin, 2002).

Aǵnor et al. (2004) articulate banks' precautionary motive for holding non-remunerated assets. In their context, a rise in actual holding of excess reserves can be construed as consistent with supply-induced reduction in credit. The main features captured in the model applied to the economy of Thailand by Aǵnor et al. include: the impact of reserve requirements; deposits volatility; liquidity risk; and the bank borrowing rate. Some previous models conclude that if the borrowing rate the bank has to pay in case of reserve deficiency is less than the rate of interest earned on loans, no excess reserves will be held by banks (Knobel, 1977).

Reserve and liquidity requirements play important role of withdrawing or enhancing liquidity in the banking system (Nyagetera, 1997). From the analysis of banks liquidity ratios, Nyagetera shows that during the era of the government-owned and controlled banking system in Tanzania, banks were highly illiquid. The reasons were the absence of punitive measures for the banks failure to observe prudential requirements, and the excessive compulsory lending to the Government. The current problem of excess liquidity in Tanzanian banks is actually a downturn to another undesirable liquidity extreme.

3.0 The Model of Banks' Demand for Excess Liquidity

For estimation of determinants of excess liquidity (*EL*) in banks we use an econometric model of banks' demand for excess reserves, regressing excess liquidity on the hypothesised determinants, which include: the rate of required reserves banks borrowing rate, credit risk and volatility of deposit holders' cash preference. Baltensperger (1972, 1980) simple model of reserves management is specified and modified to suit the Tanzania's case. The bank must decide on the amounts of non-interest bearing reserve assets, *R*, and non-reserve assets which are in illiquid form (loans), denoted by *L*. The bank's balance sheet is thus expressed as

(1) $R + L = D$,

where *D* represents deposits. Deposits flow out randomly, as $u \in (u_L, u_H)$, according to density function $\phi = \Phi$. If the bank faces shortage of liquidity, $u \geq R$, it must incur a cost of borrowing (illiquidity cost) which is proportional to liquidity deficiency, *max*(*0, u-R*). The illiquidity cost causes a bank to hedge against uncertainty by holding reserves. This cost which is referred to as the cost of uncertainty (*Cu*) can be expressed as

(2) $C_u = r_L R + q\int_R^{u_H} (u - R)\phi(u)du$,

and the bank could optimise by minimising its reserves. Whereas r_L is interest rate on loans, the bank borrowing interest rate *q* is such that $q > r_L$. Denoting a deposit rate as r_D, the profit function of the bank is written as

(3) $\prod = r_L L - r_D D - q\max(0, u - R)$,

implying that the bank expected profit is

(4) $E(\prod) = r_L L - r_D D - q\int_R^{u_H} (u - R)\phi(u)du$.

Using (2) expected profit equation (4) can be written as

(5) $$E(\prod) = (r_L - r_D)D - r_L R - q\int_R^{u_H} (u - R)\phi(u)du \,.$$

Assuming banks are risk neutral, the level of reserves is chosen such that expected profits are maximised and so the first order necessary condition is

(6) $$\frac{\partial E(\prod)}{\partial R} = -r_L + q[1 - \Phi(R)] = 0 \,,$$

which can be simplified as

(7) $$R^* = \Phi^{-1}\left(\frac{q - r_L}{q}\right).$$

Equation (7) states that the marginal opportunity cost of accumulating an extra unit of reserves, r_L, is equal to the marginal reduction in the liquidity cost. It implies that optimal reserves fall with the lending rate (r_L) and rises with the bank borrowing rate (q).

Assume a negative relationship between loans demand and the lending rate, while demand for loans is proportional to expected output (Y^e). It can be written symbolically as

(8) $$L = f(r_L)Y^e, \quad \frac{\partial L}{\partial r_L} < 0 \,.$$

By the same token the supply of deposits by the public is hypothesised as positively related to the deposit rate and proportional to the level of expected output,

(9) $$D = g(r_D)Y^e, \quad \frac{\partial D}{\partial r_D} > 0 \,.$$

The bank is supposed to maintain the amount of liquidity which is proportional to its deposit base at the rate r. If reserve requirement rate is denoted by θ and total reserves are denoted by R, the excess reserves, z, can be expressed by $z = R - \theta D$. Using equation (1), R can be eliminated to get

(10) $$z = (1 - \theta)D - L \,.$$

Currency outside banking system is denoted by C, and so money market equilibrium condition is expressed as

(11) $C + D = kY, \quad k > 0$,

where k is a reciprocal of velocity of circulation and Y is the realised output. Having cash to deposit ratio (c) as C/D and having assumed that demand for cash takes place at the end of the period after output realisation, we have

(12) $C = \frac{c}{1+c} kY$.

