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Comparative Analysis of Liquidity and Capital of Commercial Banks in Tanzania

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Abstract

This study compares the liquidity and capital of commercial banks in Tanzania. Specifically, the study examines the liquidity and capital adjustment of small, medium and large banks. The study used quarterly data of 28 commercial banks from 2010 to 2019 and applied descriptive and correlation analysis. Results revealed a negative correlation between adjustment in capital and liquid assets to customer deposits ratio. Furthermore, a significant correlation between capital adjustment and liquidity in small and large banks was also observed. The liquidity and capital adjustment between the current and previous periods do not significantly differ among small, medium, and large banks. However, a significant adjustment from regulatory minimum is observed across banks' group mean. The negative correlation between adjustment in capital and the ratio of liquid assets to customer deposits indicates that banks of higher capital have low liquidity. When capital is adjusted upward, small banks reduce liquidity while large banks increase liquidity. However, when liquidity is adjusted upward, small banks reduce capital while large banks increase capital. When capital requirements increase, the ratio of liquid assets to total assets is reduced for all banks since banks are inclined to increase capital. The results imply heterogeneity of banks' liquidity and capital. Therefore, the regulator should consider heterogeneity among banks to allow effective regulatory and supervisory mechanisms across bank categories. Moreover, bank managers should effectively manage both capital and liquidity to remain legitimate and survive.

Keywords: Capital, liquidity, capital requirement, liquidity requirement

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Introduction

Liquidity and capital ensure the stability of the banking sector. On the one hand, liquidity allows banks to efficiently meet depositors' demand for withdrawals (Diamond & Dybvig, 1983; Diamond & Rajan, 2001).On the other hand, capital enables banks to absorb risks (Milne & Walley, 2001; Wagner, 2007). Bank regulations shape banks' capital and liquidity levels because of restrictions on activities and holding of capital and liquidity, among others (World Bank, 2020; DeYoung, Distinguin & Tarazi, 2018). In this respect, Basel III regulations of 2008 reflected the importance of market risks and the macroeconomic environment by enhancing capital regulations to include a capital buffer for economic stress periods, higher requirements for systemically important financial institutions, and quality of capital and liquidity coverage ratio (Basel Committee on Banking Supervision, 2010). Liquidity coverage ratio (LCR) aimed to promote a more resilient banking sector by promoting short-term resilience of the liquidity risk profile of banks.

Consequently, liquidity and capital requirements have enabled banks to remain stable and attributed to substitution between capital and liquidity (DeYoung *et al.,* 2018; Fu, Lin & Molyneux, 2016). The substitution between capital and liquidity exists due to the shock on capital. Therefore, capital and liquidity are substitutes, but this is grounded on the minimum capital requirement and does not require minimum liquidity because banks' liquidity position improves in adjusting the capital ratio. Moreover, the trade-off between capital and liquidity has varied such that an increase in liquidity requirement led to inefficiency in non-liquid assets investment (Aldasoro, Gatti & Faia, 2016). The trade-off causes high liquid assets to generate lower returns, thus reducing profit. Empirically, authors have found a positive effect of liquidity on capital (Roy, Misra, Padhan, & Rahman, 2019; Abbas, Iqbal, & Aziz, 2019; Vodova, 2011) on the one hand, while others found a negative effect of liquidity on capital (Jokipii & Milne, 2011; (Altunbas, Carbo, Gardener, & Molyneux, 2007; Bhati, Zoysa, & Jitaree, 2019). Additionally, while some authors found a negative effect of capital on liquidity (Lotto & Mwemezi, 2015; Al-Harbi, 2017), others have found a positive effect of capital on liquidity (Morina & Qarri, 2021).

Despite previous literature contributing to understanding the relationship between capital and liquidity in banks, there is still a need for further advancing understanding of capital and liquidity in different countries, particularly developing countries such as Tanzania. First, there is a variation in the financial market development in which banks operate. Developed markets such as the U.S. and Europe have well-advanced financial markets with better access to funds compared to countries such as Tanzania, where the financial market is still nascent. In conjunction with this is the low adherence to regulatory requirements among emerging markets, with the adoption of capital regulations lagging. Tanzania is among the African countries still at the Basel II implementation stage (Ozili, 2019). Additionally, Basel III requirements in Tanzania are yet to be implemented (International Monetary Fund, 2018).

Moreover, capital breaches and funding challenges still exist in East Africa (PricewaterhouseCoopers, 2019). The focus of Tanzania is essential because the largest banks dominate the banking sector, and peer one banks drive the capital (International Monetary

Fund, 2018). Consequently, vulnerability from market shocks causes a high risk of future insolvency. The banking sector in Tanzania has evolved in regulations with revision of capital regulation (Bank of Tanzania, 2011; United Republic of Tanzania, 2006). However, the liquidity requirement remained at 20 percent. Despite high liquidity, it has declined since 2010 (Bank of Tanzania, 2012; 2017; 2019). The latest move of funds held in commercial banks by ministries, public corporations, and local government authorities to the Bank of Tanzania in late 2016 led banks to lose significant deposits, disrupting liquidity in the short term. While empirical evidence in Tanzania discusses banks' liquidity (Aikaeli, 2006; Lotto & Mwemezi, 2015; Qin & Pastory, 2012), some have focused on large banks (Qin & Pastory, 2012). However, evidence has shown variations among large and small banks (Fu *et al.*, 2016; Abbas *et al.,* 2019; Smith, Arnould, Milonas, & Vo, 2019; DeYoung *et al.,* 2018). Nevertheless, more is needed to examine liquidity and capital adjustment behavior in Tanzania. Thus, focusing on large banks does not reveal the heterogeneity in bank behavior following the increase in regulatory capital amid the declines in liquidity.

Therefore, it leaves us with less understanding of the adjustment behavior of banks' capital and liquidity in Tanzania. Given these gaps, this study aims to compare the capital and liquidity levels of commercial banks in Tanzania, specifically, the study examines the capital and liquidity adjustment of commercial banks in Tanzania, and whether there are differences between small, medium, and large banks. Financial stability is a global agenda under Basel III, and the banking sector plays a crucial role in achieving stability. This study, therefore, contributes to the empirical literature by examining the comparative analysis of liquidity and capital to researchers, policymakers, and other bank stakeholders. The study informs regulators on the heterogeneity of banks in the adjustment behavior following regulatory changes. The results support a substitution between liquidity and capital for small banks. Lastly, bank managers should effectively manage both capital and liquidity to remain legitimate and survival.

