The implications of bank risk-weighted capital and ownership on portfolio rebalancing, profitability, and stability: evidence from Tanzania

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Declaration

I, **Renatus Anathory Mchembe**, do hereby declare that the work presented in this thesis, is my own, except where acknowledged and that this thesis or any part of it, has not been previously submitted for the award of a degree at any university.

Signed ……..…… Date …….

Abstract

Banks are vital for economic growth and development as they mobilise and channel the flow of funds from surplus to deficit units and help to finance government expenditure by investing in government securities, among other activities. Bank activities are especially crucial in developing countries, due to underdeveloped financial markets, as they often dominate the financial sector. The banking crises of the last three decades have resulted in increased macroprudential regulations to protect the banking sector against the risk of failure emanating from banks' loan portfolios. A key element of these regulations is usually the prescription of minimum risk-weighted capital ratios. However, this can potentially affect bank profitability and in an attempt to rebalance their capital risk profile to match regulatory requirements, banks may alter the balance between bank lending (higher risk activities) and low risk activities, such as investment in government securities.

Contradictory evidence exists on the relationships between bank capital ratios on the one hand, and bank profitability, bank stability, and the balance between bank lending and investment in government securities on the other. Further, these relationships can be affected by the type of ownership associated with specific banks. In addition to the contradictory findings, prior research is especially limited in the context of developing countries, where most undercapitalised banks may have higher regulatory pressure than those in developed countries. Lower levels of economic development in these countries may also result in lower bank lending and investment activities and higher credit risks, potentially leading to reduced bank profitability and stability.

Using an unbalanced panel of bank-level data for 57 foreign, private-domestic, and state-owned banks between 2006 and 2020, this study provides empirical evidence on these relationships in the context of Tanzania. The country's political and economic background resulted in a diverse banking sector consisting of a mix of bank ownership models, and its legal framework allows for the public availability of the required data, including for state- and privately-owned banks. This study contributes to literature on how banks under regulatory pressure adjust their capital ratios in response to regulatory capital requirements, and the effect of capital ratios not only on bank profitability and stability, but also the extent to which it relates to their actions related to portfolio rebalancing (asset mix adjustments), such as lending and investment in government securities. It also contributes to literature on how the variations in bank ownership type affects such behaviour.

The study consists of three research components. The first component uses simultaneous models to test the effect of regulatory pressure on changes in bank capital ratios, lending activities, and investment in government securities; and whether such changes are simultaneously related. Results for both the three-stage least squares (3SLS) and conditional mixed-processes (CMP) models show that higher regulatory pressure (which increases with a bank's decrease in excess capital or with its capital ratios falling below the minimum regulatory requirement, and vice-versa) results in less adjustments in capital ratios and lending. The results from simultaneous modelling show a feedback link between changes in bank capital ratios and both changes in lending, and investment in government securities. While an increase in high risk assets (loans) reduces adjustments in bank capital ratios, an increase in less risk assets increases such adjustments. Thus, as government securities are less risk assets, their increase facilitates a switching regime from high risk assets, thus, raising adjustments in capital ratios. Further, while foreign banks reduce their high risk assets and increase holding of low risk assets, locally-owned banks reduce their holding of government securities, relative to foreign banks.

The second component of this study examines the relationship between capital ratios and bank profitability and assesses the extent to which board monitoring (board size and independence) moderates this linkage. Employing the OLS, FE or RE, and the Sys-GMM estimates, the findings suggest the existence of a positive and significant link between capital ratio and bank profitability, indicating that increasing the capital ratios enhances profitability. Moreover, there is a significant positive association between board independence and bank profitability, and the capital ratio-profitability linkage could depend on a bank's board size and independence. Further, the findings indicate that Tanzanian banks' profitability could vary across banks of different ownership type.

The third component of this study investigates the relationship between capital ratios and the stability of Tanzanian banks, and tests whether this link varies with the form of a bank's ownership. Using sys-GMM estimates, results show that an increase in capital ratio results in a positive impact on bank stability, conforming to the Regulatory Hypothesis, which suggests a positive link between bank capital and stability. Although foreign banks appear to be more stable than their counterparts, the interaction (bank ownership x capital ratios) results show a negative effect on foreign banks' stability, and a positive impact on that of both private domestic and state banks.

Based on the findings from this study, as the results show that higher regulatory pressure results in negative changes in capital ratios and lending for Tanzanian banks, it reflects the need of very-well capitalized banks to maintain a large buffer stock of capital. This could enhance the banks' capital adequacy and lending activities. Also, since the changes in bank capital ratios, lending, and government securities have an exogenous and endogenous component, this study helps regulators to understand the impact of discretionary changes in these variables thus, guide policy formulation by providing insight on the extent to which regulatory pressure to meet capital requirements affect changes in these variables, and the extent to which the variations in bank ownership type affects such changes. Thus, regulators should set capital standards that do not compromise the lending and investment in government securities activities, as they are both vital to economic growth. In addition, the results indicate that the relationship between capital ratio and bank profitability could depend on a bank's board size and independence, therefore, it suggests a need to consider the role of board size and independence in monitoring managers' decisions with regard to increased bank capital ratios. Moreover, since higher capital ratios seem to reduce bank risks (non-performing loans) and increase bank stability (Zscore), banking regulators should continue to strengthen the capital regulations and require banks to raise capital commensurately with the risk undertaken, for enhanced banking stability.

Further, regulators should find ways to motivate local banks (state- and private-domestic-owned) to increase their holdings of government securities, as they tend to reduce their investments in these securities relative to foreign banks. As the findings show that increasing capital ratios for locally owned banks increases their stability, banking regulators and policy makers should ensure that local banks observe and implement the capital requirements, especially for the state owned banks which may fail to implement the regulations due to the "dual agency" role of governments.

Keywords*: Tanzania, Basel Accord, risk-weighted, capital requirements, portfolio rebalancing, lending, government securities, profitability, stability, simultaneous, fixed effects, Sys-GMM.*

Dedication

To the Almighty Living God

In memory of my parents

To my beloved wife and our children

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Abbreviations/Acronyms

3SLS	Three-Stage Least Squares
BCBS	Basel Committee on Banking Supervision
BIS	Bank for International Settlement
BoT	Bank of Tanzania
CEO	Chief Executive Officer
CMP	Conditional mixed-process
CPI	Consumer Price Index
DSE	Dar es Salaam Stock Exchange
DWH	Durbin–Wu–Hausman
EAC	East African Community
EACB	East African Currency Board
EBIT	Earnings Before Interest and Tax
EU	European Union
FE	Fixed Effects
GDP	Gross Domestic Product
GFC	Global Financial Crisis
GMM	Generalized Method of Moments
IMF	International Monitory Fund
IV	Instrumental Variables
LCR	Liquidity Coverage Ratio
LLR	Loan Loss Reserves
LSE	Least Square Estimator
M&M	Modigliani and Miller
MENA	Middle East and North Africa
MLE	Least Square Estimator
NIM	Net Interest Margin
NPL	Non-Performing Loans
NSFR	Net Stable Funding Ratio
OBS	Off-Balance Sheet Exposures
OLS	Ordinary Least Square

PAM	Partial Adjustment
PBZ	People's Bank of Zanzibar
R0A	Return on Asset
RE	Random Effect
ROE	Return on Equity
SADC	South African Development Community
SEM	Simultaneous Equations Model
SEM-PAM	Simultaneous Equations Model with Partial Adjustment
SME	Small and Medium Enterprises
SOE	State-Owned Enterprises
SYS-GMM	System Generalized Method of Moments
U.K	United Kingdom
U.S	United States of America
URT	United Republic of Tanzania
VIF	Variance Inflation Factor
WDI	World Development Indicator

Chapter 1: Introduction

1.1 Background to the study

The last three decades have witnessed a number of banking crises[1], affecting both developed and developing countries (Reinhart and Rogoff, 2013; Krosznera, Laeven, and Klingebiel, 2007). This has increased the need for macroprudential bank regulations to protect banks against the risk of failure; especially the risks associated with their loan portfolios. Banking sector instability can have a contagion effect, resulting in broad financial crises and potentially negative effects on the entire economy (Bean, 2004). Thus, in a world with market frictions (caused by transaction costs and information symmetry), banks should be protected, as they play an important role as financial intermediaries. First, banks transform financial assets issued by firms (such as securities) into assets required by investors. Second, banks facilitate monetary mechanisms through demand deposit liabilities (Barro and Santomero, 1976). Third, banks convert deposits into loans, thus enabling risk-averse investors to maximise profits (Pyle, 1971). Fourth, banks can resolve an asymmetric information problem between investors and firms, as they minimise informational costs, offer quality information, and evade free-rider issues (Mishkin and Eakins 2009). Thus, in most countries, banking is one of the most supervised and regulated sectors of the economy.

To regulate banks, two mechanisms are used, namely protective and prudential regulations. Protective regulations, such as deposit insurance schemes, are intended to offer preventive measures. Through these schemes, customer deposits are either explicitly or implicitly insured by the government, thus reducing losses during banking crises. Unfortunately, as deposit insurance schemes reduce depositors' motives to monitor bank operations, bank managers may be motivated to take excessive risks (Demirguc-Kunt and Kane, 2002). On the other hand, prudential regulations are designed to control bank behaviour, with the intention of lowering the probability of insolvency (Flannery, 1995). One such measure is a capital requirement, which is the minimum amount of capital the relevant financial regulator requires a bank to hold (Nicolas and Firzli, 2011).

[1] See, for example Laeven and Valencia (2020), Reinhart and Rogoff (2013), Laeven and Valencia (2012), and Krosznera et al. (2007). For instance, Laeven and Valencia (2012) identify 147 different banking crises globally between 1970 and 2011, causing an average increase in debts to GDP by 12.1%, an average increase of fiscal cost to GDP by 6.8%, and an average decrease of GDP by 23%. Examining a total of 41 banking crises in 34 developed and developing countries, Krosznera et al. (2007) show that banking crisis resulted in a 1.6% average contraction in economic growth. Laeven and Valencia (2020) identify 151 banking crises, 236 currency crises, and 74 sovereign crises.

Prior to the founding of the Basel Committee on Banking Supervision (BCBS)[2], capital regulation involved a risk-unadjusted capital ratio. However, risk-independent capital regulation enforces constraints on bank growth rather than restraining risk-taking. The increased role of capital as a protection against bank risks in the 1980s led to the need to harmonise bank capital standards. Thus, in 1988, the International Convergence of Capital Measurement and Standards issued the so-called Basel I Accord that focused on credit risks (as lending was considered to be the main function of banks) and required banks to have specified minimum capital relative to their assets' portfolio risks (BCBS, 1988). The required capital ratio was set to be at least 8% of risk adjusted assets, of which half (4% of risk adjusted assets) had to be Tier I Capital[3]. The entrance of new financial instruments exposed banks to various further risks, some of which the requirements of Basel I was insufficient to manage. Basel II was issued in 2004 and, in addition to credit risks, also considered market and operational risks. Thus, it classified capital into three tiers: Tier I Capital (core capital) consisting of equity capital and disclosed reserves; Tier II Capital (supplementary capital) constituting undisclosed reserves, revaluation reserves, hybrid capital instruments such as perpetual preference shares, and subordinated term debt; and Tier III Capital, which includes only short-term subordinated debt that is unsecured, subordinated and fully paid (BCBS, 2004). However, Basel I and II provided insufficient mitigation against risks, resulting in the Basel III Accords being issued in 2010 (BIS, 2018). The latter increased required capital ratios to a minimum of 10.5% of risk adjusted assets, 8.5% of which has to be Tier I Capital; introduced liquidity standards; and endorsed additional capital buffers (BCBS, 2010a, 2010b).

Bank lending involves the provision of credit to various sectors of the economy. By mobilising, channeling, and controlling the flow of funds from surplus to deficit units, banks minimise economic disequilibrium and thereby support economic growth and development (Maurin and Toivanen, 2012). Traditionally, the central role of commercial banks is the provision of credit and so, the greater percentage of most banks' assets is composed of loans (Fungacova et al. 2014). Unfortunately, despite its importance, banks' credit allocation in developing countries is still weak, with limited supply of bank loans to the economy (Assibey and Bockarie, 2013; IMF, 2003b).

[2] Established in 1974, the Committee introduced the Basel Capital Accord (Basel I) that was endorsed by central bank representatives and regulatory authorities of the G-10 countries in 1988. Since then, BCBS members increased from the G-10 countries to 45 regulatory bodies from 28 jurisdictions (BIS, 2016, 2018).
[3] Tier-1 Capital comprises of paid-up share capital, preferred stock, and retained profits (BCBS, 1988).

Another essential activity of banks is their investment in short- or long-term government securities, such as treasury bills and bonds (Gennaioli et al., 2014). Banks' investment in government securities play a vital role in economic growth by financing government expenditures, particularly in developing countries, where the financial markets, which would provide alternative funding options, are often underdeveloped (Bouis, 2019; Egesa et al., 2015; Gennaioli et al., 2014). Thus, in recent years, banks' holding of government securities in developing countries has considerably increased (Dell'Ariccia et al., 2018). For instance, due to lower bank capital buffers in emerging markets and developing countries, domestic banks' holdings of public debt as a percentage of banks' total assets, on average, increased from 8.2% in 2008 to 11.8% in 2016 (Bouis, 2019).