Both output and $ck/(1+c)$ are assumed to be random and can be expressed as

(13) $Y = Y^e(1+\varepsilon)$ and $\frac{ck}{1+c} = \Lambda(1+\xi)$,

where ε and ξ are random shocks. Using (12) and (13) the demand for cash is

(14) $C = \Lambda k Y^e(1+\varepsilon)(1+\xi)$.

To make the analysis easy, the expression $(1+\varepsilon)(1+\xi)$ is assumed to be normally distributed with the mean μ and variance σ^2. For a bank to finance unanticipated liquidity outflows it can either borrow at the rate, q, as shown in a simple model and/or use its excess reserves, z. By equation (10), expected reserve deficiency is

(15) $\max[0, C - ((1-\theta)D - L)]$.

Using equations (8), (9), (11), (14) and (15) the bank's expected profit is now expressed as

(16) $\Pi = [r_L f(r_L) - r_D g(r_D)]Y^e + rR - qE \max[0, C - ((1-\theta)D - L)]$.

Where r denotes gains/losses from reserves held. From these derivations and assuming that the functions f and g are well behaved respective loans demand and supply functions, a theoretical bank's demand function for excess reserves is

(17) $z = z(P, V, \Re), \ \frac{\partial z}{\partial P} > 0, \ \frac{\partial z}{\partial V} > 0, \ \frac{\partial z}{\partial \Re} < 0,$

where P is the banks' borrowing rate, V is output volatility and $\Re$ is the rate of statutory required reserves.

This equation sets the foundation for empirical analysis of excess reserves. Nevertheless, for a developing country like Tanzania there are other factors to be considered including credit and liquidity risks that can lead banks to holding some liquidity which they should have otherwise lent out. The question of risks in emerging economies is very fundamental, and excess reserves may accumulate due to risk phenomenon. Risk-return considerations are the key issues that elicit the fact that banks in high risky economies operate to maximise profits but within a dilemma about how to balance between the expected returns and the inherent market risks.

Recall R as total bank reserve assets while RR and z represent statutory required reserves and excess reserves, respectively. Excess reserves can now be defined as

(18) $z = R - RR.$

From the simple commercial bank balance sheet, equation (1), loans can be defined as $L=D-R$. Using the lending rate, interest income earned by the bank is simply $r_L L$. RR is a certain proportion of deposits which can be deducted from the total bank deposits to get the amount of mobilised resources that can be loaned out. Let us denote available resources for lending as $d = D-RR$ in order to have interest income as

(19) $Income = r_L(d - z), \quad \frac{\partial Income}{\partial z} < 0.$

This equation explains the bank's earnings side, one can as well look at the cost of funds side and define it as, $cost=r_D D$. On the balance sheet, deposits are allocated to both interest earning assets (loans) and reserve assets. This implies that $cost=r_D(L+RR+z)$. If the amount of deposits allocated to required reserves is deducted from total mobilised deposits, the cost[2] of available resources is

[2] That is the cost of resources which can be invested for returns.

(20) $Cost = r_D(l + z),\ \frac{\partial Cost}{\partial z} > 0$,

where l=L-RR. From (19) it is notable that the rise in excess reserves reduces income earned by the bank, while (20) explains accumulation of excess reserves as a cause of the rising cost to the bank. Here is where the link between bank efficiency and excess liquidity stems. Accumulation of excess liquidity in banks impacts negatively on efficiency by increasing cost and hence decreasing income.