The rest of the paper is organized as follows; section 2 provides the theoretical and empirical literature on bank liquidity and bank capital, followed by the methodology in section 3 and then results and discussion in section 4. The last section, 5, concludes.

Literature Review

Theoretical review

Financial intermediation involves transforming short-term deposits into long-term loans, which attracts liquidity risk (Diamond & Dybvig, 1983). Therefore, both liquidity and capital buffers are essential for banks' safety. Accordingly, the capital buffer theory points out that banks maintain a level of capital above the required minimum (Milne & Walley, 2001; Jokipii & Milne, 2011). The capital buffers absorb losses, determine the bank's risk-taking behavior, and indicate a bank's financial strength. Hence, the capital buffer can rescue banks against the failure of unsecured deposits and money market funding.

Liquidity allows a bank to cover customer liquidity need (Diamond & Dybvig, 1983; Diamond & Rajan, 2001). Thus, banks have to balance between liquidity and capital buffers

because high liquidity buffers have an opportunity cost. The holding higher liquidity forgoes profits from investing the funds in long-term assets hence low efficiency (Aldasoro *et al.,* 2016). Low profitability affects capital through low retained earnings. Thus, banks with higher liquidity have low capital (Jokipii & Milne, 2011). Moreover, liquidity levels should balance the volatility of the funding base and the cost of raising additional funds. If banks have easy access and participation in the interbank market, or access to market funding, they reduce capital (Abbas *et al.*, 2019). Therefore, both capital and liquidity have consequences for banks. Altering capital and allowing it to fall below the minimum required level has cost implications, including bank closure.

In the case of regulations, Rupello (2005) examined the interaction between a bank and letter of last resort. In his study, when banks are subjected to both capital and liquidity requirements but are allowed to choose the liquidity buffer they want to hold, Rupello (2005) observed that the choice of the bank's risk of loan portfolio decreases with capital requirements. However, the lender of last resort reduces the incentive of banks to hold liquid assets. The trade-off between capital and liquidity requirements means that when asset liquidity becomes large, capital requirements become a less effective mechanism for stability (Wagner, 2007). An increase in liquidity improves stability by facilitating the transfer of risk from the bank and increasing the bank's profits, but this later leads to increased risk. Therefore, the capital buffer theory best explains the relationship between capital and liquidity with respect to regulatory requirements.

Empirical literature on bank capital and liquidity level of banks

There are divergent schools of thought on the relationship between capital and liquidity of banks. The relationship from liquidity to capital is conflicting. On the one hand, bank liquidity negatively influences capital (Abbas *et al.,* 2019). On the other hand, bank liquidity positively affects capital (Roy *et al.,* 2019; Altunbas *et al.,* 2007; Vodova, 2011). Roy *et al.* (2019) used a variety of liquidity measures (Liquid assets to total assets, Liquid assets to total deposits, Loans to total assets, Loans to total deposits, and the net of total deposits minus liquid assets to total assets). Their study covered the period from 2005 to 2017, divided into three distinct phases of the financial turmoil (2008 to 2010), high credit off-take (2011 to 2014), and domestic banking crisis (2015 to 2016) in India. The positive liquidity effect on capital indicates that more liquid banks have invested significant funds in low-risk and low-return assets.

Additionally, Vodova (2011) examined the liquidity of Czech Republic commercial banks and found that bank liquidity is positively related to capital adequacy. The positive influence of the share of capital on total assets is consistent with the assumption that a bank with sufficient capital adequacy should be liquid, too. Despite a robust positive effect of liquidity on capital, the relationship varied by type of bank such that higher liquidity significantly reduced the capital of savings banks in Europe (Altunbas *et al.,* 2007). In terms of the effect of capital on liquidity, capital significantly determines banks' liquidity (Roy *et al.,* 2019). Furthermore, the interactive effects among liquidity, profitability, and regulatory capital showed that banks are more liquid with less profit but less risky with more liquidity.

Moreover, Al-Harbi (2017) examined the determinants of bank liquidity in developing countries and found that capital ratio negatively affected liquidity. Similarly, Morina and Qarri (2021) in Kosovo, who used data from 2012- 2019 and found that non-performing loans and capital adequacy had a positive effect on liquidity while interest rates on loans negatively affected liquidity.

Bhatti *et al.* (2019) examined the liquidity of Indian banks using four liquidity measures and found that banks rely more on asset-based liquidity and less on liability-based liquidity. Liquid asset to total asset ratio negatively affected capital to total asset ratio and bank size; hence, banks with higher assets and capital have lower liquidity. Additionally, liquid assets to total assets did not have any significant relationship with the cash reserve ratio but had a negative relationship with the statutory liquidity ratio. Therefore, the cash reserve ratio could have been more effective in managing banks' liquidity, while the statutory liquidity ratio negatively affected liquidity. Despite examining regulatory variables, their study did not consider regulatory periods. Al-Homaidi, Tabash, Farhan, & Almaqtari, (2019) examined the determinants of liquidity of 37 Indian listed commercial banks from 2008 to 2017, using both GMM and pooled fixed and random effects. Results revealed that bank size, capital adequacy, deposits ratio, operation efficiency, and return on assets positively impacted liquidity. However, asset quality and management, return on equity, and net interest margin negatively impacted liquidity. Additionally, interest rates and exchange rates significantly affected liquidity. These studies examined the Indian sector, whose financial sector likely is different when compared to Tanzania. The study does not consider regulatory periods whereby banks undergo adjustments to meet regulatory requirements.