However, the implementation of the Basel Accords has increased concerns on the consequences of regulatory capital requirements on banks' core role as loan suppliers to the real economy. Higher risk-weighted capital requirements may exert pressure on banks, causing them to increase lending rates, leading to a contraction in loan growth, which, in turn, may accelerate economic downturns. Studies show that the risk-based capital accord was an important factor in describing the early 1990s credit crunch (see, for example, Berger et al., 1995; Brinkmann and Horvitz, 1995; Hancock et al., 1995; Peek and Rosengren, 1995a; Wall and Peterson, 1995; Hall, 1993; and Hancock and Wilcox, 1993). Consequently, the implementation of higher risk-weighted capital requirements may motivate banks to *rebalance their portfolios* (Bouis, 2019) thus, substituting loans, which are higher risk-weighted assets, with government securities, which are considered a very low risk asset class (IMF, 2009; Wagster, 1999; Berger and Udell, 1994). For example, Berger and Udell (1994) argue that Basel I capital standards resulted in a slight decline of bank lending in the U.S. in the early 1990s, and that banks reallocated from loans to securities. More government debt can also lead to a crowding-out effect and thus, reduce bank lending. For instance, in Sierra Leone, the IMF (2009) shows that banks' claims on the private sector as a percentage of their claims on government debt decreased from 74.62 percent in 1987 to an average of 56 percent between 2001 and 2009.

Regulatory capital requirements are primarily intended to increase banks' capital ratios to levels considered to be adequate to ensure solvency in crises (BCBS, 2004). However, as capital requirements may also have an impact on bank lending and investment in government securities, it is thus relevant to regulators how banks under regulatory pressure adjust their capital ratios in response to regulatory capital requirements, and the effect of capital ratios not only on bank

profitability and stability, but also the extent to which it affects their asset-mix adjustments, such as lending and investment in government securities. Studies on the relationship between capital requirements and bank capital ratios are, however, mixed. While some studies show a positive association (for example, Francis and Osborne, 2012; Brewer, Kaufman, and Wall, 2008; Aggarwal and Jacques, 2001; and Rime, 2001), others show a negative or no link (see, for example, Minni, 2016; Gropp and Heider, 2010; Ahmad, Ariff, and Skully, 2009; and Flannery and Rangan, 2008).

The Buffer Capital Theory suggests that, under capital requirement, banks may create buffers above the minimum requirements to evade regulatory penalties (Berger et al., 2008; Peura and Keppo, 2006; Rime, 2001). Asymmetric information and higher costs of equity may also cause banks to hold excess capital that serve as a buffer against unforeseen shocks (Ayaydin and Karakaya, 2014). According to the theory, the effect of regulatory capital requirements on a bank's capital ratio depends on whether or not it holds capital (a buffer) above the requirement. When a bank faces a shortage of capital it may adjust its balance sheet to attain the required capital ratio. This can be done by increasing its equity. As higher capital may increase public confidence, this may reduce a bank's funding cost (Zheng et al., 2017; García-Herrero et al., 2009), enabling a bank to lower its lending rates, resulting in increased loan demand (Francis and Osborne, 2012).

Unfortunately, since raising equity may be costly, particularly in less developed economies, this may compel banks to increase their lending rates, which may lower loan demand (Ibrahim et al. 2012; Bolton and Freixas, 2006). Alternatively, avoiding costly equity, banks may adjust their capital by reducing their holding of higher risk-weighted assets (lending), and possibly increase the proportion of less risky assets (government securities) (Ibrahim et al., 2012; Slovik, 2012; Bolton and Freixas, 2006; Milne, 2002). In turn, banks holding more government securities or reduced lending can increase their capital ratios (Fuster and Vickery, 2018; Polat and Al-khalaf, 2014; Abdioglu, 2011; Jacques, 2008). Thus, under regulatory pressure, there is a theoretical link (simultaneous) between capital ratios, lending, and investment in government securities. As both bank lending and investment in government securities have a significant impact on a country's economy, a good understanding of the effect of capital requirements on changes in bank capital ratios and their inherent pressures on changes in bank lending and investment in government securities is fundamental for a sound regulatory and monetary policy formulation.

In addition, as an increase in regulatory bank capital requirements may be expected to result in higher average bank capital ratios than would otherwise be the case, these higher capital ratios can in turn reduce credit risks and enhance bank profitability and stability. The Expected Bankruptcy Hypothesis and the Regulatory Theory advocate a positive effect of higher capital ratios on bank profitability and stability, respectively. It is argued that higher bank capital ratios act as cushion to absorb bank risks and serve as a buffer against unexpected losses (Ayaydin and Karakaya, 2014; BCBS, 2004). Therefore, higher capital ratios should increase bank soundness and reduce systematic risks, resulting in increased bank profitability and stability. However, theories based on agency costs and moral hazard suggest a negative relationship between capital ratios and bank profitability and stability. Studies in support of these theories argue that more stringent capital ratios can lower competition, induce banks to take more risks, and so lower banks' profitability and stability (see, for example, Altunbas et al., 2007; Berge et al., 2008; and VanHoose, 2007).

Moreover, regulators are increasingly concerned with bank governance, such as the need for banks to have strong board oversight. Bank profitability can also be influenced by corporate governance structures, such as the board size and independence (Pathan, 2009). Although there is no globally accepted set of principles that can be applied to board structures (Rezaee 2009), the Agency Theory suggests that, for effective corporate governance, there should be, among others, a smaller board size with a high proportion of non-executive directors on the board (Chowdary, 2002). Thus, boards dominated by non-executive directors are largely grounded in agency theory (Dalton et al. 1999). The Theory asserts that an effective board should be comprised of a majority of non-executive directors, who are believed to increase bank profitability due to their independence from firm management (Dalton et al. 1999).

On the other hand, boards dominated by executive directors are grounded in stewardship theory (Dalton et al. 1999). The stewardship theory argues that managers are good stewards of the organisation and work to attain higher profits and shareholder returns (Donaldson and Davis 1991). Executive directors are tasked with the day-to-day operation of the business. They are expected to bring in specialised expertise and wealth of knowledge to the firm (Weir and Laing, 2001). However, since directors are not in a position to monitor or discipline the CEO, mechanisms to monitor the actions of the CEO and executive directors should be set (Weir and Laing, 2001).

Apart from capital regulations, the BCBS also advocates for strong boards of directors in banks, and emphasises the recognition of the board of directors as a key player in risk management and control (BCBS, 2006). This denotes the importance of internal risk control mechanisms (e.g., boards) in complementing the external regulations (e.g., higher capital requirements). There is a theoretical linkage between board monitoring and capital regulations as they are complimentary mechanisms for risk-management (Hagendorff et al., 2010; Becher and Frye, 2009; Baxter, 2003). Thus, both higher capital ratios and board size and board independence can be used to curb bank risks and thus enhance profitability. For instance, while higher capital ratios act as a buffer against unforeseen shocks (BCBS, 2004; Choudhry, 2011; Ayaydin and Karakaya, 2014), the Agency Theory argues that as non-executive directors are less accountable to management, they can increase bank monitoring and lower credit risks (Hermalin and Weisbach, 2003), thus increasing profitability. A smaller and independent board may reduce agency costs, leading to low funding cost (Pathan and Skully, 2010) and increased bank profitability.

Studies on this topic are contradictory and most of them concentrate on the effect of either bank capital ratios or board size and board independence, on bank profitability (see Chapter 3). Thus, the link between the bank capital ratio, board monitoring (board size and board independence), and profitability is not well examined. Available studies are also mixed and do not primarily test the linkage as, for example, they focus on the link between bank capital, corporate governance, and risk-taking (Abou-El-Sood, 2017), board monitoring, bank regulations, and announcement period returns (Hagendorff et al., 2010), and board characteristics, regulation, and bank risk taking (Vita and Luo, 2018) (see Chapter 3). As board size and independence are central to internal risk control mechanisms (Zabri et al., 2016; Adams and Mehran, 2012; Bonn et al. 2004), they may influence the impact of bank capital ratios on profitability (Cabo et al., 2012).

Further, many countries, especially developing ones, have recently embarked on liberalising their banking sectors, and so allowed private banks to join the industry, with the intention of creating well-diversified, competitive, and stable financial systems that would enhance economic growth (Rutihinda, 1993). However, as the separation of power between owners and managers (mostly in privately owned banks), may result in a conflict that can undermine bank value and hence lower its profitability and stability, the Agency Theory advocates that ownership type can align the

interests of managers and shareholders and improve firm performance and stability (Dalton, et. al, 2003). Empirical studies on this topic are, however, contradictory. While domestic (private and state) banks in developing countries are constrained by weak financial markets (Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002), foreign banks (especially from developed economies) operating in these countries have greater access to developed capital markets (Claessens et al., 2001). This enables foreign banks to raise capital at low cost (Zheng et al., 2017; Admati et al., 2010) and so, be more profitable, provide loans and buy government securities (Bonner, 2016; Francis and Osborne, 2012). Also, as foreign banks have higher risk management skills (Claessens et al., 2001; Berger, 2000; Clarke et al., 2000), they can reduce risks and so be stable, endure greater lending (Akhtar et al., 2019; Chernykh and Theodossiou, 2011) and operate profitably. However, as they are relatively less risk averse, the local subsidiaries of foreign banks in developing countries may underperform relative to local banks (De Nicolò and Loukoianova, 2007). Local banks are also able to mobilise local deposits more than foreign banks (Swai, 2019).

While private domestic banks may operate profitably due to their ability to create an aggressive loan strategy which leads to low non-performing loans (NPLs) (Mian, 2003), they may have higher rates of interest expenses on deposits than foreign banks (Mian, 2003.). However, private domestic banks outperform state banks because, as the government plays the "dual-agency" role, both as the owner as well as the regulator, state banks may be allowed to circumvent government regulations, and so increase their risk-taking (Andrews, 2005), resulting in bank instability. State banks may also underperform as they may be used to fulfill political agendas (Andrews, 2005; Chijoriga, 2000), or because they may encounter government intervention (García-Herrero et al., 2009). Also, higher capital ratios may result in higher risk-taking and instability of state banks due to government bail outs and insurance deposits which are mostly given to these banks (Andrews, 2005). However, state banks may invest more in government securities due to moral suasion (where banks are forced to buy the securities) (Reinhart and Sbrancia 2011).

Further, since the cost of funding may vary across different bank ownership types, the effect of capital ratios on a bank's stability may differ, depending on its ownership type. For instance, as foreign banks in developing countries can raise fund from developed capital markets at low cost, they can have higher capital ratios and so may be more profitable and stable than local banks

(Gupta and Muhakad, 2020). However, unlike foreign and private domestic banks, state banks may receive funding support from governments (Andrews, 2005), and thus be able to maintain stability.

Figure 1-1 below is drawn from the relevant literature review as described in Chapters 2, 3 and 4 of this thesis, and depicts a conceptual framework on the effect of regulatory pressure on changes in bank capital ratios, lending and investment in government securities, and the interrelationships between these variables. The figure also links the capital ratio to bank profitability and stability.

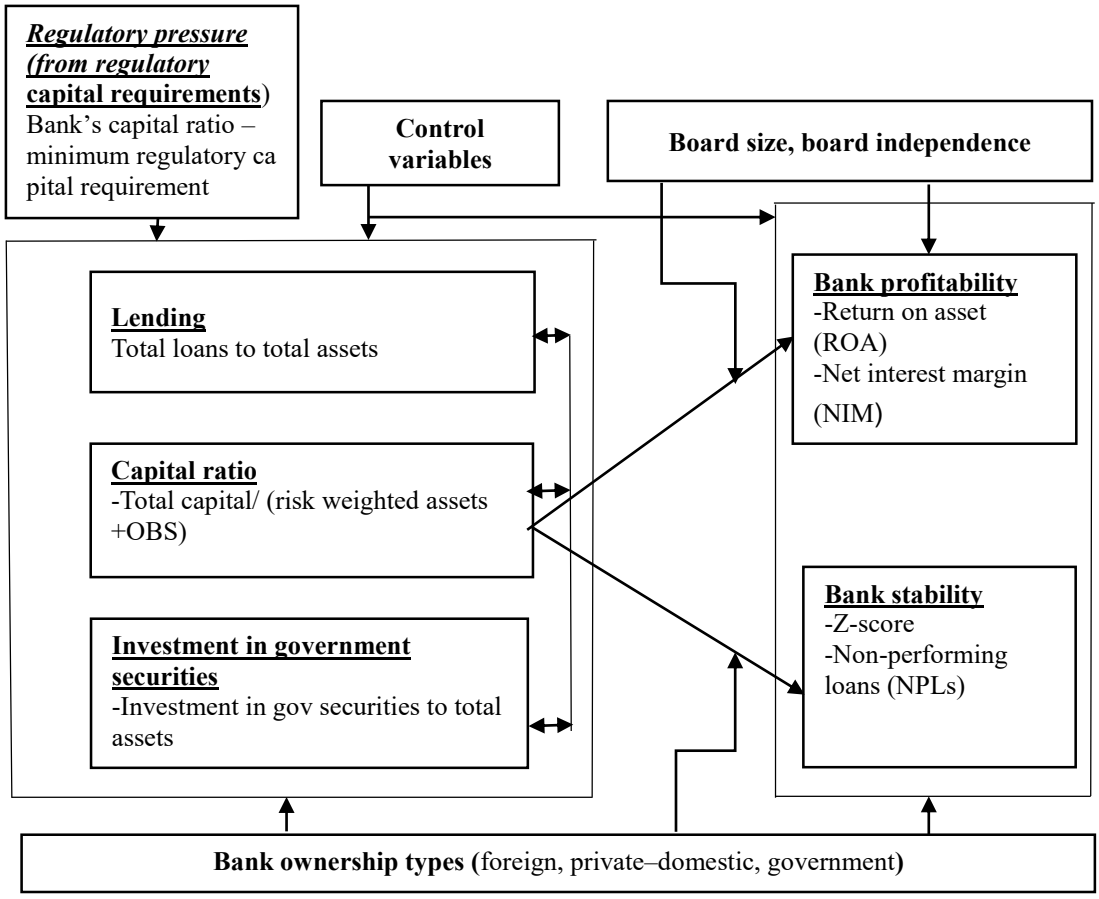

Figure 1-1: Capital requirements and bank responses

Source: Author's compilation from the literature

1.2 Justification and context of the study

Since their inception in 1998, the Basel Accords have been widely adopted globally, resulting in many national regulators imposing regulations on bank capital based on these accords. For instance, a survey by the World Bank (2013) reports that by 2011, capital regulation in all 143 respondent countries was based on either the Basel I, II or Basel III Accord. The Financial Stability Institute (2015) also shows that by June 2015, 95 out of 117 non-Basel Committee countries had implemented, or were in the process of implementing, Basel III. The Accords aim to increase bank capital ratios to enhance bank stability by protecting banks from the risk of failure (BCBS, 2004). Theory suggests that capital requirements induces banks to increase buffer capital. However, in developed countries, evidence is mixed on how capital requirements affect bank capital ratios[4], and whether in practice higher capital ratios increase bank stability[5] and reduce their risk of failure.