Expressing excess reserves as a subject in (19) and (20), and then differentiating partially with respect to interest rates yields

$$z = d - \frac{Income}{r_l}, \quad \frac{\partial z}{\partial r_L} > 0 \quad \text{and}$$

(21) $$z = \frac{Cost}{r_d} - l, \qquad \frac{\partial z}{\partial r_D} < 0.$$

Assuming stable financial situation and the well functioning markets, conditions (21) can hold, such that: due to a rise in the lending rate (a price for loans), investors demand for those reserves may fall and hence leading to an increase in excess reserves. When the deposit rate rises, it implies a mounting cost of funds and so bank's excess reserves decline owing to an increased use of internally accumulated protective reserves rather than market sourced funds. But even when markets are far from perfection and the forces of demand and supply don't work in theoretically hypothesised directions, conditions (21) have a reasonable implication. Ideally, the rise in lending rate is most likely attributable to the increased cost of funds and/or the rising market risks. Consistent with the high risks in developing markets, a rise in excess reserves could spring from towering credit risks and eventually accentuate inefficiencies in the banking sector ascribed to the discussed cost-income effects. In the process of hedging against those risks, lending rates are set high

while on the other side deposit rates are low. As a result, this leads to a wide margin between lending and deposit rates, which are indicative of bank inefficiency.

For estimation purposes the following autoregressive distributed lag (ADL) model (22), which accounts for both contemporaneous and lagged effects, is estimated to investigate determinants of excess liquidity in Tanzanian banks. Note that all variables are in the log form.

$$(22) \qquad z_t = \tau + \sum_{i=1}^{p} \delta_i z_{t-i} + \sum_{j=0}^{r} \alpha_{1j} x_{1,t-j} + \sum_{j=0}^{r} \alpha_{2j} x_{2,t-j} + ... + \sum_{j=0}^{r} \alpha_{Kj} x_{K,t-j} + \upsilon_t ,$$

which is rearranged to have

$$(23) \qquad z_t - \sum_{i=1}^{p} \delta_i z_{t-i} = \tau + \sum_{j=0}^{r} \alpha_{1j} x_{1,t-j} + \sum_{j=0}^{r} \alpha_{2j} x_{2,t-j} + ... + \sum_{j=0}^{r} \alpha_{Kj} x_{K,t-j} + \upsilon_t .$$

This model can be expressed more compactly as $B(L)z_t = \tau + \sum_{i=1}^{K} C_i(L) x_{i_t} + \upsilon_t$. Defining polynomials in the lag operator we have

$$B(L) = 1 - \delta_1 L - \delta_2 L^2 - ..... - \delta_p L^p \ ; \quad \text{and}$$

$$C_1(L) = 1 + \alpha_{11} L + \alpha_{12} L^2 + ... + \alpha_{1r} L^r$$

$$C_2(L) = 1 + \alpha_{21} L + \alpha_{22} L^2 + ... + \alpha_{2r} L^r$$

$$\vdots$$

$$C_K(L) = 1 + \alpha_{K1} L + \alpha_{K2} L^2 + ... + \alpha_{Kr} L^r ,$$

where in this case *L* denotes a lag operator in the empirical model.

The variables are defined as:

$z_t = EL$, which represents excess liquidity. Excess liquidity is computed as the bank's total liquid assets minus the amount sufficient to finance statutory required reserves, expected deposit outflows, and the short-term maturing obligations;

z_{t-i} = lagged values of *EL*, which capture the dynamics of adjustment of commercial banks demand for excess liquidity;

$x_{1t} = (RR/D)$, representing the impact of reserve requirement rate set by the central bank. *RR* is the amount computed as a proportion of deposits (*D*) that commercial banks should keep with the central bank by law. The hypothesis is that raising *RR* would draw some idle reserves from banks especially where liquidity appears to be high;

$x_{2t} = (C_T - C)$, captures the cyclical pattern of deposit holders' cash preferences and signals liquidity risk since it is formed from cash trend deviations. C_T represents a non-linear cash trend, while *C* is actual cash in a bank at the respective point in time;

$x_{3t} = r$, is the banks' borrowing rate, i.e. a unit cost of funds in case of illiquidity. This is a penalty which the bank faces if it falls short of its liquidity requirement. It means in case a bank needs some liquidity, that is the price it should pay for;

$x_{4t} = Loans\ return\ deviations$. This is a proxy for credit risk which is reflected by the variations of loans return from the mean. If returns variance is too volatile it indicates that the involved risks are also high, which implies a bank may easily gain or lose;

τ is a constant, while υ_t is an error term. $B(L)$ and $C_i(L)$ are lag polynomials. The Excess liquidity demand function (22) is a linear ADL model with a classical disturbance. As such, is estimated using ordinary least squares technique for the tests and analysis of the determinants of excess liquidity in commercial banks.