Munteanu (2012) examined 27 Romanian banks using regression and considered the pre and post-crisis periods. The study used the net loans to total asset ratio, the liquid asset to demand deposit, and the short-term funding ratio as liquidity measures. Munteanu (2012) found that capital adequacy, z-score, impaired loans, interbank funding, cost-income ratio, and credit risk rate significantly affected liquidity as measured by net loans to total assets. However, loan loss provisions, funding costs, and unemployment significantly affected liquid asset to demand deposit and short-term funding ratio. The results on the effect of capital are similar to Singh and Sharma (2016), who examined 59 banks in India from 2000 to 2013 and found that bank size and GDP negatively affected liquidity while deposits, profitability, capital adequacy, and inflation had a positive effect on bank liquidity. The cost of funding and unemployment had an insignificant effect on bank liquidity. Despite the similarity in their results, contextual differences among countries and the impact of financial crisis affected countries differently. Additionally, these studies do not consider regulatory periods.

In Tanzania, Aikaeli (2006) examined the causes of excess liquidity and found that factors such as cost of funds, credit risks, volatility of deposit holders' cash preference, and the rate of required reserves affected liquidity. Furthermore, Qin and Pastory (2012) examined the liquidity position of three commercial banks (NBC, CRDB, NMB) in Tanzania from 2000 to 2009. Liquidity measures used were core deposit to total funding, liquid assets to demand liabilities, and gross loans to total deposits. Using ANOVA, results revealed that banks had

high liquidity, although varied over the years, with NMB maintaining the most substantial liquid level compared to the other two banks. Tanzania's banking sector liquidity level has been above the required minimum, but declining trends call for an understanding of the changes in liquidity and capital.

Yona and Iyanga (2014) found that bank reforms in Tanzania did not impact banks' innovation in offering various products to customers. Furthermore, there was a negative relationship between reforms in bank regulations on minimum capital and cash balance requirements and the banks' financial and operational performance. Lotto and Mwemezi (2015) used 49 banks from 2006 to 2013 on determinants of liquidity and found that capital negatively affected liquidity. Moreover, bank size and interest rate margin negatively affected liquidity. The negative effect of size on liquidity means that small banks hold short-term loans while large banks hold long-term loans that take longer to mature.

Fu *et al.* (2016) examined banks' liquidity creation and capital in 14 Asia-Pacific economies from 2005 to 2012 and found that higher capital reduced liquidity creation. The negative impact of liquidity creation on capital suggested liquidity substitution. The relationship between liquidity creation and regulatory capital revealed that the trade-off between the benefits of financial stability induced by enhanced capital requirements and those of higher liquidity creation applied to all sample banks, regardless of the size and economic region of the bank. However, larger banks had higher regulatory capital ratios. Additionally, larger banks produced less liquidity, while for small banks, regulatory capital ratios significantly negatively influenced liquidity creation, indicating liquidity substitution. Despite considering regulatory impact in different economic regions and across bank sizes, there are contextual differences given the variation in the development of capital markets.

Distinguin *et al.* (2013) investigated the relationship between regulatory capital buffer and liquidity in the U.S. and European publicly traded commercial banks (574 in the U.S. and 207 in Europe) from 2000–2006. Results revealed that banks decrease their regulatory capital ratios when they face higher illiquidity. Moreover, considering other measures of illiquidity that focus more closely on core deposits in the U.S., results showed that small banks strengthen their solvency when exposed to higher illiquidity. These findings support that large banks behave differently from smaller banks. However, large and small European banks do not strengthen their regulatory capital ratios when facing higher illiquidity. When small banks face higher illiquidity, they increase their regulatory capital, probably to secure access to external sources of liquidity if necessary. In the case of large banks, there was no significant positive relationship between regulatory capital and illiquidity.

Empirical evidence indicates large and small banks' capital and liquidity behavior variation. Moreover, the markets in which banks operate vary. The U.S. and Europe have well-advanced financial markets that allow quick access to funds compared to other countries such as Tanzania, where the financial market is nascent. Additionally, there needs to be better adherence to regulatory requirements in emerging countries. Banks adjust their liquidity with the non-existence of minimum regulatory liquidity. However, capital minimum requirements are binding. Thus, the current study examines Tanzanian commercial banks which have

operated under the 20 percent minimum liquidity requirement, which has stayed the same over a long time. However, the minimum capital requirement has changed over time. It examines the before and after capital regulations considering three years before and three years after the change when banks adjust to the new capital level. Moreover, the study considers variations in bank sizes to examine the adjustment in liquidity and capital and hypothesize that;

H_1: There is a significant difference in the liquidity and capital level of small, medium and large banks in Tanzania.

Empirical literature on bank capital and liquidity adjustment of banks

Changes in bank regulations lead banks to adjust capital to avoid regulatory penalties. In their study, Jokipii and Milne (2011) examined adjustment of capital and risk and found that banks with higher liquidity have low capital. Moreover, banks with small capital buffers rebuild an appropriate capital buffer by raising capital while simultaneously lowering risk. In contrast, well capitalized banks maintain their capital buffers by increasing risk when capital increases. Heidi *et al*. (2003) examined the relationship between capital and risk and it was found that capital and risk adjustments depend on the amount of capital held by the bank in excess of the regulatory capital. Banks with low capital buffers rebuild capital buffer by raising capital and simultaneously lowering risk. Banks with high capital buffers maintain their capital buffer by increasing risk when capital increases. Rime (2000) used a sample of four big banks in Swiss and a simultaneous equation of adjustment in capital and risk from 1989 to 1995. It was found that banks with low capital buffer increase their capital but did not affect the level of risk of the bank. These studies, though examined capital adjustment however did not consider liquidity adjustment. Carsamer, Abbam, & Queku, (2022) used GMM to examine Basel III new liquidity ratios in Ghana, how they affected bank capital and risk adjustments and how banks responded to the new liquidity regulations. Results revealed that short-term adjustments in new liquidity rules inversely impacted capital, and capital adjustments adversely affected changes in the liquidity coverage ratio. Therefore, a negative relationship between capital and liquidity.