In developing and emerging countries, capital regulation has also become important as, in these countries, the risk of bank failure is high due to weak capital markets (Griffith-Jones and Tyson, 2013). Bank failures in these countries, where banks are the main source of funding, can result in financial crises, with significant negative impacts on economic welfare. Thus, as higher capital could protect banks against the risk of failure, these countries have also continued to impose capital regulations so that banks are adequately capitalised (BCBS, 2004). However, most studies on developing countries are contradictory (e.g., Bougatef and Mgadmi, 2016; Bouheni and Rachdi, 2015; Osei-Assibey and Asenso, 2015). Further, most studies examine bank capital ratios, and lending, or government securities separately. Thus, the simultaneous link between changes in these variables (suggested by the theory above) is mostly unexplored, despite that the changes have an exogenous and endogenous component. On profitability and stability, studies are also mixed, as are studies on the effect of board size and independence on bank profitability, which do not test if board size and independence may moderate the effect of capital ratio on bank profitability (see chapters 3 and 4). Finally, as noted above, studies on the effect of bank ownership type on capital ratios, lending, investment in government securities, profitability, and stability are mixed, and do not test whether the effect of capital ratios on bank stability may vary with bank ownership type.

[4] See the literature (Chapter 2) on the relationship between capital requirement and bank capital ratios.

[5] While higher bank capital acts as a cushion to absorb risks and as a buffer against unexpected losses, enabling banks to withstand banking crises, banks may react by also undertaking more risky activities, which could reduce bank stability (Altunbas et al., 2007; Iannotta et al., 2007; Berger and Patti, 2006; and Rime, 2001).

Thus, this study provides empirical evidence on the links between bank capital ratios, bank profitability and stability, lending and investment in government securities from Tanzania, a less developed country, which has a uncommon historical (economic and political) background, and a diversified banking sector. First, unlike many other sub-Saharan countries, Tanzania implemented a strongly socialist economic model after independence in 1961. During this period, all private banking activities were prohibited in the country (see Section 1.5 below). However, state banks could not perform well due to inadequate capital, poor governance and lack of competition (PSRC, 2000). Although, as explained in Section 1.5 below, liberalisation in the 1990s sought to improve the sector, the reform objectives could not be achieved. For instance, the IMF remarks:

> *"Despite some indications of progress following recent extensive policy reforms, the current depth and efficiency of the financial system fall well short of what is needed to help support economic growth. Credit to the private sector remains very small and mostly short-term; interest rate spreads though declining are very high as well as accumulated extensive holdings of government paper and sizeable off-shore dollar placements"* (IMF, 2003).

Moreover, despite the reforms of the 1990's that also permitted private banks to join the sector, banks continued to fail (see Section 1.5 below), thus, reducing the number of banking institutions to 46 in 2020 (from 59 in 2016). This study thus examines whether the joint effect of bank capital ratios and ownership type would enhance bank stability. Secondly, until the 1990's, Tanzania was characterised by a centrally planned economy with state control of the general economy. Therefore, the country lagged behind most countries in terms of financial market development. A banking survey by Ernst and Young (2013) in East Africa revealed that the Tanzanian banking sector has the lowest capital adequacy ratios among comparable economies. Despite the recent economic and financial reforms, the sector is still constrained by lack of capital and concentrated ownership with only 8 banks (out of 58) being domestically listed (DSE, 2020). Thus, in less developed capital markets, adjustments in banks capital ratios, to avoid regulatory penalties or to create capital buffers for precautionary purpose, can be difficult due to limited financing options and higher funding costs (Rime, 2001). As a result, some banks in these countries could temporarily operate below capital requirement (regulators being lenient). However, in extreme cases, this could result in winding-up. For instance, in Tanzania, banks that operated below capital requirement include:

the Covenant Bank for Women (2013-2016), Efatha Bank (2013-2016), Kagera Cooperative Bank (2011), and Njombe Community Bank (2013 and 2014). These were among banks that were closed by the BoT in 2018, due to critical undercapitalisation (BoT, 2018) (Table 1A-4). Third, with the recent mode of state control of the economy, it is argued that the government of Tanzania continues to impose excessive control of banks (Chijoriga, 2000). This could result in, among others, moral suasion where banks (especially state owned) in the country may be forced to purchase government securities. Also, Tanzanian banks may experience government interference and ineffective oversight by boards of directors (Chijoriga, 2000; World Bank, 1999). Banks in the country may thus experience multi-directives from political authorities (Chijoriga, 2000) which could affect the implementation of the capital requirements. Thus, this study also examines how an independent board of directors (and its size) could increase monitoring, and also interact with capital ratios to mitigate risks, and, so improve the profitability of Tanzanian banks.

Fourth, as most of the variables for this study are bank-level data, it is convenient to conduct the study in Tanzania where the researcher could easily obtain the relevant bank data, including that for private (unlisted) banks. Tanzanian law requires all banks operating in the country, regardless of whether they are listed or not, to publicly publish their financial reports (URT, 2014). Although some other countries may also require banks to publish their data, it is often not easy to get bank-level data either from the banks' websites (especially historical data), or from their central banks, who usually report only at the banking sector-level. Thus, this study uses bank-level data to examine the role of bank capital ratios on the performance of banks and the extent to which it varies with bank governance, and ownership types (foreign, private-domestic, and government banks. Ownership type can align the interests of managers and shareholders and improve firm performance and stability (Dalton, et. al, 2003). Thus, as noted by VanHoose (2007), in a diverse banking system, it is important to examine the role of capital regulation for bank behaviour.

This study explores the effect of regulatory pressure on changes in capital ratios, lending, and investment in government securities; examines the simultaneous relationship between changes in bank capital ratios, lending, and investment in government securities. It also examines the impact of capital ratios on banks' profitability and stability. The study further tests the extent to which bank ownership type affects these relationships (see the structure of the study in Section 1.6).

1.3 Research objectives

The main aim of this study is to examine the effect of regulatory pressure and ownership type on changes in bank capital ratio, lending, and investment in government securities; and the extent to which capital ratios and ownership type affect bank profitability and stability, with specific reference to Tanzania. Specifically, the study aims to achieve the following three objectives:

(i) To investigate the effect of regulatory pressure (to meet regulatory capital requirements) and bank ownership type on changes in bank capital ratio, lending, and investment in government securities; and the extent to which banks under regulatory pressure balance the simultaneous relations between changes in capital ratios, lending and investment in government securities.

(ii) To examine the extent to which capital ratios and ownership type relate to bank profitability; and whether board size and independence moderate the capital ratio-profitability linkage.

(iii) To assess the effect of bank capital ratio on bank stability, and the extent to which this varies across bank ownership types.

1.4 Significance of the study

This study seeks to help regulatory bodies formulate sound policies to strengthen the financial markets; develop and implement appropriate capital regulations to improve the banking sector's capital adequacy; and ensure that banks increase capital commensurably with their risk profile for a sustainable banking sector in the country. The significant results on the simultaneous estimates reminds regulators on setting capital standards that do not compromise the lending and investment in government securities activities. It should be noted that if regulations are not properly addressed, they can lead to bank failures and closure. In turn, bank closure have negative externalities, including a reduction in the economic welfare in a country. To banks, as higher capital ratios enhance bank profitability and stability, the study acts as a self-check and sheds light on the importance of complying with regulations, such as the minimum regulatory capital requirements. Thus, banking shareholders and other stakeholders can have empirical evidence regarding returns on their investments. Further, results on the role of ownership types can help banks to adopt proper strategies that fit their ownership type, on lending and government securities' investments so as to mitigate risks for improved customer confidence, bank profitability and stability. Lastly, findings of this study can potentially be applied to developing countries other than Tanzania.

1.5 Overview of the Tanzanian banking system

The Tanzania banking sector has gone through several reforms, in an attempt to strengthen the country's financial system. Prior to independence in 1961, Tanzania's banking industry was largely unregulated and mainly composed of foreign banks[6]. Soon after the independence, several local banks[7] were established to cater for the needs of native Tanzanians previously overlooked by the foreign banks (Lwiza and Nwankwo, 2002). In an attempt to promote self-sustaining economy, Tanzania resorted to the creation of State Corporations, commonly called parastatal organisations or state-owned enterprises (SOEs) (Nyerere, 1968). Following The Arusha Declaration (an ideology of socialism) of 1967, Tanzania became a centrally planned economy. Between 1961 and 1997, 425 parastatal organisations (including banks) were established, either by way of incorporating new ones, or by nationalising private enterprises (PSRC, 2000). All bank branches in mainland Tanzania were taken over by the National Bank of Commerce (NBC), whilst those in Zanzibar and Pemba were added to the People's Bank of Zanzibar (PBZ). This was intended to create a banking sector which would offer priority to serving the community, rather than pursue profits (Kahama et al., 1986). It was thought that state owned banks would be more capable of reallocating savings to cater for economic development, and thus ensure that rural areas are also adequately served (Kahama et al., 1986; Abdi, 1977).

Unfortunately, the sector did not perform well as it was characterised by public sector dominance as regard to ownership and control of the institutions; government interference in the management and resource allocations; inadequate capital; an inefficient payment system; and monopolistic and uncompetitive financial institutions; (Nyagetera and Tarimo, 1997). Similarly, Cheng and Podpiera (2008) observe that the regulatory system was inadequate, fiscal and financial operations were interacted, and NPLs were over 65% of the loan portfolio. Also, the World Bank (1999) notes that there was no legal framework to harmonise financial institutions' activities, and no supervisory authority to enforce prudential regulations. The government monitored interest rates, and used

[6] Under German rule (up to 1914), there were only two banks operating in Tanzania, then known as Tanganyika, namely the Deutsche Ostafrikanische Bank (1905) as a central and a commercial bank, and the Handelsbank für Ostafrika (1911) as a cooperative bank (Lwiza and Nwankwo, 2002). During British rule, the East African Currency Board (EACB), founded in 1919, operated as a central bank, and Barclays Bank, National and Grindlays Bank, and the Standard Bank dominated the sector up to 1950.

[7] In 1966, the Bank of Tanzania took over from the EACB, and the National Co-operative Bank (1962), the Tanzania Bank of Commerce (1965), and the People's Bank of Zanzibar (1966) were established.

state banks to allocate credit to cooperatives and parastatals. However, financial institutions' ignorance on asset quality and bad economic conditions led to a huge accumulation of non-performing loans (World Bank, 1999). Moreover, in the 1980's, an immense economic crisis hit the country, striking the banking sector too. To resolve the above weaknesses and in response to the 1980's crisis, a presidential (the Nyirabu) Commission was formed in 1990. This enabled the enactment of the Banking and Financial Institutions (BAF) Act of 1991 that provided for comprehensive bank supervision and regulation to ensure stability of the sector (URT, 1991). An efficient banking sector could assist in the country's economic growth by improving deposits mobilization and increased credit supply (Brownbridge and Gayi, 1998). The Commission noted:

> *"In Tanzania, the banking sector was inefficient, commercial banks had problems and some were technically insolvent. Banks had large volumes of non-performing loans, and unprofitable operations" (Nyirabu Commission, 1990).*

The Commission suggested that, among others, the banking industry be liberalised, permitting private banks to join the sector. This aimed at creating a well-diversified, competitive, independent, sound, and solvent financial system to enhance economic growth (Rutihinda, 1993). The BAF Act in 1991, which allowed private entities to enter the financial sector, formed the basis of the introduction of free market operations in the Tanzanian financial sector (URT, 1991). Thus, private banks joined the sector, and the highest number was in 2016, with 59 banking institutions, of which 7 (11.9%) were state, 22 (37.3%) private-domestic, and 30 (50.8%) foreign owned (BoT, 2016).

In addition, Tanzania's regulatory practices (adoption, implementation, and enforcement) have converged with global standards over time. Driven in part by the EAC harmonisation agenda, the country only finished implementing risk-based supervision in 2009 and decided on selective execution of the Basel II and III Accords beginning in 2017 (Gray, 2022) (see also Table 1Ain the appendices). Although Tanzania has been a slow adopter of Basel standards, its regulatory system is reasonably good for its level of economic development (IMF, 2018; 2017; 2010; 2004). The country continues to regulate the sector by implementing such regulations intended to increase banking capitalisation and strengthen banks' boards of directors. For instance, to implement the Basel Accord, and in an effort to strengthen the sector, the BoT has issued several capital adequacy regulations. The 2008 regulations require all banks and financial institutions operating in Tanzania to maintain a minimum core and total capital ratios of 10% and 12%, respectively (URT, 2008).

Also, in 2008, the BoT issued the Guidelines for Boards of Directors of Banks and Financial Institutions in Tanzania. The guidelines spell out that the institutions should be well governed, function in a sound and safe manner, and be in compliance with applicable laws and regulations so as to protect their depositors' interests. The guidelines require a Tanzanian bank to have, among others, at least five directors- two thirds of whom should be independent (URT, 2008).