4.0 Empirical Analysis

Owing to data availability, the ADL model is estimated for the (June 1999-December 2004) period, using monthly data. Excess liquidity is regressed against five explanatory variables comprising lagged values of itself, the rate of required reserves, deposit holders' cash preferences, the bank borrowing rate, and the loans return variations.

Empirical results indicate that in the long-run excess liquidity is derived by the cause-factors included in the estimation model. Nevertheless, during the study period there was some misalignment between the long-run and short-run results. While in the long-run the volatility of cash preferences had a big influence on accumulation of excess liquidity, in the short-run it was not significant. Whereas raising the rate of required reserves reduced excess liquidity in the long-run, in the short-term it caused a surge in banks protective reserves.

4.1 Some Supply and Demand Side Issues

There are factors inherent in either side of the market that influence banks' liquidity. Besides those issues of demand and supply there are also exogenous structural factors which impact on the behaviour of both commercial banks and borrowers in relation to lending activities. Here is some glimpse of what might be thought in developing economy, but cautiously, as the driving forces to accumulation of excess liquidity in banks.

Demand Side: A major concern on demand side is whether banks are industriously keen to provide more loans to private sector based on their practical screening criteria, but owing to raison d'être on their clients' side, the process is halted and therefore resulting in credit rationing. In imperfect information markets, the higher the lending rates the more

the riskiness of potential borrowers, and so the less the banks' expected returns, which eventually reflects a relatively smaller amount of loans. Another demand side concern in asymmetric information situation relates to collateral requirement. A question is, with excess supply of funds, why banks don't increase collateral requirement to give more secured loans to demanding firms? Obviously, that approach means a reduction of debt-equity ratio of the borrowing clients, which is not necessarily optimal to banks.

On the other hand, a challenge is that Tanzania did not experience an alarming rate of companies' liquidation over the study period; instead, there was continued privatisation of the Government parastatals and a rise in the number of new domestic and foreign companies incorporated in the country. This indicates an expansion of the private sector which would play down the problem of excess liquidity through credit creation by banks. These developments suggest that demand side of the credit market was growing and should have substantially absorbed excess liquidity through loans received.

Supply Side: On the supply side of the credit market the first focus is on the subject of alternative returns. This is in the context of options the lenders have between investing in liquid and illiquid assets as regards obtainable returns. Treasury bills are conventionally among liquid assets in commercial banks, however, for the Tanzania's case the caution is- although T-bills are liquid assets, they also stand out as one of the competitive alternative earning assets to loans. The rationale behind this argument lies upon T-bills rate, which compete with recorded minimum lending rates given to banks' prime customers. This is perhaps more of fiscal policy issue than credit market supply side problem per se, but essentially, it undermines credit allocated to the private sector by commercial banks. It prompts banks to keep more liquidity for investment in government papers especially vis à

vis their relative lesser risk than that in loan instruments. Another central question is about how costly is the holding of excess liquidity to commercial banks? In other words, one could think of whether there are hedged liquidity and/or credit risks, which in the event that they happen might be of higher cost than keeping protective liquidity. Estimation results authenticate the significance of explanatory variables of excess liquidity and so straight forwardly providing some key answers to such kind of questions.

4.2 Estimation Results

Estimation of determinants of excess liquidity in Tanzanian commercial banks took into account the fact that T-bills can act as an alternative asset to other earning bank investments. To that effect, two models were estimated: the first is the model excluding Treasury bills from banks' liquid assets; and the second one includes Treasury bills in banks' liquid assets.

Starting with the first ADL model, three major steps were followed. In the first step the time series characteristics of the data were investigated. The results of unit root tests suggest that all the variables were integrated of order one (Table 1).