DeYoung *et al.* (2018) in the U.S. found that in repairing their regulatory capital ratios, capital-constrained banks tend to enhance their liquidity risk position even without formal regulatory minimum requirements. Additionally, banks increase their net stable funding ratio following a negative shock to their risk-based regulatory capital ratios. However, capital and liquidity were not substitutes at larger banks. For low-capital banks, there was no evidence that equity capital and liquidity are either substitutes or complements. Similarly, Smith *et al.* (2019) examined the interaction between capital and liquidity transformation of banks in England and found that capital and liquidity requirements are, to some extent, substitutes. They found a negative relationship between capital and the extent of liquidity transformation. Furthermore, the relationship between capital and liquidity remained the same after the financial crisis in 2007. However, results showed a significant difference in the behavior of small and large banks as more capital does not affect liquidity risk. Their study supported an inverted U-shaped relationship between capital and liquid assets. Furthermore, capital

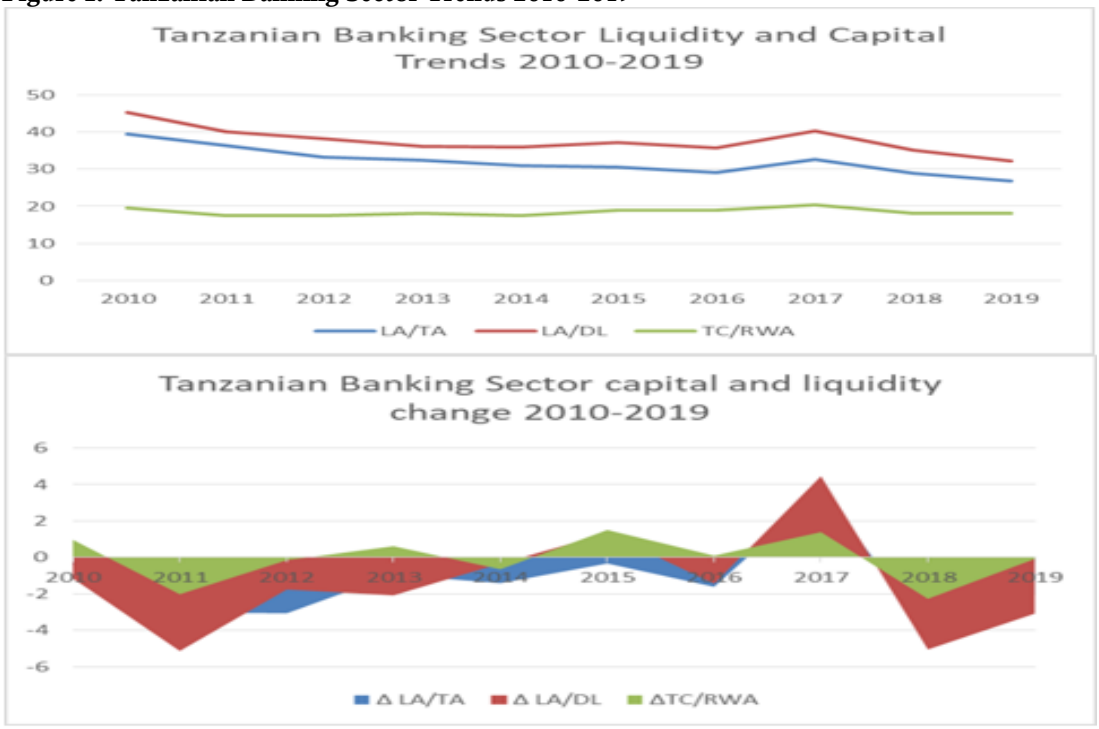
increases the probability of surviving a liquidity shock, as any decrease in liquid asset holding is insufficient to outweigh the capital increase. The reviewed literature on adjustment is mainly in developed economies, hence the current study examines the Tanzanian banking sector and hypothesize that;

H_2: There is a significant difference in the liquidity and capital adjustment of small, medium and large banks in Tanzania.

Banking sector capital and liquidity trends in Tanzania

Capital requirements play an essential role in enhancing the capital of banks. Capital has remained relatively stable across the period from 2010 to 2019. However, after the increase in capital requirements in 2014, there was a sharp increase in capital in the following year. The increase remained until 2017, the end of the moratorium period, followed by a sharp decline in capital level.

Figure I: Tanzanian Banking Sector Trends 2010-2019



Source: Bank of Tanzania

The decline indicated a potential relaxation of banks after the moratorium period ends; hence Central bank supervisors should be keen on banks' behaviors as regulatory effects tend to be short-term. The liquidity is above the requirement of 20 percent, attributed to the high cost of funds, credit risks, volatility of deposit holders' cash preference, and the rate of required reserves (Aikaeli, 2006). For instance, the statutory minimum reserve requirements (SMR) reduction in April 2017 from 10 percent to 8 percent. In December 2014, the SMR ratio on private sector deposits was reduced from 10 percent to 8 percent, while in May 2015, a revision from 8 percent to 10 percent. In April 2017, a reduction to 8.0 percent from 10.0

percent. Both liquidity and capital have positively contributed to the improvement of the operating efficiency of banks (Lotto, 2019). Liquidity has been consistently declining since 2010 (See Figure I), depicted by the changes in liquidity. There was a drastic increase in liquid assets to total assets and liquid assets to demand liabilities in 2017. The recent move of funds held in commercial banks by ministries, public corporations, and local government authorities to the Bank of Tanzania in late 2016 led banks to lose significant deposits. It disrupted banks' liquidity in the short term. As a result, interbank volume increased in 2016, indicating other banks' high need for interbank borrowed funds, followed by a subsequent decline in 2017.

Methodology

Sample and Data

The target population was commercial banks operating in Tanzania. At the end of 2019, the banking sector had a population of 51 banks, of which 38 were commercial banks, six community banks, five microfinance banks, and two development banks. The sampling used the population of 38 commercial banks as of December 2019 (Bank of Tanzania, 2019). Accordingly, the study selected a sample of 28 banks by eliminating banks that did not exist in 2010. This approach is different from Qin and Pastory (2012), who used only the three largest banks when examining bank liquidity in Tanzania. Thus, this study used varying bank sizes because liquidity and capital are crucial for all banks, and changes in regulatory requirements affect all banks. However, response behavior will be different among small, medium, and large banks. Banks' categorization used the total asset value at the end of 2019 as a proportion of commercial banks' assets in Tanzania. The summary of the determination of bank categories is displayed in Table I.