However, the sector was constrained by low capital and mismanagement, leading to high growth in NPLs, low profitability, and failures. By 2012, six banks had failed, namely, the Housing Bank, Meridian Biao Bank (T) Ltd., Greenland Bank (T) Ltd., Trust Bank (T) Ltd, First Adili Bank (T) Ltd, and Delphis Bank (T) Ltd. (Temu and Andilile, 2011).

Moreover, to ensure that Tanzanian banks have adequate capital, in 2012, the BoT increased the minimum core capital to TZS (Tanzanian Shillings) 15 billion from TZS 5 billion (BoT, 2012). Nevertheless, between 2012 and 2018, the sector's return on assets decreased consecutively as shown in Table 1-1 (for details see Fig. 1A-1 and 2 in the appendices), and its loan growth was unsteady. Also, the sector recorded a consecutive rise of NPLs from 2013 to 2017. For instance, in 2017, this ratio was 11.60%, up from 6.43 % recorded in 2013. Banks failed between 2017 and 2018 include: Mbinga Community Bank, Meru Community Bank, Covenant Bank, Efatha Bank, Njombe Community Bank, Kagera Farmers Cooperatives Bank, and Twiga Bancorp (BoT, 2018).

Further, the share of assets held in government securities by banks is comparatively low and has been decreasing in recent years (IMF, 2016). Thus, in 2020, the BoT reduced haircuts (the difference between a security's market value and the amount to be used as loan collateral) for Treasury bills from 10.0 % to 5.0 % and Treasury bonds from 40.0 % to 20.0 %, so that, with less collateral (BoT, 2020) banks could be induced to buy more government securities.

Table 1-1: Tanzania banking sector performance trend-selected indicators (2012-2018)

Ratios (%)	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Return on assets-ROA	2.58	2.55	2.51	2.49	2.09	1. 15	1.04
Lending (loan growth)	18.27	17.12	19.89	25.07	2.69	-1.76	6.83
NPLs to gross loans	8.01	6.43	6.83	7.88	10.27	11.90	10.51

Source: Bank of Tanzania (BoT): Financial Sector Supervision Reports (2012-2018)

Unsteady loan growth, an increase in NPLs, a decrease in the sector's profitability, and continued bank failure in the country raises questions as to the efficiency of regulations on banking stability. Since the financial sector in Tanzania is dominated by banks, bank failure in the country may have a contagion effect as it can result in an overall financial crisis and tribulations of the economy. Unfortunately, as noted above, most studies are contradictory and focus on developed countries. Studies in these countries may not be generalisable to developing countries, as banks in developing countries are constrained by lack of funding, concentrated ownership, less expertise, low technology, and mismanagement (Claessens et al., 2001). In addition, bank decisions in developing countries may be affected by extensive political interference (Andrews, 2005; Chijoriga, 2000).

1.6 Structure of the study

This thesis is organised into five chapters. Chapters 1 and 5 concentrate on the study's background and conclusion, respectively, whilst the other three empirical chapters address the broad objectives as outlined above. The study is thus structured as follows: Chapter 1 includes a background to the study, justification and context, objectives, and significance of the study.

Chapter 2 focuses on the effect of regulatory pressure (to meet regulatory capital requirements) on changes in bank capital ratio, lending, and investment in government securities. Employing the three-stage least square (3SLS) estimation method, the study further investigates the extent to which banks under regulatory pressure balance the simultaneous relationship between changes in bank capital ratios, lending and investment in government securities, and the extent to which the variations in bank ownership type affects such changes.

Chapter 3 examines the effect of capital ratios and ownership type on bank profitability, using both the dynamic (the generalised method of moments, Sys-GMM) and the static (the ordinary-least square and the fixed- or random- effect) models. The chapter also examines the impact of board monitoring (board size and board independence) on bank profitability and the extent to which the interactive effect of bank capital ratio and board monitoring may affect this relationship.

Chapter 4 investigates the relationship between capital ratios and bank stability, using a Sys-GMM model. It further tests the extent/degree to which bank ownership affects or enhances this relationship. Chapter 5 concludes the study, provides policy implications and recommendations, and makes suggestions for future research.

Chapter 2: Regulatory pressure, ownership, and simultaneous changes in bank capital ratios, lending, and investment in government securities

2.1 Introduction

Banking crises experienced over the past three decades have increased the need for capital regulations to protect banks against the risk of failure arising from their loan portfolios (BCBS, 2004). The Basel I, II, and III Capital Accords require banks to increase equity in line with the riskiness of their assets (BCBS, 2004, 2010). Regulatory capital requirements are meant to increase banks' equity capital. However, raising equity may be costly, especially in less developed capital markets, due to information asymmetry and market imperfections (Baker and Wurgler, 2015; Ibrahim et al., 2012; Bolton and Freixas, 2006). These funding costs can be passed on to borrowers through higher lending rates or tighter lending standards, which may reduce bank lending (Francis and Osborne, 2012; Ibrahim et al., 2012). In general, banks may respond to higher regulatory capital requirements by investing more in lower risk assets (e.g., government securities) or reduce higher risk assets (e.g., loans), thus increasing risk-weighted capital ratios (Fuster and Vickery, 2018; Jacques, 2008), as they rebalance their portfolios towards low-risk assets (Bouis, 2019).

Adjustments in bank capital ratios and associated portfolio rebalancing can have great economic implications. As banks dominate the financial system, particularly in developing countries where financial markets are weak (Assibey and Bockarie, 2013), they play a significant role in financial intermediation by converting deposits into loans, and channeling funds from surplus to deficit units, thereby lowering economic disequilibrium and boosting economic growth (Maurin and Toivanen, 2012). Thus, if higher regulatory pressure force banks to adjust their capital ratios by lowering their lending, it can restrain economic activities. For instance, in developing countries, where banks are the main sources of funds, contraction in lending to sectors considered risky, such as agriculture, can weaken agricultural activities, and so, hinder economic growth. On the other hand, if higher regulatory pressure induce banks to decrease their investments in less risker and lower return instruments, for example government securities, it may undermine government expenditure, as banks take up a big stake of these securities (Egesa et al., 2015). According to Egesa et al. (2015), due to weak financial markets structure/systems in developing countries, there are limited government funding options, therefore, banks' investment in government securities support economic growth by financing government expenditure.

Although, as noted above, regulatory capital requirements are primarily meant to increase banks' capital ratios, evidence on whether they are successful is mixed, with only some studies finding real increases in capital ratios (for example, Francis and Osborne, 2012; Berger et al., 2008; Brewer, Kaufman, and Wall, 2008; Aggarwal and Jacques, 2001; Rime, 2001). However, others find little evidence or a negative effect of regulatory capital requirements on capital ratios (see, for example, Minni, 2016; Gropp and Heider, 2010; Flannery and Rangan, 2008).

In addition, although in theory higher regulatory capital requirements should decrease bank lending, empirical studies are contradictory on this point. Several studies show a positive relationship between regulatory bank capital requirements and lending[8]. Higher capital requirements can induce a bank to increase its equity capital, thus increasing its lending capacity. Francis and Osborne (2012) argue that a bank with more capital encounters less constraints in its ability to lend compared to an undercapitalised one. Moreover, higher capital ratios can increase funders' confidence in a bank, and so lower funding cost (Zheng et al., 2017; Admati et al., 2010; García-Herrero et al., 2009), which may result in lower lending rates and increased loan demand. Rajan (2005) opines that higher regulatory capital requirements might compel some banks to increase investment in risky assets (such as loans) in order to gain higher earnings. In contrast, others argue that the higher cost of equity may be passed on to borrowers through higher lending interest rates, which ultimately constrains loan demand (Ibrahim et al. 2012; Bolton and Freixas, 2006). In addition, rather than raising new equity (which is costly), banks can opt to reduce their higher risk weighted assets - mainly loans (Minni, 2016; Milne, 2002). In some cases, if faced with higher capital requirements, banks can reduce lending to borrowers or activities thought to be more risky (Popov and Udell, 2012; Albertazzi and Marchetti, 2010; Peek and Rosengren, 2000).

Moreover, capital requirements can affect bank investment in government securities. It is argued that capital requirements can increase banks' equity capital, thereby increasing their ability to invest in government securities (Egesa et al., 2015). Studies also show that banks struggling to meet regulatory capital requirements tend to increase their holdings of lower-risk weighted assets, such as government securities (Bonner, 2016; Korte and Steffen, 2015; Cummings and Nel, 2005).

[8] See, for example, Olszak et al. (2016), Osei-Assibey and Asenso (2015), Gambacorta and Mistrulli (2004), and Albertazzi and Marchetti (2010).

For instance, Bonner (2016) shows that in the Netherlands banks constrained by capital requirements buy considerably more government bonds than unconstrained ones. Likewise, Korte and Steffen (2015) report that in European countries bank capital regulation induces banks to hold a comparatively large amounts of government bonds. In South Africa, Cummings and Nel (2005) show that an increase in regulatory capital requirements results in lower risk-weighted assets.

Further, the manner in which a bank changes its capital ratios, lending, and investment in government securities often depend on its ownership structure or the type of ownership. For example, foreign banks operating in developing countries often have more access to developed capital markets and higher risk management skills (Claessens et al., 2001, Berger, 2000; Clarke et al., 2000). Therefore, they can raise capital at lower cost, reduce risks, sustain greater lending and increase investment in less risky assets like government securities (Chernykh and Theodossiou, 2011, Bonner, 2016; Egesa et al., 2015; Korte and Steffen, 2015, Francis and Osborne, 2012 Zheng et al, 2017; Admati et al., 2010). In emerging Asian markets, Akhtar et al. (2019) find that foreign banks have a relatively higher lending capacity. On the other hand, private-domestic and government banks in developing countries may have low capital due to less-developed capital markets, low levels of technology, and low risk management skills, thus limiting their lending potential (Berger et al 2008; Barth et al 2004; Mian, 2003; La Porta et al 2002). However, unlike private banks, state banks may have capital injected by their governments. They may also extend more credit to the state, increasing their loan portfolio. In Latin America, Cull and Peria (2013) find that lending growth for state banks surpassed that of foreign and private-domestic banks. Although private domestic banks in developing countries may invest less in government securities due to low capital, state banks may increase such investment (Becker and Ivashina, 2018; Marco and Macchiavelli, 2016; and Horváth et al., 2015) due to moral suasion (where banks are forced to buy government securities), which is likely to be higher in domestic banks (Reinhart and Sbrancia 2011), specifically for state banks. Also, as the government is the major shareholder in state banks, it can dictate the structure of a bank's security portfolio (Chronopoulos et al, 2020). Becker and Ivashina (2018) report that state ownership of banks is positively linked to their holdings of Eurozone government debt. In the EU, Marco and Macchiavelli (2016) also find state banks to exhibit higher home bias.

Despite the contradictory results (see literature below), the effect of regulatory pressure on changes in bank capital ratios, lending and investment in government securities in developing countries remain less explored. Most studies focus on developed countries with well-developed capital markets, where most banks usually hold excess capital (buffer), or can easily adjust their capital (Rime, 2001) and so, reduce their funding costs. Thus, as most banks in developed countries typically have excess capital or have higher ability to adjust their capital ratios and risk, relative to those developing markets(Rime, 2001), they may have less regulatory pressure.

This study, which focuses on the Tanzanian banking sector, contributes to the literature in three aspects. First, since most developing countries have weak capital markets (Griffith-Jones and Tyson, 2013), bank capital ratios and risk adjustments (to meet higher regulatory capital requirements) in these countries may result in higher funding costs. For instance, Ibrahim et al. (2012) report a significant increase in funding cost during the post-recapitalisation period in Nigeria. As higher bank capital ratios adjustments can increase funding costs (Francis and Osborne, 2012; Ibrahim et al., 2012; Bolton and Freixas, 2006), this may increase lending rates, leading to constrained loan growth (Francis and Osborne, 2012; Jimenez et al., 2012) and accelerate economic downturns. Since banks should adjust their capital ratios or create buffers to avoid regulatory penalties (Rime, 2001), the impact of regulatory pressure in developing countries may be more severe. This is especially relevant to Tanzania, where the capital market is under-developed, with only eight listed banks out of 57 (DSE, 2020).

Secondly, few studies examine how banks react to higher regulatory capital requirements. Theoretically, when faced with regulatory pressure to meet higher capital requirements, undercapitalised banks may simultaneously increase capital and reduce higher risk-weighted assets (such as loans). However, higher capitalised banks may concurrently maintain existing levels of capital and increase risky assets (Rime, 2001). Past studies employ simultaneous models to investigate the link between changes in capital ratios and bank behaviour (see, for example, Ashraf et al., 2016; Zhang et al., 2008; Barth et al., 2004; Rime, 2001; and Shrieves and Dahl, 1992). Unfortunately, despite focusing on developed countries, most past studies have looked at bank capital ratios and lending, or government securities separately, whereas this study examines a simultaneous link between changes in these three variables. As the changes in bank capital ratios, lending, and investment in government securities have an exogenous and endogenous component,

this study examines the impact of discretionary changes in these variables due to endogenous or exogenous policy stimuli and guide policy formulation by providing insight on the extent to which regulatory pressure affect changes in bank capital ratios, lending, and investment in government securities and the extent to which such changes vary across banks of different ownership types.