Table 1: ADF Unit Root Test

Variable[3]	Statistic - level	Statistic – 1st difference	Critical value 1% level
LZ	-3.443362	-6.543324	-3.5345
LX_1	-3.491855	-5.514884	-3.5345
LX_2	-2.457604	-4.731596	-3.5345
LX_3	-1.211926	-3.615197	-3.5345
LX_4	-3.283010	-6.465800	-3.5345

The second step involved cointegration analysis to establish the long-run relationships among the variables. A central issue here was to see whether the variables tend to wander together. Cointegration test shows that variables of the first ADL model are cointegrated.

[3] Note that prefix L on all estimation variables just denote the log of the variable.

See below the normalised coefficients of cointegrating equation, which bear out the prior hypothesised theoretical underpinnings.

$$LZ = -46.815 - \underset{(4.493)}{5.874}\,LX_1 + \underset{(9.003)}{8.659}\,LX_2 + \underset{(0.869)}{0.240}\,LX_3 + \underset{(1.009)}{1.089}\,LX_4$$

Log likelihood is 130.510, and in the parentheses are the standard errors.

In the long-run, a rise in the rate of required reserves (x_1) by 1 percent lowers excess liquidity by about 6 percent, while one percent surge in: volatility of cash preference (x_2); the bank borrowing rate (x_3); and variations of loans return (x_4), increase excess liquidity by about 9 percent, 0.2 percent and 1.1 percent, respectively.

The third step dealt with estimation of the error correction model (ECM). The approach used is general to specific modelling technique whereby using Akaike information criterion test of the lag length, we started off with six lags on each variable then proceeding with simplification to the most parsimonious characterisation of the data. Table 2 summarises the results of parsimonious model, reduced from a general ADL model whose values of F and F-probability do not reject the joint significance hypothesis.

2: Estimates of the Simplified Error Correction ADL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
τ	0.035609	0.012961	2.747341*	0.0082
DLZ(-1)	-0.393448	0.117124	-3.359242*	0.0015
DLZ(-2)	-0.399348	0.107562	-3.712725*	0.0005
DLZ(-3)	-0.360640	0.119802	-3.010311*	0.0040
DLX1(-3)	0.230467	0.089244	2.582433**	0.0126
DLX1(-4)	0.229957	0.091431	2.515091**	0.0150
DLX3(-3)	0.302848	0.097028	3.121235*	0.0029
DLX4	0.030916	0.012422	2.488833**	0.0160
RESID01(-1)	-0.112772	0.033437	-3.372701*	0.0014
R-squared	0.463405	Akaike info criterion		-1.758104
Adjusted R-squared	0.382410	Schwarz criterion		-1.449326
Log likelihood	63.50122	F-statistic		5.721375
Durbin-Watson stat	2.042855	Prob (F-statistic)		0.000030
Prob (Jarque-Bera)	0.788091	Prob (LM-Test)		0.778868
Prob (ARCH)	0.475955			

Note that * and ** denote significance at 1% and 5%, respectively.

Diagnostic tests characterise residuals of the simplified model as being normally distributed, homoskedastic and non-autocorrelated. The Chow stability test suggests absence of parameter instability especially from the mid 2002.

The error correction term in the ECM has a correct sign and is significant, meaning there are adjustments toward the long-run equilibrium over time. Sum of the coefficients of differenced first three lags of the values of excess liquidity ($DLZ_{(-i)}$) in the error correction model is significant and has a negative sign (Table 3). This means in the short-run, contemporaneous amount of excess liquidity is less if banks managed to accumulate substantial quantity of liquidity in the previous periods, particularly within a given quarter.

Table 3: Significance of the Sum of Coefficients of ADL Model

Summed Lags	Coefficient	F-value	F-probability
$\sum DLZ_{(1-3)}$	-1.1530	20.780*	0.0000
$\sum DLX1_{(3-4)}$	0.4604	10.184*	0.0023
$DLX3_{(-3)}$ [Ŧ]	0.3028	3.1212*	0.0029
DLX_4 [Ŧ]	0.0309	2.4888**	0.0160

* and ** denote significance at 1% and 5%, respectively

[Ŧ] Means for this variable reference is made to t-statistic and its probability

Contrary to the long-run situation, the sum of coefficients of differenced third and fourth lags of the rate of required reserves ($DLX_{1(-i)}$) is significant and has a positive sign. In the short-run, if the central bank constrains reserves, commercial banks hedge by accumulating more protective liquidity. In essence, raising the rate of statutory required reserves is perceived by commercial banks as one of the likely causes of liquidity shortage given their plans at least in a quarterly time span.