Table I: Categorization of sample banks' assets

Bank Category	No. of banks	Total assets (TZS)	Banks' Total assets to Commercial Banks' Assets (%)
Small Banks	11	76-276 billion	0.0 – 0.76%
Medium Banks	9	315-956 billion	0.8- 2.6%
Large banks	8	>1000 billion	>2.7
Total sample banks	28		

Quarterly data from published quarterly financial statements of commercial banks from 2010 to 2019. This study period was selected because it allows examining the effects of regulatory change experienced in 2015. Hence, comprising of three years before the regulatory change 2012-2014 and three years after the regulatory change from 2015-2017. Banks had three years to adhere to new regulations. Additionally, data on banking sector liquidity and capital was from the Bank of Tanzania.

Description of variables

Capital adequacy (CAR) and liquidity (LIQ) are the main variables. Banks with high capital buffers have a higher capacity to absorb risk. Thus, they can invest more in non-liquid assets due to higher risk absorption. Capital is the ratio of equity to total assets. Banks with high capital reduce liquidity (Lotto & Mwemezi, 2015). However, banks with high liquidity reduce capital (Jokii & Milne, 2009; Altunbas *et al.,* 2007). The adjustment in the capital (ΔCAR) is the difference between the current and previous periods' capital levels. Liquidity (LIQ) is the liquid assets to total assets (Altunbas *et al.,* 2007). Additionally, adopting DeYoung *et al.* (2018) traditional liquidity measures (liquid assets to total assets or core deposits to loans), the study used liquid assets to customer deposits as a regulatory measure in Tanzania. Therefore, an adjustment in regulatory liquidity (ΔLIQr) is the difference between the current and the previous year's liquidity level. The study also used the difference between capital and liquidity levels and the minimum requirements (Jokipii & Milne, 2011). The estimation of the adjustment was determined as follows;

$$\Delta rCAR_{it} = MinCAR_{it} - CAR_{it-1} \quad \text{(i)}$$

$$\Delta rLIQr_{it} = MinLIQ_{it} - LIQr_{it-1} \quad \text{(ii)}$$

$$\Delta rLIQ_{it} = MinLIQ_{it} - LIQ_{it-1} \quad \text{(iii)}$$

Whereby ΔrCAR is the adjustment in capital from the regulatory requirement, Min CAR_{it} is the minimum capital requirement, and Min LIQ_{it} is the minimum liquidity requirement. CAR_{it-1} and $LIQr_{it-1}$ capture the observed actual levels of capital and risk in the previous periods. These equations indicate that changes in the capital and liquidity levels in period t as a function of the difference between the minimum required level of capital and liquidity in period t and the previous period's actual capital and liquidity.

Data analysis

The study used a descriptive approach, applied correlation analysis, and hypothesis testing to compare the capital and liquidity of commercial banks in Tanzania. Given the comparison among bank categories, the Wald chi-square and Likelihood-ratio tested for the equality of means between the three groups of banks (small, medium, and large). The Likelihood-ratio test eliminates the assumption of equal covariance matrices for the groups and produces a likelihood-ratio test for the equality of the group means.

Findings

Descriptive statistics

The descriptive analysis showed observed differences between capital and liquidity of small, medium, and large banks (See Table II). In the case of small banks, liquid assets to total assets had a mean of 38.7 percent, while that of medium banks was 40.3 percent and that of large banks was 37.6 percent. Therefore, medium banks have a high-risk absorption capacity compared to other banks. The result is the same when considering adjustments in liquidity. Results of liquid assets to total assets show that medium banks have the highest adjustment in liquidity, with an increase of 2.944, followed by large banks, with an increase of 1.283, and

small banks, with an increase of 0.669 in liquidity. Therefore, medium banks have the highest liquidity adjustment, evidenced by the highest increase in liquidity. In the case of liquid assets to customer deposits, small banks had the highest liquidity, followed by medium and lastly large banks with a mean of 0.663, 0.620, and 0.551, respectively. This ratio explains the sensitivity towards deposit withdrawals; thus, a lower ratio reflects a low ability to meet the banks' obligations. Therefore, large banks have a high vulnerability in deposit withdrawals. The adjustment in liquid assets to customer deposits shows large banks increased liquidity, followed by small and medium banks by 6.226, 4.944, and 4.834, respectively. Therefore, average adjustment showed that liquid asset-to-customer deposits declined for small and large banks but increased for medium banks. The average downward adjustment implies a higher vulnerability of bank funding.

Table II: Capital and Liquidity levels of the small, medium, and large banks

BANKCATEGORY SMALL					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
CAR	440	0.174	0.073	-0.001	0.672
LIQr (LA/DL)	440	0.663	0.447	0.168	6.339
LIQ (LA/TA)	440	0.387	0.151	0.065	1.232
ΔCAR	429	-0.004	0.037	-0.350	0.283
ΔLIQr	429	-0.008	0.451	-5.292	4.944
ΔLIQ	429	-0.002	0.089	-0.710	0.669
BANKCATEGORY MEDIUM					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
CAR	359	0.123	0.034	0.012	0.228
LIQr (LA/DL)	359	0.620	0.439	0.146	5.358
LIQ (LA/TA)	359	0.403	0.213	0.110	3.385
ΔCAR	350	0.000	0.018	-0.181	0.085
ΔLIQr	350	0.010	0.474	-4.121	4.838
ΔLIQ	350	-0.004	0.230	-2.945	2.944
BANKCATEGORY LARGE					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
CAR	320	0.135	0.047	0.090	0.852
LIQr (LA/DL)	320	0.551	0.464	0.246	6.969
LIQ (LA/TA)	320	0.376	0.111	0.144	1.705
ΔCAR	312	0.001	0.058	-0.702	0.710
ΔLIQr	312	-0.001	0.651	-6.380	6.226
ΔLIQ	312	-0.002	0.114	-1.293	1.283

In the case of capital, small banks had the highest capital, followed by large and lastly medium banks at 0.174, 0.135, and 0.123, respectively. Thus, small banks keep pace with the required capital levels. Moreover, on average, all banks had capital above the minimum requirement of 0.125. Therefore, banks desire to remain legitimate and avoid regulatory penalties. On average, small banks had a higher decrease in capital adjustment. Thus, a shock to capital causes small banks to decrease capital more compared to medium and large banks.