Finally, most studies on this topic measure regulatory pressure (resulting from regulatory capital requirements) as a dummy variable, that is, it takes a value of 1 if a bank meets the minimum requirements, and zero if it does not (e.g., Minni, 2016; Van Roy, 2005; Rime, 2001; and Shrieves and Dahl. 1992). However, a bank's capital ratio may be influenced by a number of macroeconomic, industry and bank-specific factors other than regulatory capital requirements (Van Roy, 2005). Thus, a dummy variable may not adequately capture the distance of a bank's capital ratio from the regulatory minimum capital requirement, as it simply differentiates between banks that comply or meet the minimum requirement and those that do not, thus not reflecting the extent to which regulatory pressure affects the variability of different banks' capital ratios (BCBS, 1988). Following Osei-Assibey and Asenso (2015), this study defines the regulatory pressure (the distance from the regulatory minimum capital requirement) as the difference between the minimum regulatory capital requirement and a bank's actual capital ratio. All other factors constant, the further a bank's capital ratio is below the minimum regulatory capital requirement, the higher the pressure exerted by higher capital requirements, and vice-versa. Thus, this approach captures the effect of regulatory pressure and helps to examine simultaneous response of changes in bank capital ratios, lending, and investment in government securities.

This study examines the effect of regulatory pressure and bank ownership type on changes in bank capital ratio, lending, and investment in government securities; and the extent to which banks balance the simultaneous link between such changes. The study has the following three objectives:

(i) To examine the effect of regulatory pressure on changes in bank capital ratios, lending, and investment in government securities.
(ii) To assess how banks under regulatory pressure balance the simultaneous relationship between changes in bank capital ratios, lending and investment in government securities.
(iii) To analyse the extent to which variations in bank ownership type affect changes in bank capital ratios, lending and investment in government securities.

2.2 Theoretical perspectives and hypotheses development

2.2.1 The Buffer Capital Theory

The relationship between capital requirements and bank capital ratios can be explained by the Buffer Capital Theory, which suggests that banks may hold capital in excess (a buffer) of the minimum requirement (Lindquist, 2004). According to the literature, banks' motives for holding excess capital include the creation of a buffer which can help them meet future changes in regulatory requirements and mitigate risks of regulatory penalties (Berger et al., 2008; Peura and Keppo, 2006; Estrella, 2004; Furfine, 2001). In addition, higher capital may help a bank to evade regulatory intervention and market discipline (Furfine, 2001). Berger et al. (2008) also argue that excess capital above the regulatory requirement enables banks to react to ever-changing market pressure and risk of assets, like loan portfolios. Also, under capital regulation, adjusting the capital ratio through the issue of equity can be costly due to information asymmetries, which may convey negative information to the market about the bank's value, making shareholders unwilling to provide new capital when the bank is highly undercapitalised. Thus, asymmetric information and the higher costs of new equity issues may motivate banks to hold excess capital that can act as a cushion to absorb their risks and serve as a buffer against unforeseen shocks (BCBS, 2004; Choudhry, 2011; Ayaydin and Karakaya, 2014). Excess capital can also enable banks to explore investment opportunities (Berger et al., 1995).

Moreover, banks may hold buffer capital in relation to the level of risk of their assets, such as loans and government securities. In this regard, Milne and Wiley (2001) argue that, unlike banks with lower portfolio risk, those with riskier portfolios will tend to hold more buffer capital since their capital is likely to drop below the regulatory minimum requirement. If a bank has complied with the regulatory minimum capital and has buffer capital, a regulatory pressure can have less or no effects on the bank's behaviour. Thus, according to the Buffer Capital Theory, as banks tend to create capital buffers above the minimum regulatory requirement to avoid costs such as regulatory penalties, liquidation, and market pressure (Berger et al., 2008; Peura and Keppo, 2006; Estrella, 2004; Furfine, 2001), this study expects regulatory pressure to have a significant relationship with changes in bank capital ratios, leading to the null hypothesis below:

$H2A_o$: There is no significant relationship between regulatory pressure and changes in bank capital ratios.

However, as raising equity may be costly, banks under regulatory pressure to increase capital ratios may increase their lending rates, which may result in a decrease of loan demand (Ibrahim et al. 2012; Bolton and Freixas, 2006) and thus, reducing bank lending (Francis and Osborne, 2012). Thus, when capital buffers are adequately low and it is also costly to raise new equity, banks may experience higher regulatory pressure, and so they can reduce lending to meet regulatory capital requirements, and vice versa. Alternatively, to avoid raising costly equity, banks under regulatory pressure (to meet capital requirements) may adjust their capital ratios by reducing their higher risk-weighted assets (e.g., loans), and increasing the percentage of lower risky assets, such as government securities (Ibrahim et al., 2012; Slovik, 2012; Bolton and Freixas, 2006; Milne, 2002).

Theoretically, as raising equity capital is costly, banks faced with regulatory pressure may adjust their capital ratios by shrinking the portfolios of risky assets (e.g., loans), whilst increasing holdings of less risk-weighted assets, such as government securities (Fuster and Vickery, 2018; Kim et al., 2017). This study expects regulatory pressure to be significantly related to banks' changes in lending and investment in government securities, leading to the null hypotheses below:

$H2B_o$: There is no significant relationship between regulatory pressure and changes in bank lending

$H2C_o$: There is no significant relationship between regulatory pressure and changes in banks' investment in government securities

2.2.2 Portfolio Rebalancing Hypothesis

The relationship between changes in bank capital ratios, lending, and investment in government securities can be explained by the Portfolio Rebalancing Hypothesis. According to this theory, banks trying to increase their *capital ratios* to meet higher regulatory capital requirements may substitute low risk-weighted assets for high risk-weighted assets (Juelsrud and Wold, 2020). This adjustment reflects a rebalancing of banks' portfolio towards lower risk and safer assets (Bouis, 2019). Thus, given the large difference in mean risk weights between bank lending and investment in government securities, a decrease in mean risk weights can suggest a comparative decrease in bank *lending*, and so an increase in less risk-weighted assets, such as *government securities*. For instance, Gropp, Mosk, Ongena, and Wix (2019) reveal that banks across Europe react to capital requirements by decreasing risk-weighted assets rather than increasing equity.

Thus, faced with regulatory pressure, banks may either raise equity or reduce their higher risk-weighted assets (Berger et al., 1995). Whatever option is chosen, any adjustment could increase lending interest rates and lower loan demand. As government securities are interest earning assets for banks, their holdings will be affected by the allocation strategy of a bank's portfolio. Egesa et al. (2015) argue that the allocation of funds to invest in government securities may be driven by such factors as bank capital and lending behaviour. Although, according to the doom loop theory, higher banks' sovereign exposure can cause banking systemic risk, as heavy government debt can affect its incentive to bail out banks, however, increased banks' holdings of sovereign debt may strengthen the government's incentives to repay (Gennaioli et al. 2014; Bolton and Jeanne, 2011).

Literature also suggests that the relationship between bank capital ratios, lending, and investment in government securities depends on whether a bank holds capital (a buffer) above the regulatory requirement. While banks that hold higher buffers (excess capital) may reduce (or maintain) their capital ratio or increase higher risk assets, banks with lower capital ratios may raise capital or reduce higher risk assets, such as loans (Milne and Whalley, 2002; Rime, 2001). This potentially results in an increase in the proportion of lower risk assets, such as government securities, held by such banks. However, while undercapitalised banks may increase their risk, hoping to gain profits, over-capitalised banks may increase capital for precautionary motives (Rime, 2001). Consequently, a higher regulatory pressure can lead to an increase in bank capital ratios, reduce bank lending, and so, induce banks to substitute lending with increased investment in government securities. As discussed above, there is a theoretical feedback relationship between changes in bank capital ratios, lending and investment in government securities. While positive changes in bank capital ratios can respectively result in negative and positive changes in lending and investment in government securities, positive changes in higher risky assets (e.g., loans) can result in negative changes in capital ratios, as loans constitute a greater part of the denominator of a bank's capital ratio. On the other hand, as government securities are less risky assets, their increase facilitates a switching regime from higher risky assets, leading to positive changes in banks capital ratios. Thus, this study expects banks under regulatory pressure to simultaneously balance their changes in capital ratios, lending, and investment in government securities, hence the null hypothesis below:

$H2D_o$: There is no significant simultaneous relationship between changes in bank capital ratios, lending, and investment in government securities.

2.3 Empirical evidence

2.3.1 Regulatory capital requirements (regulatory pressure) and changes in bank capital ratios

Although bank capital regulations should theoretically have a positive effect on bank capital ratios, empirical studies on this are contradictory. Some studies report a positive effect. For instance, the study by Shrieves and Dahl (1992) examines, among others, the impact of regulatory pressure on changes in bank capital of 1800 Federal Deposit Insurance Corporation (FDIC) and holding company affiliated banks over the period 1984 to 1986. In the study, banks with capital ratios less than the minimum capital requirement (i.e., 7%) are considered to be under regulatory pressure. The study finds the effects of regulatory pressure on target capital levels to be positive for banks with capital ratios less than 7%. Moreover, undercapitalised banks are found to adjust their capital ratios higher than well-capitalised banks, confirming the efficiency of bank capital regulation, especially for undercapitalised banks.

Unlike Shrieves and Dahl (1992) who use equity-asset ratios, Aggarwal and Jacques (2001) examine the impact of a new capital regulation (requiring a 7.25% minimum ratio) on the banks' risk-based capital ratio in the U.S over the period 1990 to 1997. This study also considers the intervention in troubled banks under the Prompt Corrective Actions (PCA) norms, which classified banks as well-capitalised, adequately capitalised, undercapitalised, significantly under-capitalised, and critically undercapitalised. The study finds that new regulation resulted in an increase in the Tier 1 ratios for all banks, indicating that the new capital regulation could have caused great regulatory pressure on the banks. However, undercapitalised banks are found to adjust their Tier 1 capital quicker than well- and adequately capitalised banks.

Similarly, Rime (2001) finds that Swiss banks near the regulatory minimum capital tend to increase their capital to risk-weighted asset ratio, indicating a positive effect of regulatory pressure on capital ratios. Also, the study finds a positive and significant effect of regulatory pressure on capital to total assets ratio, noting that increasing capital (equity capital or retained earnings) is less costly than adjusting portfolio risks, probably due to an undeveloped market for asset-backed securities in Switzerland. Investigating the effect of capital requirement on the behavior of Indian public sector banks, Ghosh et al. (2003) find that capital requirements significantly affect banks' capital ratio decisions, and that banks with capital ratios above the minimum threshold respond to changes

in regulatory pressure more significantly compared to undercapitalised ones. Using a sample of 78 of the largest banks in twelve developed countries from 1992 to 2001, Brewer, Kaufman, and Wall (2008) investigate the impact of capital regulation, safety nets, prompt corrective action, supervision authority independence, and degree of external governance on the banks' capital ratios. These researchers find that banks with higher capital ratios are found in countries with stringent capital requirements, more active prompt corrective actions, and effective corporate governance. Moreover, the impact is more pronounced for risk unadjusted capital ratios than for the risk-based capital ratios. The study further reports the inadequacy of Basel I criteria in decreasing cross-country capital ratio variations between large banks.

Similarly, Van Roy (2005) undertakes a study to compare the effect of regulatory effects (defined by the minimum capital ratio plus one bank-specific standard deviation) in six G-10 countries over the period 1988 to 1995. Separating regulatory effects from market effects, the study finds that Basel I capital regulation effectively induces undercapitalised banks in Canada, Japan, the U.K and the U.S to increase their capital. However, the study finds no effects of Basel I capital regulation in France and Italy.

Francis and Osborne (2012) find a positive relationship between capital regulation and bank capital ratios in the UK, indicating that banks respond to higher capital requirements by increasing their actual capital ratios, and vice versa. They argue that, while setting their capital ratios in accordance with regulatory capital requirements, banks add a buffer above the required level. Moreover, the authors show that this association is not asymmetric, as the impact is stronger in larger banks and for lower capital buffers. These authors further find that in good economic conditions banks increase capital ratios more, thus signifying the pro-cyclical impact of capital regulation.

In contrast, others find a negative association between capital regulation and bank capital ratios. For instance, on a sample of 42 Malaysian domestic financial institutions over the period 1995 to 2002, Ahmad et al. (2009) examine the determinants of bank capital ratios. The study measures regulatory pressure by three indicators: a dummy variable Y96 (1 for observations in 1996 and 0, otherwise), to capture for the 1996 regulatory requirement; a dummy variable POST99 (1 for the observations in 1999 to 2002 and 0, otherwise); and a dummy variable, REGRWC, measured by

1 for banks with capital ratio below the industry average, and 0, otherwise. The study finds capital requirement of post-1996 and of 1999 to 2002 to be ineffective and effective, respectively. REGRWC is consistently significant with negative coefficients, indicating that undercapitalised banks responded to the capital regulation by reducing their capital ratios. The results thus suggest that higher regulatory capital standards could have influenced undercapitalised banks to shrink their risk-weighted capital ratios.

Using a large panel data of U.S. banks from 2001-2016, Ding and Sickles (2019) examine the effect of regulatory pressure on changes in bank capital ratios, portfolio risk, and cost efficiency. Regulatory pressure (REG) is measured by a dummy variable equal to 1 if a bank's capital buffer is less than the cutoff value, and zero otherwise (buffer is defined as total risk weighted capital ratio minus 8%). Employing spatial fixed effect and GMM fixed effects estimates, they find a negative effect of REG on changes in bank capital ratios, suggesting that banks with low capital buffers increase capital by less than banks with large capital buffers. Similarly, Minni (2016) investigates the impact of regulatory pressure on capital ratios of European banks over the period 2004 to 2013. To measures regulatory pressure, the study uses 13% as a cut-off level to the capital ratio that distinguishes between lower-capitalised and higher-capitalised banks. The study finds a negative and statistically significant relationship between regulatory pressure and capital ratios.