Excess liquidity in commercial banks is found to be positively and significantly related to the differenced third lag of the values of cost of funds ($DLX_{3(-3)}$). This variable captures the fear of illiquidity cost since it is the rate a bank has to pay for cash if it falls short of liquidity. Given that banks in Tanzania recourse to inter-bank cash market for their frequent borrowing, the money market rate is used in this case instead of discount rate. In

view of the fact that depositors' cash preference is volatile and somehow unpredictable; and having the money market rates over and above deposit rates, banks are very likely to accumulate protective reserves.

There is evidence from the findings that even in the short-run loans return variations (DLX_4), prompt banks to keep excess reserves. This variable takes care of the credit risk aversion where banks limit credit extension to the private sector due to default risk. It means extreme return deviations from the trend signals high risks involved in the bank credit instruments. Credit risk is the factor which has been widely singled out as the rationale for banks to refrain from issuing loans adequately despite the high lending rates and the presence of credit demand by the private sector in developing countries.

Considering commercial banks mounting investment in the government papers, the second ADL model which includes T-bills as a part of liquid assets in banks was estimated. The only difference for this variant of the model is that excess liquidity variable is now constructed without excluding T-bills from liquid assets; all other variables remain the same. In spite of changing the composition of excess liquidity, the results portray a similar picture like that of the findings from the former model. The variables are integrated of order one, and cointegration test results in a long-run cointegrating equation encompassing hypothesised theoretical relationships:

$$LZ_b = -45.438 - \underset{(3.511)}{5.549}\,LX_1 + \underset{(6.739)}{6.756}\,LX_2 + \underset{(0.821)}{0.335}\,LX_3 + \underset{(0.787)}{1.041}\,LX_4 .$$

Log likelihood is 147.360, and in the parentheses are the standard errors.

Note that excess liquidity variable is symbolised in this model as LZ_b instead of the original LZ notation. Notwithstanding the inclusion of T-bills, changes in excess liquidity

in commercial banks were influenced by the same factors outlined in the preceding model and they fairly turned out to be consistently inclined to the same directions (Tables 4 & 5).

Table 4: Estimates of the Simplified Error Correction ADL Model, T-bills Included

Variable	Coefficient	Std. Error	t-Statistic	Prob.
τ	0.039089	0.010184	3.838199*	0.0003
$DLZ_{\mathbf{b}(-1)}$	-0.388954	0.126984	-3.063004*	0.0034
$DLZ_{\mathbf{b}(-2)}$	-0.379797	0.117252	-3.239150*	0.0021
$DLZ_{\mathbf{b}(-3)}$	-0.415523	0.122212	-3.400008*	0.0013
$DLX_{1(-3)}$	0.152093	0.062520	2.432718**	0.0184
$DLX_{1(-4)}$	0.171178	0.062959	2.718888*	0.0088
$DLX_{3(-3)}$	0.172388	0.067678	2.547162**	0.0138
DLX_4	0.021163	0.008885	2.381975**	0.0208
$RESID01_{(-1)}$	-0.095326	0.023984	-3.974566*	0.0002
R-squared	0.458829	Akaike info criterion		-2.43458
Adjusted R-squared	0.377143	Schwarz criterion		-2.125805
Log likelihood	84.47207	F-statistic		5.616972
Durbin-Watson stat	1.702362	Prob(F-statistic)		0.000036
Log likelihood	84.47207	Prob (LM-Test)		0.889210
Prob (ARCH)	0.162618			

Note that * and ** denote significance at 1% and 5%, respectively.