Table III: Capital and liquidity level of banks before and after a regulatory change

		BEFORE REGULATORY CHANGE				**AFTER REGULATORY CHANGE**			
		SMALL BANKS							
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**	**Mean**	**Std. Dev.**	**Min**	**Max**
CAR	132	0.163	0.056	0.027	0.331	0.156	0.043	-0.001	0.221
LIQr (LA/DL)	132	0.595	0.234	0.271	1.789	0.631	0.270	0.168	1.555
LIQ (LA/TA)	132	0.378	0.130	0.095	0.733	0.370	0.167	0.083	1.232
ΔCAR	132	-0.002	0.030	-0.100	0.192	0.001	0.019	-0.032	0.092
ΔLIQr	132	0.003	0.190	-1.381	0.900	0.008	0.155	-0.772	0.797
ΔLIQ	132	0.002	0.077	-0.554	0.287	-0.002	0.096	-0.645	0.669
		BEFORE REGULATORY CHANGE				**AFTER REGULATORY CHANGE**			
		MEDIUM BANKS							
Variable	Obs	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
CAR	108	0.108	0.032	0.012	0.221	0.134	0.029	0.074	0.222
LIQr (LA/DL)	108	0.555	0.232	0.146	2.160	0.588	0.370	0.156	2.494
LIQ (LA/TA)	108	0.392	0.127	0.120	0.770	0.358	0.140	0.110	0.772
ΔCAR	108	0.001	0.017	-0.088	0.085	0.003	0.014	-0.036	0.051
ΔLIQr	108	0.008	0.177	-0.297	1.532	-0.012	0.314	-1.917	1.462
ΔLIQ	108	-0.005	0.068	-0.258	0.207	-0.003	0.048	-0.227	0.218
		BEFORE REGULATORY CHANGE				**AFTER REGULATORY CHANGE**			
		LARGE BANKS							
Variable	Obs	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
CAR	96	0.125	0.019	0.090	0.189	0.149	0.076	0.095	0.852
LIQr (LA/DL)	96	0.606	0.743	0.255	6.969	0.546	0.346	0.246	3.444
LIQ (LA/TA)	96	0.388	0.077	0.221	0.586	0.360	0.076	0.174	0.542
ΔCAR	96	0.001	0.010	-0.032	0.048	0.009	0.073	-0.019	0.710
ΔLIQr	96	0.004	1.044	-6.380	6.226	0.033	0.358	-1.256	2.953
ΔLIQ	96	0.001	0.045	-0.126	0.134	-0.001	0.042	-0.204	0.112

Moreover, capital adjustment revealed the highest increase, with large banks at 0.710, small banks at 0.283, and medium banks at 0.085. Large banks maintain low liquidity and high capital, while medium banks maintain higher liquidity and lower capital. Thus, larger banks rely more on capital for stability compared to liquidity. Hence, this may be due to the ease with which large banks can obtain funds from the financial market.

In the case of regulatory periods, the results of the two periods in Table III summarize the before and after regulatory capital change among the three bank categories. Before the

regulatory change (2012-2014), the adjustment in capital and liquidity showed that small banks had the highest increase in capital and liquidity of 0.192 and 0.287, respectively. Liquid asset to customer deposit ratio showed that large banks had the highest increase in liquidity, followed by medium and lastly small banks at 6.226, 1.532, and 0.900, respectively. Moreover, large banks had less funding vulnerability than other banks, supported by the highest positive adjustment in liquid assets to customer deposits. However, the opposite in the case of liquid assets to total assets, whereby small banks led, medium followed, and large banks by 0.287, 0.207, and 0.134, respectively. After the change in capital requirements, small banks lead the increase in liquid assets to total assets, then medium and lastly large banks with 0.669, 0.218, and 0.112, respectively. Therefore, small banks maintain high liquidity and thus have great shock absorptive capacity from their liquidity. However, this could also imply low efficiency in terms of investment, hence low profitability.

After the regulatory change (2015-2017), large banks had the highest increase in capital adjustment. Therefore, large banks seem to raise capital by engaging in more risky investments, supported by the high liquidity of 54.6 percent. Thus, large banks use their capital to absorb liquidity risk. Smaller banks have the lowest increase in liquid assets to customer deposit ratio contributed by low deposits hence higher funding vulnerability. However, the high liquid asset-to-customer deposit in large banks relative to other banks indicate that, after a regulatory change, large banks have high liquid assets to cover volatile funding such as deposits. Thus, they have low sensitivity to deposit withdrawals. On average, all banks have a downward adjustment in liquid assets to total assets ratio.

Correlation analysis

In the case of small banks, liquidity and capital level variables do not have a significant correlation (Table IV). However, adjustment of both liquid assets to total assets ratio and liquid assets to customer deposit ratio have a significant correlation with capital adjustment. An increase in the liquid assets to customer deposit ratio had a significant negative correlation with capital, while an adjustment in liquid assets to total assets significantly improved capital adequacy. Thus, a significant negative correlation between adjustment in capital and the ratio of liquid assets to customer deposits. Therefore, small banks' capital adjustment led to a liquidity reduction. As a result, they can lend out less than larger banks. When small banks adjust liquidity upward, capital is adjusted downward in the case of liquid assets to customer deposits ratio. In contrast, capital is adjusted upward in the case of liquid assets to total assets.

The results indicate whether liquidity has a positive or negative correlation with capital will depend on the type of liquidity measure. Medium banks had no significant correlation between liquidity and capital adequacy. However, the adjustment in both capital and liquidity has a significant positive correlation with capital and liquidity levels.

In the case of large banks, there was a significant positive correlation between adjustment in liquid assets to customer deposit ratio and adjustment in capital. However, there was no significant correlation between the liquid assets to total assets ratio and capital adjustment.

Furthermore, capital adjustment positively correlated with the liquid assets to customer deposits ratio. Hence, for large banks, adjustment was positively correlated with liquidity management. In contrast, in the case of small banks, capital adjustment was significantly and negatively correlated with the liquid assets to customer deposits ratio. For large bank-level variables, liquid assets to customer deposit had a positive and significant correlation with capital. Therefore, large banks maintain high liquidity reflected by low deposit vulnerability, contributing to high capital. Their ability to get more deposits hence more investments in loans that increase profits, contribute to higher capital. Additionally, there was a significant negative correlation between adjustment in liquidity and capital for small banks. In contrast, a non-significant correlation was observed between the adjustment of liquid assets to customer deposits ratio and capital for medium banks.