However, other studies find little evidence or no effect of capital regulation on bank capital ratios. For instance, the study by Flannery and Rangan (2008) on U.S banks over the period 1986 to 2001 finds little evidence on the link between capital regulation and capital ratios. Surprisingly, others show that bank capital ratios are primarily affected by such factors as profitability, bank size, and economic growth, more than by capital regulation (Bokhari et al., 2012; Gropp and Heider, 2010).

Generally, the above empirical studies on the relationship between regulatory capital requirements and bank capital ratios appear to be inconclusive. However, according to the Buffer Capital Theory, banks tend to create capital buffers above the minimum regulatory requirement to avoid costs such as regulatory penalties, liquidation, and market pressure (Berger et al., 2008; Peura and Keppo, 2006; Estrella, 2004). Thus, as hypothesised above, this study expects a significant relationship between regulatory pressure (caused by regulatory capital requirements) and bank capital ratios.

2.3.2 Regulatory capital requirements (regulatory pressure) and changes in bank lending

Empirical evidence on the effect of capital requirements on bank lending are contradictory. Several studies show that higher capital requirements (regulatory pressure) can increase a bank's ability to provide loans. One such strand of the literature argues that higher capital requirements can increase banks' risk-based capital, thus decreasing the probability of insolvency which, in turn, increases the level of public confidence, resulting in reduced funding cost (Zheng et al., 2017). This argument is supported by García-Herrero et al. (2009), who show that banks holding higher capital appear more creditworthy and so experience lower funding costs. Admati et al. (2010) opine that, as higher capital makes both debt and equity funding safer, the cost of funding therefore decreases when capital requirements increase. Thus, under higher capital requirements, reduced funding costs can enable banks to increase lending. Francis and Osborne (2012) show that banks with more capital encounter less constraints in their capability to lend compared to undercapitalised banks.

In addition, higher capital requirements increase franchise value (the stream of future profits), which enables banks to remain capitalised and so engage in prudent lending (Martynova, 2014). Olszak et al. (2016) investigate the effect of bank capital ratios on loan supply and the determinants of possible variability on the effect in 27 EU countries over the period 1996 to 2011. The study uses two measures of capital requirements: the overall capital regulatory index, with values ranging from 0 to 7, greater values showing higher regulatory stringency; and the initial capital stringency index, with values from 0 to 3, greater values again indicating more stringent capital regulations. Employing a two-step GMM methodology, they find that countries with more stringent bank regulations have higher loan growth. The study also indicates that loan growth is more sensitive to bank capital for large banks, both during contractions and normal times. Thus, the results suggest that bank capital ratios are essential determinants of lending in large banks.

Moreover, regulatory capital requirements can enhance bank profitability, thus increasing a bank's ability to provide loans. In Ghana, Osei-Assibey and Asenso (2015) use a bank-level dataset of eleven banks over the period 2002 to 2012 to examine the effect of the capital requirements on banks' interest rate spread, credit supply, and non-performing loans. Using GMM estimation on a system of simultaneous equations, the study finds a positive association between minimum capital requirements and net interest margin, indicating that higher capital requirements can broaden the

spread between the saving and lending rates. Moreover, the study reports that excess capital above the required minimum ratio increases credit growth. However, higher capital is linked to higher NPLs, implying that an increase in excess capital results in increased bank risk-taking behaviour.

Further, the literature argues that higher capital enables banks to sustain lending during monetary shocks and economic recessions. This is because higher capital holdings improve a bank's ability to increase non-insured debt, enabling it to resist financial tremors and so sustain lending capabilities despite a decline in deposits. It is suggested that well-capitalised banks can protect their lending against monetary shocks due to their proximity to uninsured external financing (Gambacorta and Mistrulli, 2004). Also, well-capitalised banks can absorb their borrowers' short-term financial troubles, thus sustaining long-term lending affiliations (Gambacorta and Mistrulli, 2004), as can lower the cost of a crisis by sustaining bank lending (BCBS, 2019). For instance, the study of Albertazzi and Marchetti (2010) in Italy during the crisis period of 2007 to 2009 reveals that, unlike higher bank capitalisation, low capitalisation is linked to a shrinkage in credit supply.

Gambacorta and Mistrulli (2004) also examine the response of bank lending to monetary policy and GDP shocks due to variations in bank capitalisation in Italy for the period from 1992 to 2001. The study uses the excess capital (a bank's regulatory capital minus minimum capital requirement) to-asset ratio. Using the GMM estimator, the results show the impact of excess capital on bank lending to be positive and significant, arguing that well-capitalised banks are less affected by capital requirements and have more prospects to increase their loan portfolio. The result thus suggests that capital levels can transmit diverse types of tremors to bank lending due to capital restrictions and market imperfections. However, the study defines capital requirement as a dummy variable that measures whether banks in the sample have solvency ratios greater than 8% or not. This approach, as noted above, does not capture the variability of different banks' capital levels.

A similar study by Berger and Bouwman (2013) of US banks shows that, due to regulatory and market constraints during crises periods, well capitalised banks could have greater flexibility to make certain types of loans that may be unavailable to lower capital banks. Similarly, Chernykh and Theodossiou (2011) opine that, as well-capitalised banks in Russia can survive the risks stemming from long-term lending, higher capital requirements are major factors for loan supply.

In contrast, other studies show that regulatory capital requirements can cause loan supply to shrink, thus indicating a negative effect of capital regulation on bank lending. One such strand of the literature suggests that adjusting capital ratios (to meet higher capital requirements) can increase the costs of capital (Francis and Osborne, 2012; Ibrahim et al., 2012; Bolton and Freixas, 2006). For instance, the study in Nigeria by Ibrahim et al. (2012) shows a significant increase in funding cost during the post-recapitalisation period. Increased funding costs may then be passed on to borrowers through higher lending rates[9]. Consequently, higher lending rates may constrain loan demands and, ultimately, reduce bank lending (Francis and Osborne, 2012; Jimenez et al., 2012). A study by Jimenez et al. (2012) on monthly Spanish Credit Register data reveals that a 1% rise in interest rates reduces credit supplied by undercapitalised banks by 3.9% more than credit supplied by well-capitalised banks. This result suggests that the impact of short-term rise in interest rates is higher on lending activities of undercapitalised banks than that of well-capitalised ones.

Further, another strand of the literature argues that instead of injecting new capital (which is costly) to meet the capital requirements, banks can increase their capital ratio by reducing the higher risk-weighted assets. However, as loans constitute a larger part of a bank's risk-weighted assets, banks increasing capital ratios through this approach will mostly opt to decrease their amount of loans. Thus, a study by Catalan et al. (2017) in Indonesia show that Indonesian banks tend to reduce lending conditional on their capital levels.

Peek and Rosengren (2000) also argue that banks that are required to increase capital ratios can decrease loan supply to react to unexpected decreases in capital. Using a panel dataset of 41 credit institutions from 13 European countries over the period 2004 to 2013, Minni (2016) examines the effect of higher bank capital regulation on bank lending. Employing the two stage least square (2SLS) and the generalised method of moments (GMM) estimation techniques, the study finds a negative relationship between capital ratios and bank lending, indicating that banks reduce loan supply following an increase in their capital ratios.

[9] For instance, using data from 13 OECD countries, the BCBS (2010c) finds that a 1% increase in capital ratio rises lending spreads by 13 basis points. Similarly, in three OECD countries, Slovik and Cornede (2011) find that a 1% increase in the ratio of capital to risk-weighted assets rises lending spreads by 14.4 basis points, In the US, Kashyap et al. (2010) show that a 1% rise in capital requirement increases lending rates by 2.5 to 4.5 basis points.

Moreover, others argue that banks under high regulatory capital requirement can reduce lending only to borrowers or activities considered to be very risky (Albertazzi and Marchetti, 2010). For instance, in 16 emerging European countries, Popov and Udell (2012) assess the sensitivity of lending in relation to a bank's financial situation and find that the impact of crises on a bank with regards to its lending behaviour is greater for riskier companies and firms with less physical assets. Examining the impact of capital regulation on sectoral lending in the UK, Bridges et al. (2014) find that, while a 1% increase in capital requirements results in an 8% decrease in loan growth for commercial real estate, it results in a 3.9% decrease in loan growth for other corporate lending.

Similarly, Peek and Rosengren (2000) use the banking crisis in Japan as a shock to loan supply and show that the crisis is associated with the decline of commercial real estate activities in the U.S. However, they argue that shrinkage of lending in the real estate due to regulatory pressures results in weakening of the real economy. Examining the effect of bank capital requirements on credit supply in developing countries, Chiuri et al. (2002) conclude that the implementation of capital requirements decreases the credit supply, particularly in less capitalised banks. Using an unbalanced panel bank-level data for 13 banks, Assibey and Bockarie (2013) examine the determinants of bank lending in Sierra Leone. Employing bank and time-specific fixed effects models, these researchers show that Tier 1 capital and credit risks affect the credit supply to the private sector, and hence earning assets.

Generally, the empirical studies on the relationship between bank capital requirements (regulatory pressure) and lending are inconclusive. However, according to the theoretical and empirical arguments discussed above, adjusting capital ratios to meet a higher capital requirement can increase a bank's costs of funding, which may then cause higher lending rates, leading to a decrease in loan demand, and finally, lower bank lending (Francis and Osborne, 2012; Ibrahim et al., 2012; Bolton and Freixas, 2006). In addition, rather than injecting new capital (which is costly) to meet the capital requirement, banks under regulatory pressure may raise their capital ratio by shrinking or cutting their higher risk weighted assets. Moreover, banks under regulatory pressure to meet high capital requirements can reduce loan supply to the riskiest projects (Albertazzi and Marchetti, 2010). Thus, this study expects regulatory pressure to have a significant relationship with changes in bank lending.

2.3.3 Capital requirements (regulatory pressure) and changes in banks' investment in government securities

The results of studies relating to the effect of bank capital requirements on investment in government securities are mixed. Some studies report a positive impact and argue that capital requirements can increase banks' capital levels, which is then apportioned to different assets, including government securities. For instance, Egesa et al. (2015) investigate the determinants of securities investments of twelve banks in Uganda over the period 2006 to 2012, using the sum of the stock of treasury bills and bonds measured as a ratio of the stock to total assets as indicators of securities investment. Capital adequacy is expressed as the ratio of a bank's tier 1 capital to total assets. Employing generalised method of moments (GMM) estimations, the study finds a positive and significant relationship between capital adequacy and the banks' investment in government securities. However, as the study uses the capital-asset ratio, it does not capture the role of regulatory pressure.

Some studies focus on both capital regulation and the Basel III liquidity requirements. For instance, Bonner (2016) uses a sample of seventeen Netherlands banks to examine the effect of macro-prudential capital and liquidity regulation on banks' demand for government bonds for the period 2009 to 2012. Further, the study tries to differentiate internal from regulatory effects and investigates whether the regulation compels banks to substitute other types of bonds with government bonds. The study finds that banks constrained by capital or liquidity requirements buy considerably more government bonds compared to unconstrained ones. Moreover, the results reveal a substitution effect, with banks disposing more other bond types while purchasing more government bonds. The above findings by Bonner (2016) are consistent with those of the U.S. Treasury (2011), who report that the demand for treasury bonds increased following the implementation of Basel III liquidity regulation for banks.

Milne (2002) examines the incentive effect of capital requirements on bank portfolio choices. The author shows that in the short run, banks struggling to meet regulatory capital requirements will reduce the holding of high-risk assets while well-capitalised banks face little regulatory pressure in allocating their portfolios. Cummings and Nel (2005) examine the impact of risk-based capital requirements on bank lending and credit growth in South Africa over a period 1991 to 2003. Specifically, the authors intend to assess the effect of risk-weighted capital requirements on the

banks' levels of capital, assets, and on the risk composition of assets. The study finds that banks react to regulatory capital requirements by raising extra capital and reducing lending, thereby shifting to lower risk weighted assets. However, government securities may not be preferred by banks due to various reasons. It is argued that since risk-free securities (such as government securities) have low returns, banks may be motivated to take more risk by providing loans (Rajan, 2005). Fuster and Vickery (2017) also note that investment in government securities can lead to significant interest rate risk exposure as these securities have a longer duration. Thus, studying Indian public sector banks, Ghoshi et al. (2003) report that capital requirements affected the decisions of bank management to participate in risk-taking behaviour. Specifically, the empirical evidence reveals that the banks in that country do not substitute low risk-weighted assets (government securities) for high risk-weighted assets (*e.g.*, loans).

However, it is argued that banks' investments in government securities can be prompted by factors other than capital requirements. For instance, it is argued that some banks will prefer to buy government bonds of lower quality, so as to benefit from preferential regulatory treatment (Korte and Steffen, 2015; Acharya and Steffen 2013). On the other hand, Gennaioli et al. (2014) argue that some banks may hold more government bonds as they offer a reliable source of collateral and liquidity. Moreover, a bank may buy domestic government securities to increase the probability of public support (Farhi and Tirole, 2014).

Generally, as indicated above, empirical findings on the relationship between capital requirements and bank's investment in government securities are inconclusive. It is argued that capital requirements can increase banks' capital ratios, thus enhancing their ability to invest in government securities (Bonner, 2016; Egesa et al., 2015; Korte and Steffen, 2015; Cummings and Nel, 2005).

Moreover, since raising equity capital is costly, particularly in developing economies, banks under higher regulatory pressure to meet capital requirements may opt to shrink or cut the portfolios of their higher risk-weighted assets (loans) and invest more capital in low risk-weights assets such as government securities (Fuster and Vickery, 2018; Kim et al., 2017; Jacques, 2008). Therefore, this study expects capital requirements and banks' investment in government securities to be significantly related.