Table 5: Significance of the Sum of Coefficients of ADL Model, T-bills Included

Summed Lags	Coefficient	F-value	F-probability
$\sum DLZ_{\mathbf{b}(1-3)}$	-1.1530	20.035*	0.0000
$\sum DLX_{1(3-4)}$	0.4604	10.611*	0.0020
$DLX_{3(-3)}$ [Ŧ]	0.1724	2.5472**	0.0138
DLX_4 [Ŧ]	0.0212	2.3820**	0.0208

* and ** denote significance at 1% and 5%, respectively

[Ŧ] Means for this variable reference is made to t-statistic and its probability

The error correction term in the simplified second ECM has a correct sign and is significant as well. All other major findings from the estimates of this model bring the same conclusions like those drawn from the first ADL model. That means whether we think of T-bills as liquid assets in Tanzanian commercial banks or just as one of earning assets like any other imaginable illiquid assets, the factors that derive accumulation of excess liquidity are identical. In the short-run, high cost of funds in case of illiquidity, credit risk, and the rate of required reserves contributed positively to the accumulation of excess liquidity in commercial banks. In addition, the more banks had accumulated excess

reserves in the previous periods the less were inclined to further accumulation of liquid assets in the subsequent periods.

5.0 Conclusions and Policy Implications

The major objective of this study was to investigate the determinants of excess liquidity in commercial banks in Tanzania. The results of the ADL model were analysed for both long-run and short-run situations. In the long-run, an increase in the rate of required reserves lowers excess liquidity in commercial banks. Other factors which affect excess liquidity positively in the long-term include: volatility of cash preference; the bank borrowing rate; and variations of loans return or credit risk. Within the study period, the rise in any of these variables caused a surge in excess liquidity of commercial banks.

Turning to the short-run conclusions, two models were estimated: one which considers Treasury bills as liquid assets of commercial banks, and the other which considers Treasury bills as one of the earning bank investments with almost the same characteristics as illiquid assets. Results from both versions of the model turned out to be fairly identical and had the same main conclusions. Estimations indicate that there are adjustments toward the long-run equilibrium over time.

In the short-run, contemporaneous amount of excess liquidity becomes less if banks managed to accumulate substantial quantity of liquidity in the previous periods. If the central bank constrains reserves, commercial banks hedge by accumulating more protective liquid assets. The threat of illiquidity cost was found to have a positive impact on excess liquidity. As the price of funds (bank borrowing rate) increases, banks take heed of possible risk-cost associated with liquidity shortage in case it happens and this prompts

them to accumulate more reserves. Volatilities in loans return variance impel banks to keep excess reserves. This is because, extreme return deviations from the trend signal high risks involved in bank credit instruments.

Based on these conclusions, there are policy implications worth noting. Reserve requirement regulation was found to be effective especially in achievement of the medium and long-term policy objectives. This instrument can remain as a tool for monetary policy. Nevertheless, it is ineffective in the short-run and this necessitates the need for the central bank to be innovative in the ways it can encourage banks to grant more credits to economically strategic areas. Sometimes it may be optimal to guarantee some credits.

The findings imply that it is necessary for the Government to exert more efforts in ensuring a well-functioning legal framework in order to facilitate enforcement of contracts because it has a bearing on reduction of credit risks. Steps have to be taken towards establishment of reputable independent credit information bureau in Tanzania. Protection of both borrowers and the credit institutions can be an easy game theoretic approach to motivating financial institutions to extend more credits to the real sector, and on the other hand, to obligating loans repayment.

Low inflation is a prerequisite to attenuation of the future price uncertainties which are apt to affect interest rate and exchange rate stabilities. The idea is to lessen inflation rate in view of the fact that high inflation raises interest rates and consequently affecting credits and economic performance in general. As long as soaring cost of funds accelerates accumulation of protective excess liquidity, price stability will help reducing exaggerations of costs the banks incur in case they borrow.

According to finance theory, the risk of financial distress will largely depend on the earnings and cash flow volatilities in the firm. Estimations of the ADL model attest that volatility of cash preference impacts positively on the banks' excess liquidity in the long-run. This conclusion calls for the banks to design proper liquidity management that will ensure unswerving forecasts of their cash flows. In order to offset unnecessary variations in planned cash trends, proficient financial experts should be employed in banks to help doing projections in a contemporary scientific manner.

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