Table IV: Correlation Analysis of capital and liquidity level

BANK CATEGORY			SMALL			
	CAR	LIQr (LA/DL)	LIQ(LA/TA)	ΔCAR	ΔLIQr	ΔLIQ
CAR	1.0000					
LIQr (LA/DL)	0.1102	1.0000				
LIQ(LA/TA)	0.0758	0.4013*	1.0000			
ΔCAR	-0.0348	-0.3361*	0.0143	1.0000		
ΔLIQr	-0.2035*	0.4649*	-0.0615	-0.4017*	1.0000	
ΔLIQ	0.0690	-0.1179	0.2689*	0.1686*	-0.1279	1.0000
BANK CATEGORY			MEDIUM			
	CAR	LIQr (LA/DL)	LIQ(LA/TA)	ΔCAR	ΔLIQr	ΔLIQ
CAR	1.0000					
LIQr (LA/DL)	0.1201	1.0000				
LIQ(LA/TA)	0.0833	0.6202*	1.0000			
ΔCAR	0.2626*	-0.0275	-0.0712	1.0000		
ΔLIQr	-0.0007	0.6858*	0.3484*	-0.0312	1.0000	
ΔLIQ	0.0033	0.3643*	0.5365*	-0.0406	0.6777*	1.0000
BANK CATEGORY			LARGE			
	CAR	LIQr (LA/DL)	LIQ(LA/TA)	ΔCAR	ΔLIQr	ΔLIQ
CAR	1.0000					
LIQr (LA/DL)	0.3000*	1.0000				
LIQ(LA/TA)	-0.1242	0.2909*	1.0000			
ΔCAR	0.6098*	0.2485*	-0.0156	1.0000		
ΔLIQr	0.2325*	0.6922*	0.1293	0.3747*	1.0000	
ΔLIQ	0.0042	0.1772*	0.5148*	-0.0092	0.2526*	1.0000

Level of significance * $p<0.05$

Hypothesis Testing

The Wald chi-square and Likelihood-ratio tests were used to test the equality of means between the three groups of banks. The Likelihood-ratio test eliminates the assumption of equal covariance matrices for the groups and produces a likelihood-ratio test for the equality of the group means. The summary of results on the equality of group means among the three bank categories is summarized in Table V. For the level variables, both the Wald test and likelihood-ratio test rejected the hypothesis of equality of means. Thus the three groups are unlikely to have equal means. Therefore, results are consistent with H_1 on the *significant difference in the liquidity and capital level of small, medium and large banks in Tanzania.* Therefore, banks are heterogeneous when evaluating liquidity and capital at levels because their means are different.

Table V: Hypothesis testing

	Variables	Test for equality of 3 group means, allowing for heterogeneity
	CAR	Wald chi2(6) = 186.49
	LIQr (LA/DL)	Prob > chi2 = 0.0000 (chi-squared approximation)
	LIQ (LA/TA)	Prob > chi2 = 0.0000 (James' approximation)
		LR chi2(6) = 166.33
		Prob > chi2 = 0.0000
	ΔCAR	Wald chi2(6) = 6.25
	ΔLIQr	Prob > chi2 = 0.3961 (chi-squared approximation)
	ΔLIQ	Prob > chi2 = 0.4007 (James' approximation)
		LR chi2(6) = 6.24
		Prob > chi2 = 0.3970

Variables	Test for equality of 3 group means, allowing for heterogeneity	
	BEFORE REGULATORY CHANGE	AFTER REGULATORY CHANGE
CAR	Wald chi2(6) = 122.23	Wald chi2(6) = 45.20
LIQr (LA/DL)	Prob > chi2 = 0.0000 (chi-squared approximation)	Prob > chi2 = 0.0000 (chi-squared approximation)
LIQ (LA/TA)	Prob > chi2 = 0.0000 (James' approximation)	Prob > chi2 = 0.0000 (James' approximation)
	LR chi2(6) = 99.69	LR chi2(6) = 42.64
	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000
ΔCAR	Wald chi2(6) = 3.09	Wald chi2(6) = 2.20
ΔLIQr	Prob > chi2 = 0.7980 (chi-squared approximation)	Prob > chi2 = 0.9007 (chi-squared approximation)
ΔLIQ	Prob > chi2 = 0.8039 (James' approximation)	Prob > chi2 = 0.9038 (James' approximation)
	LR chi2(6) = 3.09	LR chi2(6) = 2.21
	Prob > chi2 = 0.7969	Prob > chi2 = 0.8994

In terms of the adjustment behavior of capital and liquidity, results showed that p>0.05 and hence changes in capital and liquidity of the three groups have equal means, therefore inconsistent with H_2 on *presence of significant difference in the liquidity and capital adjustment of*

small, medium and large banks in Tanzania. It implies that adjustment in the capital and liquidity between the current and previous periods is equal for the small, medium, and large banks. Results also revealed no differences between the two regulatory periods in capital and liquidity level and the adjustment in liquidity and capital. Therefore, the behaviour of capital and liquidity are the same across the mean values of the three bank categories. It implies that the magnitude of the impact of policies such as regulatory requirements and statutory minimum reserve is temporal and hence provides a temporary effect towards enhancing liquidity.

Results of the deviation from required minimum, that is liquidity and capital adjustments are summarized in Table VI. In the case of the whole sample, results differ when comparing the present and previous period levels in the base results - the p-value of the James approximation and the Likelihood ratio test p-value, which is significant. The significant results imply that adjustments of the previous year's levels from the target minimum requirement differ across small, medium, and large banks. Moreover, the results of the two regulatory periods are similar since small, medium, and large banks show significant p-value of both the James approximation and Likelihood ratio test. The result indicates significant differences in the group means. In the period after the regulatory change, the Wald chi (2) value is higher than before. Therefore, the pressure to adjust capital to meet the minimum requirement and avoid regulatory penalties for non-compliance have played a critical role in enhancing capital.