2.3.4 Simultaneous changes in capital ratios, lending, and investment in government securities

Despite empirical findings being contradictory, the studies discussed above do not test for a simultaneous relationship between changes in bank capital ratios, lending, and investment in government securities. Theoretically, under regulatory pressures to increase capital ratios, banks can mainly adjust their balance sheets by reducing lending (higher risk- weighted assets) and increasing investment in government securities (lower risk-weighted assets), and thus reinstate their capital ratios (Maurin and Toivanen, 2012). Therefore, under capital regulations, there exists a theoretical simultaneous relationship between changes in bank capital ratios, bank lending and bank investment in government securities. In this vein, several studies use simultaneous models to investigate the simultaneous relationship between bank capital ratios and bank behaviour (see, for example, Ashraf et al., 2016; Zhang et al., 2008; Barth et al., 2004; Rime, 2001; and Shrieves and Dahl, 1992).

For instance, Shrieves and Dahl (1992) investigate the simultaneous relationship between changes in capital ratios and risks of the1800 commercial banks and holding companies affiliated with the Federal Deposit Insurance Corporation (FDIC) over the period 1984 to 1986. Employing simultaneous models to analyse adjustments to capital and risk levels, the study finds a positive relationship between changes in capital and asset risk. Similarly, Rime (2001) uses simultaneous models to examine the link between changes in capital and risk of 125 regional, 25 national, and 4 big Swiss banks, for the period 1989 to 1995. The study reports a positive and significant relationship between changes in capital ratio and changes in risk. A study by Ashraf et al. (2016) on 21 Pakistan listed banks from 2005 to 2012 finds that banks adjust their risk portfolio in response to capital regulation. They conclude that the risk-based capital regulation is an important mechanism in decreasing bank asset portfolio risk. However, these studies focus on the simultaneous relationship between changes in capital ratios and risks, and not between changes in capital ratios, lending, and investment in government securities.

Maurin and Toivanen (2012) examine the determinants of banks' target capital ratio, loan policy and securities investment. The study uses a panel dataset of 51 listed banks and country-specific variables (financial markets and macroeconomic indicators) in the euro area (Austria, Belgium, France, Germany, Italy, Portugal, and Spain) over the period 2005 to 2011. Employing the

generalised method of moments (GMM) estimations, the results on the two balance sheet items (total loans and total securities) indicate that the effect of capital is larger on security holdings than on loans. The study shows that undercapitalised banks tend to reduce lending to the economy, as the comparatively higher cost of equity capital results in banks deleveraging to meet target capital ratios; and further that the changes in target capital ratio replicates the changes in risks and earnings of a bank. Unfortunately, the study considers holdings of total securities (securities portfolio), and so does not specifically focus on government securities. Moreover, the study does not test the simultaneous relationship between changes in bank capital ratios, lending, and investment in securities.

In the UK, Francis and Osborne (2012) investigate the available alternative actions banks can take when responding to changes in regulatory capital requirements to attain their internal capital targets. The study uses a comprehensive dataset of all the UK banks' quarterly returns from 1996 to 2007, individual banks' capital requirements, and other balance sheet data. Employing fixed effects panel estimations, the study reports a positive relationship between individual bank's capital requirements and capital ratios. A positive and significant relationship is found between capital regulations and each of the three balance sheet variables (loans, risk-weighted assets, and total assets), indicating that lending and balance sheet growth is higher for banks with capital above the preferred targets. It is further found that as bank capitalisation declines (increases), lending and balance sheet growth falls (increases), respectively. However, the study neither considers investment in government securities, nor examines the simultaneous relationship between changes in capital ratios, loans and other assets.

Gennaioli et al. (2014) study over 20,000 banks in 191 countries over the period from 1998 to 2012 to investigate their holdings of public bonds, and the effect of these bonds on sovereign defaults. They report that banks hold much of public bonds (on a mean of 9% of total assets) - mainly in low financially developed economies. The study also shows that during sovereign defaults, there is a negative association between bond holdings and lending at bank-level. The study further shows that losses on previous government bonds decreases bank capital compelling banks to deleverage, and in turn, this decreases banks' capacity to perform the funding intermediation function for investments.

Using data from 27 public sector banks in India for the period from 1997 to 1999, Ghosh et al. (2003) examine the effect of capital requirements on bank behavior, and also investigate whether, following the introduction of the capital adequacy standards, banks adjust the asset side of their balance sheet, thus substituting less-risky government securities for more risky loans, or alternatively, raise equity capital from the capital market or through retained earnings. They show that adjustments of banks' capital ratios are mainly achieved through improving their capital rather than by substituting high-risk loans with low-risk government securities. Thus, capital requirement is an interesting regulatory mechanism, as it helps to strengthen the stability of the banking sector without distorting the banks' lending decisions.

Minni (2016) uses a simultaneous equations model to examine the causal relationship between bank capital ratios and loan growth of 41 credit institutions in 13 European countries from 2004 to 2013. The study finds that in the loan growth equation, the effect of bank capital ratio on loan growth is negative and statistically significant at a 1% significance level. However, in the capital equation the effect of loan growth on bank capital is found to be not statistically significant. This study focuses only on bank capital and lending, and does not, however, consider investments in government securities.

Using a panel data set of 128 Japanese commercial banks, Ogawa and Imai (2014) investigate the determinants of the demand of commercial banks for Japanese government bonds (JGB). Employing fixed effect models, the study finds that commercial banks with higher price–cost margins for lending (expressed as the ratio of the loan rate to unit lending costs) increase the loans value and reduces government bond holdings. These results indicate that the shift in bank portfolios from lending to government bonds was due to a decrease in the bank's price–cost margin for lending.

In terms of the theoretical and empirical (but contradictory) reviews discussed above, banks can simultaneously adjust their capital ratios, as well as their lending and investment in government securities. Therefore, as hypothesised under Section 2.2 above, this study expects changes in capital ratios, changes in lending, and changes in investment in government securities to be significantly related.

Literature gap

The above studies mostly focus on developed countries, result in contradictory findings, and do not consider the simultaneous relationship between changes in capital ratios and bank lending and investment in government securities. Studies in developing countries are also mixed and do not test the simultaneous link between these variables. For instance, in Tunisia, Bouheni and Rachdi, (2015) report that banks under regulatory pressure reduce their capital ratios. Likewise, Hussain and Hassan (2005) show that banks under capital regulation reduce both their Tier 1 and total capital. However, the study by Saadaoui (2011) in 29 emerging countries finds that banks increase risks to increase capital. In Ghana, Osei-Assibey and Asenso (2015) find that regulatory capital above the required ratio increases credit growth. Surprisingly, in the MENA countries, Bougatef and Mgadmi (2016) show that banks under capital regulation do not adjust their capital to asset risk.

Bouis (2019) examines the link between banks' holdings of domestic sovereign securities and credit growth to the private sector in emerging and developing countries, and finds a negative association between government securities and credit growth, both in emerging and developing economies. The result suggests a rebalancing of banks portfolio towards a more liquid and safer public assets in times of stress. However, the study does not examine the effect of capital regulation. Also, it does not consider the causal relationship between the variables. In contrast, Egesa et al. (2015) finds the impact of capital on investment in government securities to be positive and significant in Uganda (discussed above). However, the study also does not assess the effect of regulatory pressure.

In the context of Tanzania, capital regulatory studies (e.g., Swai, 2019; Lotto, 2018; Malimi, 2017; and Pastory and Mutaju, 2013) also do not investigate the simultaneous relationship between changes in bank capital ratios, lending, and investment in government securities. Specifically, these studies examine the relationship between the capital adequacy and asset quality (Pastory and Mutaju, 2013); the impact of capital adequacy, profitability, and loan growth on non-performing loans (Malimi, 2017); and the effect of regulatory capital requirements on operating efficiency (Lotto, 2018). However, a study in the country that examines the relationship between bank capital regulation and portfolio behaviour is conducted by Swai (2019). The study investigates the effect of the portfolio behaviour on the capital structure of 20 commercial banks in Tanzania over the

period 2002 to 2017. The study measures capital structure as the core capital to average total assets. Portfolio behaviour is defined as the ratios of loans to total assets, government securities investment to total assets, interbank loans to total assets, and earning assets to total assets. Using fixed effect estimations, the study finds all the study variables to be significant (except bank size), indicating a positive effect of portfolio behaviour on capital structure. The study concludes that bank capital structure relies on the method of investment, as well as on the regulatory threshold on non-earning assets. However, the study by Swai (2019) does not use the risk-weighted capital ratio, and does not consider the regulatory pressure nor the simultaneous relationship between bank capital ratios, lending, and investment in government securities.

Thus, studies in Tanzania do not examine the effect of regulatory pressure. As developing countries have less developed capital markets (Griffith-Jones and Tyson (2013), they may face difficulties in implementing the higher capital requirements and thus, according to The Buffer Capital Theory (discussed above), regulatory pressure may have different impacts in these countries. In addition, the studies do not test whether in developing countries like Tanzania, there is a simultaneous link between changes in capital ratios, and bank lending and investment in government securities. Interconnected banking issues should be inseparably assessed for better supervision and regulation (Barth et al., 2004). Thus, there are benefits of probing a range of bank variables simultaneously to recognise those which enjoy a robust and interdependent link.

Therefore, using the risk-weighted capital ratio and a different measure of regulatory pressure (discussed in the methodology section), this study contributes to the literature by testing whether and how regulatory pressure (resulting from egulatory capital requirements) affect changes in bank capital ratios, lending and investment in government securities, with specific reference to Tanzania. Further, using simultaneous models, the study examines the simultaneous relationship between changes in bank capital ratios, lending, and investment in government securities.

Conceptual Framework

Figure 2.1 illustrates the conceptual framework for this study. This study establishes links to test whether and how risk-weighted capital requirements (regulatory pressure) and the control variables relate to bank capital ratios, lending, and investment in government securities. In

modelling the effects of capital requirements on these adjustments, this study takes into consideration the interrelationship between changes in bank capital ratios, lending, and investment in government securities. Bank capital ratios are calculated as the ratio of total capital to risk-weighted assets, where the assets comprise of higher risk-weighted assets such as bank loans and low-risk-weighted assets such as government securities. Thus, banks may respond to capital requirements by investing more in less risky assets (e.g., government securities) or reduce their lending (higher risk-weighted assets), and thus increase risk-weighted capital. Therefore, a simultaneous equations model is employed to examine the interrelationship between bank capital ratios, lending, and investment in government securities. Further, the study also considers whether and how bank capital ratios, lending, and investment in government securities may be influenced by the type of bank ownership.

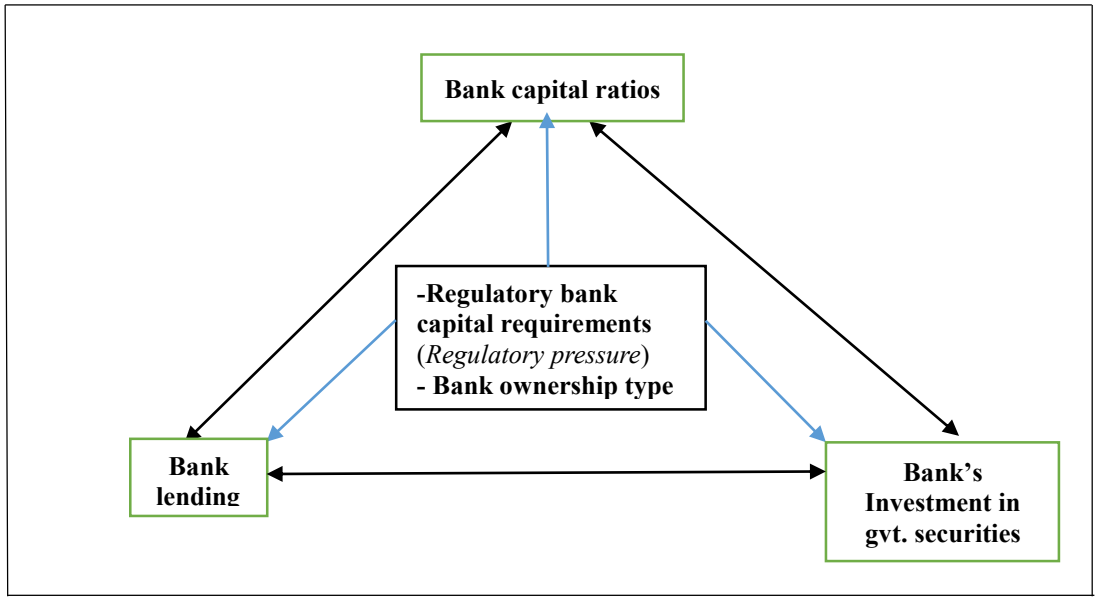

Figure 2-1 Conceptual framework for the relationship between regulatory bank capital requirements and portfolio rebalancing

Source: Author's compilation from the literature

2.4 Data and Methodology

2.4.1 Data

This study uses an unbalanced panel of 57 banks operating in Tanzania, across the period of fifteen years from 2006 to 2020. The study uses multiple sources of data, including the audited annual financial reports published by Tanzanian banks, and Financial Regulations and Guidelines issued by the Bank of Tanzania (BoT). In Tanzania all banks and financial institutions (both public and private) are required to publish their annual financial reports for public consumption (URT, 2014). Data covering 2006 to 2009 are obtained from the Tanzania Banking Sector Performance Review Report published by Ernst and Young in 2010 (also based on the publicly published Tanzanian bank reports). Macro-economic indicators (real interest rates, inflation rates, and annual GDP growth) are obtained from the World Development Indicator database provided by the World Bank.