Table VI: Deviation from Required Minimum

Variables	Test for equality of 3 group means, allowing for heterogeneity
ΔrCAR	Wald chi2(6) = 183.96
ΔrLIQr	Prob > chi2 = 0.0000 (chi-squared approximation)
ΔrLIQ	Prob > chi2 = 0.0000 (James' approximation)
	LR chi2(6) = 163.82
	Prob > chi2 = 0.0000

Variables	Test for equality of 3 group means, allowing for heterogeneity	
	BEFORE REGULATORY CHANGE	**AFTER REGULATORY CHANGE**
ΔrCAR	Wald chi2(6) = 39.92	Wald chi2(6) = 67.91
ΔrLIQr	Prob > chi2 = 0.0000 (chi-squared approximation)	Prob > chi2 = 0.0000 (chi-squared approximation)
ΔrLIQ	Prob > chi2 = 0.0000 (James' approximation)	Prob > chi2 = 0.0000 (James' approximation)
	LR chi2(6) = 36.84	LR chi2(6) = 59.55
	Prob > chi2 = 0.0000	Prob > chi2 = 0.0000

Discussion

Large banks have high capital and low liquidity thus, rely on capital to absorb shocks. The result is similar to Fu *et al.* (2016), who found that larger banks have higher capital ratios. Medium banks have high liquidity and build up their liquidity buffer faster than other banks. The negative correlation between adjustment in liquidity and capital in small banks is similar to the literature that found that banks with higher liquidity hold less capital (Jokipii & Milne,

2011; Altunbas *et al.,* 2007). Therefore, holding high liquidity reduces capital in banks. Unlike small banks, large banks had a significant positive correlation between adjustment in liquid assets to customer deposits and capital. The non-significant correlation between liquid assets to total assets ratio with capital is similar to what Abbas *et al.* (2019) observed on large banks having a negative non-significant effect of liquidity on capital.

Additionally, there was no significant correlation between capital adjustment and the liquid asset to total asset ratio for large banks. The result is similar to DeYoung *et al.* (2018) that banks tend to increase liquidity as a result of the adjustment in the capital, but there was no support for this substitution for large banks. Similarly, Smith et al. (2019) discovered that capital does not affect liquidity risk hence capital and liquidity are not substitutes in large banks. Additionally, large banks have a low liquid-to-customer deposit ratio indicating that large banks have different ways of managing liquidity risk than small banks. Moreover, large banks may rely on the lender of the last resort in case of liquidity problems or bail out due to the too big to-fail hypothesis.

The negative correlation between liquidity and capital in small banks and the positive correlation between liquidity and capital for large banks indicate that smaller banks either strengthen capital when faced with low liquidity or strengthen liquidity when their capital declines. It is similar to Distinguin *et al.* (2013), who found that small banks strengthen their capital due to illiquidity. The negative relationship between liquidity and capital indicates a possible substitution among small banks, similar to Distinguin *et al.* (2013) and Fu *et al.* (2016). However, large banks maintain higher capital and liquidity to remain legitimate. Similarly, medium banks had a positive correlation between liquidity and capital. Therefore supporting the capital buffer stability as large banks are likely to have high capital buffers, thus more financial strength. Moreover, this enhances their access to financial markets compared to smaller banks, which likely face uncertainties in access to financial markets.

Before the regulatory change, small banks had a higher increase in capital and liquid assets to total assets ratio. In contrast, large banks had a high liquid asset-to-customer deposit ratio. However, after the change in capital requirements, large banks were less vulnerable to deposit withdrawals than other banks due to the higher adjustment of liquid assets to customer deposits. However, small banks had high liquid assets to total assets ratio, indicating a great shock absorptive capacity using their liquid assets. Therefore, large banks maintain high capital to remain legitimate, while small banks rely on liquidity. The increase in statutory minimum reserve in May 2015 reduced liquidity on average across all three bank categories. Moreover, the liquidity shock on all banks following the transfer of public institutions' funds in commercial banks to the Bank of Tanzania in early 2017 may have led large banks to rely on their capital to remain stable. This was due to high deposit vulnerability possibly as a result of deposit concentration in large banks. After the regulatory change, banks adjusted capital to meet the capital minimum requirement and avoid penalties. Thus, large banks maintained high capital to absorb their liquidity shock.

The difference in the capital adjustment results among the banks indicated heterogeneity in bank adjustment, implying that banks' reaction to adjusting capital immediately after a change

in regulations before the moratorium period ends (2015-2017) showed an increase led by large banks. However, after banks had stabilized, following an earlier regulatory change (2012-2014), on average, small banks' capital adjustment was downward. The before and after regulatory change capital adjustment indicates that small banks take longer to rebuild their capital buffers. Thus, regulators should be keen on all banks since they reduce the liquid assets to total assets, particularly small banks with the highest decline. Thus, monitoring needs to be strict after the moratorium period allowed to adjust capital ends since all banks reduce liquidity as a result of the upward adjustment in the capital.

Conclusions

This study aimed to compare capital and liquidity of commercial banks. Specifically, the study examined the capital and liquidity level of small, medium, and large banks on the one hand and the capital and liquidity adjustment of small, medium and large banks on the other hand. The study used 28 commercial banks' quarterly data from 2010 to 2019. The results revealed a negative correlation between adjustment in capital and liquid assets to customer deposits ratio. Moreover, there was a significant correlation between capital adjustment and liquidity in small and large banks. When capital is adjusted, small banks reduce the liquid, while large banks increase liquidity. However, when liquidity is adjusted upward, small banks reduce capital while large banks increase capital. Thus, well-capitalized larger banks absorb their liquidity risk with capital. The variation among banks implies that capital regulations affect banks differently hence the variation in capital and liquidity. Liquidity and capital levels among the three bank categories do not have equal means. Thus, it implies that shocks such as changes in capital regulations do not significantly impact banks' adjustment behavior between the current and previous periods. However, considering a deviation from the minimum requirement reveal significant differences across the three group mean.

The findings have implications for policy and bank managers. Regulators should consider the heterogeneity among banks to allow effective regulatory and supervisory mechanisms across bank categories. All banks reduce liquidity on average and increase capital, indicating that banks keep pace to meet the minimum requirement and avoid regulatory penalties. Thus, the negative correlation between capital and liquidity of small banks implies that capital covers liquidity risk. Bank managers should effectively manage both capital and liquidity to remain legitimate and survival. The study is limited to commercial banks; thus, future studies should include other banks, such as community and microfinance banks.

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