2.4.2 Study variables and measurements

i) Regulatory pressure (reg)

This study uses regulatory pressure to capture the impact of regulatory capital requirements on changes in bank capital ratios, lending, and investment in government securities. Although this variable is used in other studies to determine the effect of capital requirements on bank behaviour (e.g., Minni, 2016; Van Roy, 2005; Rime, 2001; and Shrieves and Dahl. 1992), most studies employ a dummy variable, 1 for banks holding capital equal or above the regulatory requirements and 0 otherwise. As noted earlier, such an approach may not fully capture the exact variability of different banks' capital ratios. This study measures regulatory pressure as the difference between the regulatory minimum capital requirement and a bank's own capital ratio (i.e. excess capital). This approach allows all banks' own capital ratios to differ across the minimum regulatory capital requirement, thus provide insight as to the role of regulatory influence on both overcapitalised and undercapitalised banks As banks mostly create buffers above the regulatory minimum capital requirement, and that such buffer depends on the variability of a bank's own capital ratio (Van Roy, 2005), excess capital thus helps to evaluate whether and how banks keep their capital ratios above the minimum capital requirement (Osei-Assibey and Asenso, 2015). Although other studies also use excess capital (for example, Osei-Assibey and Asenso, 2015; Alexandre and Bouaiss, 2009; Zhang et al., 2008; Ayuso et al., 2004), they do not focus on the relationship between changes in bank capital ratios, lending, and bank investment in government securities.

This study uses the regulatory requirement of total capital to risk-weighted assets of 8% for the years 2006 to 2008, and 12% for 2009 to 2020 to reflect the Bank of Tanzania (BoT)'s adequacy capital regulations of 2001 and 2008, respectively (URT, 2001, 2008). Regulatory pressure depends on whether a bank holds capital above or below the minimum capital requirement. According to the Buffer Capital Theory, banks with excess capital (with low regulatory pressure) may maintain/reduce their capital ratios or increase their portfolio risk (Rime, 2001). However, undercapitalised banks (with high regulatory pressure) are expected to increase capital ratios or reduce risks to avoid regulatory penalties (Milne and Whalley, 2002; Rime, 2001). For instance, Nachane et al. (2001) and Rime (2001) find a positive effect of regulatory pressure on bank capital ratios. Thus, banks with high regulatory pressure are expected to reduce lending and increase investment in government securities. As noted earlier, as capital requirements can increase funding cost, it may cause lending rates to rise, resulting in reduced lending. It may also compel banks to cut higher risk assets (loans) and increase investment in low-risk assets (government securities).

ii) Bank capital ratio (car)

This study defines bank capital ratio as the ratio of total capital to risk-weighted assets and off-balance sheet exposures, as also defined by others (for example, URT, 2001; BCBS, 2004; BoT, 2008). This is computed as:

$$Car = \frac{Tier\ 1\ capital + Tier\ 2\ capital}{Total\ risk\ weighted\ assets + OBS} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2.1)$$

Where: -

- *Car*- is the bank capital ratio
- *Tier 1* capital comprises of shareholders' equity and disclosed reserves (BCBS, 2004);
- *Tier 2* capital includes undisclosed reserves, revaluation reserves, hybrid capital instruments (such as perpetual preference shares) and subordinated term debt (BCBS, 2004);
- *Total risk-weighted assets* are the sum of asset book value and their related risk weights[10]; and
- *OBS* are off-balance sheet exposures[11]

[10] The Basel Accord assigns risk weight according to the credit risk of an asset, ranging from 0%, 10%, 20%, 50%, to 100%. For instance, it may be computed as, (cash * 0%) + (balances with other banks + interbank loans and receivables * 20%) + (investment in government securities + investment in debt securities * 0%) + (loans, advances and overdrafts * 100%) (Ernst and Young, 2010; BCBS, 1988).

[11] The major components of off-balance sheet items include such items as letters of credit, guarantees and indemnities, undrawn balances of loans, advances and overdraft, and forward exchange bought (BoT, 2016).

iii) Bank lending (lend)

Bank lending is defined as the ratio of total loans to total assets (Swai, 2019; Polat and Al-khalaf, 2014; Van Roy, 2008). As higher lending may be associated with earnings through interest rates, higher ratios may suggest that a bank has informational advantages and low intermediation costs (Dietrich and Wanzenreid, 2011). However, a higher ratio may imply loose lending conditions (Naceur and Omran, 2011; Amidu and Hinson, 2006).

iv) Banks' investment in government securities (inv_gs)

Investment in government securities is measured by a bank's total holding of short-term and long term government securities[12] divided by total assets (Swai, 2019; Gennaioli et al., 2014).

The one-year lagged capital ratio, lagged lending, and lagged investment in government securities are included as explanatory variables to test for their rates of adjustment. They are measured as the magnitude of the coefficient of the lagged values of the capital ratio, lending, and investment in government securities (see, for example, Ding and Sickles, 2019; Minni, 2016; Egesa et al., 2015; Alexandre and Bouaiss, 2009; Zhang, 2008; Van Roy, 2005; Shrieves and Dahl, 1992). This study expects negative coefficients for these variables. It is argued that banks with higher capital ratios, lending and investment in government securities during the previous period will tend to have low adjustment rates in the current period (Berger, 2008; Rime, 2001; Shrieves and Dahl, 1992).

Simultaneous changes in bank capital ratios, lending, and investment in government securities

This study defines changes in capital ratios (*Δcar*), lending (*Δlend),* and investment in government securities (*Δinv_gs*) as the difference between the current and the one-year lagged capital ratio, lending, and investment in government securities, respectively (Minni, 2016; Rime, 2001; Berger et al., 2008; Shrieves and Dahl, 1992). It is expected that the relationship between changes in bank capital ratio and changes in lending will be negative, but positive with changes in investment in government securities. As noted in the literature, to meet capital requirements, a bank may increase its capital ratio by issuing equity, but may pass the cost of equity on to borrowers through higher lending rates, and so decrease loan demand (Slovik and Cournede, 2011). Alternatively, a bank may shrink or cut down lending (higher-risk assets) and so increase its relative holdings of

[12] Government securities include treasury bills, bonds and other government securities (Egesa et al., 2015; Ernst and Young, 2010).

government securities (low risk assets) (Fuster and Vickery, 2018; Kim et al., 2017; Jacques, 2008). Either way, an increase in capital ratio reduces lending and increases holdings of government securities (VanHoose, 2007).

Therefore, from the above arguments, the relationship between changes in lending and investment in government securities is expected to be negative. Gennaioli et al. (2014) show a negative link between bond holdings and bank lending. Changes in lending and investment in government securities are expected to have a negative and positive impact on changes in bank capital ratios, respectively. It was noted above that banks holding more government securities or reduced lending can increase their capital ratios (Fuster and Vickery, 2018; Polat and Al-khalaf, 2014; Abdioglu, 2011; Jacques, 2008). Asymmetric information in developing countries result in more costly lending, causing banks to reduce their capital to increase profits (Polat and Al-khalaf, 2014; Abdioglu, 2011). Moreover, for portfolio rebalancing (see literature review above), changes in investment in government securities and changes in capital ratios can be positively related.

Bank specific variables affecting changes in capital, lending, and investment in gov. securities

As noted earlier, Models (2.8), (2.9), and (2.10) below envisage that changes in capital ratios, lending, and investment in government securities in period t are a function of the target and lagged capital ratios, lending, and investment in government securities, as well as other exogenous shocks. Thus, in this study, return on assets, net interest margin, liquidity, non-performing loans, and bank size are used as bank specific control variables. Several studies have previously used these variables, as indicated below for each of the respective indicators.

i) Return on assets (ROA)

This study defines ROA as the ratio of profit after tax to total assets, similar to prior studies (e.g., Naceur and Kandil, 2009; Rime, 2001) and expects it to have a positive relationship with changes in capital ratios. Profitable banks can build up additional equity capital to safeguard against the possibility of liquidation. In addition, current earnings can improve a bank's capital when it chooses to build up its equity through retained earnings instead of new equity issues (Rime, 2001). However, profitability may also negatively impact capital ratios. This may happen when high profitability is considered as a sign of a low likelihood of failure (Yu, 2000), resulting in bank

management decreasing a bank's capital ratio. Higher profitability may also motivate banks to increase risk-taking (Durand, 2019; Khrawish, 2011), resulting in reduced capital ratios. Berger et al. (2008) find little evidence to support the hypothesis that high profits are the determinant of higher capital ratios, and that banks retain profits rather than paying out dividends. On the other hand, as profitable banks can increase their lending capacity, ROA and lending are expected to be positively related. However, as noted above, pursuit of higher profits may motivate risk-taking, leading to significant provision for loan losses (Durand, 2019; Khrawish, 2011), resulting in lower profits and reduced lending capacity. Thus, the study expects a negative relationship between return on asset and changes in investment in government securities. Higher profitability (especially from lending activities) will favour the issuance of loans compared to investing in government securities, and vice versa (Ogawa and Imai, 2014).

ii) Net interest margin (NIM)

In this study NIM is measured as the ratio of net interest income to total assets (Osei-Assibey and Asenso, 2015; Ahmad et al., 2009; Naceur and Kandil, 2009). It is a profitability indicator which is an indicator of a bank's ability to cover intermediation costs. As banks with higher NIM margins are likely more profitable (Reaz, 2005), they are able to provide loans. Thus, NIM and changes in lending are expected to be positively related. A higher NIM can increase loan supply as this may indicate increased lending practices (Khrawish, 2011). However, as noted above, higher profit motives may lead to higher risk-taking, resulting in increased loan loss provision (Durand, 2019; Khrawish, 2011). This can, in turn, lower bank profits resulting in reduced lending capacity.

iii)Liquidity (LAD)

This study defines bank liquidity (LAD) as the ratio of liquid assets to total deposits, as also defined by other studies (e.g., Roy et al., 2019; Ayaydin and Karakaya, 2014; Ahmad et al., 2009). Theoretically, increased bank liquidity reduces liquidity risk, resulting in a lower liquidity premium on the required rate of return for its shares, thus motivating a bank to increase its equity (Ahmad et al., 2009) and thus, increase its ability to provide loans and buy government securities. Fungacova and Poghosyan (2011) show that the more a bank's demand liabilities are backed by liquid assets, the less it encounters liquidity risk. Also, De Mendonça and de Moraes (2018) argue that the higher the liquidity of bank assets, the less the risk of the assets, and so the higher the

buffer capital. Thus, the variable is also expected to have a positive effect on bank lending and investment in government securities. Bank liquidity can determine a bank's ability to supply loans (Minni, 2016). Moreover, banks with more liquid assets are less likely to suffer a shock (Berger and Bouwman 2009), and thus are able to engage in lending and investment. Studies show that banks with low liquidity cut lending to ensure that their holdings of liquid assets are above severely low levels (Cornett et al. 2011; Kashyap and Stein 2010). According to Kashyap and Stein (2010), in the case of dwindling reserves and/or deposits, more liquid banks can buy securities to fill-up their asset portfolios (such as loans and securities' investment). Therefore, a decline in liquidity can lower bank lending and investment. For instance, a transfer of government deposits from private banks to the Bank of Tanzania in 2016 caused a liquidity shortage in the banking sector, thus affecting loan supply (BoT, 2016).

iv) Non-performing loans (NPL)

In this study, non-performing loans-NPL is measured by the ratio of gross non-performing loans to total loans (Majumder and Li, 2018; Zhang et al., 2013; Ahmad et al., 2009), and is expected to have a negative relationship with changes in bank capital ratios. It is argued that an increase in credit risks could lower the solvency level (capital ratio) of a bank (Sanyal and Shankar (2011), and that higher NPLs may lower bank profitability, resulting in lower retained earnings, which decreases bank capital. On the other hand, a positive relationship can be expected. Under regulatory pressure to meet the risk-weighted capital requirement, banks can simultaneously increase risk taking and capital ratios (Lee and Hsieh, 2013; Rime, 2001; Shrieves and Dahl 1992). Thus, a study by Rime (2001) on Swiss banks finds a positive and significant association between risks and changes in the ratio of capital to total assets. Shrieves and Dahl (1992) also reports a significant and positive relationship between non-performing loans and capital ratios for both the well-capitalised and undercapitalised banks.

The relationship between NPLs and changes in lending is expected to be negative. Higher NPLs are often linked to poor loan management (Barrios and Blanco, 2003). This is because higher NPLs show that a bank is taking more risk in its operations and so is likely to encounter loan defaults (Zhang et al., 2013). Thus, higher NPLs can alert banks to reduce excessive risk in their lending activities (BoT, 2016).

The relationship between NPLs and changes in banks' investment in government securities is expected to be positive. According to the Portfolio rebalancing Hypothesis, higher NPLs can induce banks to invest in low-risk assets, such as government securities (Bouis, 2019). As loan performance deteriorates, banks are likely to invest more in government securities, which offer less risky investment alternatives to safeguard their depositors' funds (Egesa et al., 2015). For instance, Ogawa and Imai (2014) report a positive and significant effect of bank NPLs on Japanese Government Bond holdings for a sample of Japanese banks. Similarly, Bouis (2019) finds a positive relationship between NPL ratios and the banks' holdings of government debt in emerging and developing countries. In Uganda, Egesa et al. (2015) find that worsening loan performance (an increase in loan loss provisioning) caused an increase in investment in government securities.

v) Bank size (size)

This study measures bank size by the natural log of total assets (as per Chronopoulos et al., 2020; Egesa et al., 2015; Ahmad et al., 2009; Francis and Osborne, 2012; and Rime, 2001). Bank size and changes in capital ratios are expected to be positively related. Theoretically, big banks have higher diversification, and more access to investment opportunities, and so they can lower their funding cost and be able raise more equity capital (Ahmad et al., 2009; Rime, 2001; Shrieves and Dahl, 1992). However, as big banks may have many branches and large management teams, bureaucratic decision-making and the "too-big-too-fail" policy may cause larger banks to hold comparatively lower capital (Francis and Osborne, 2012; Ahmad, 2009).

Bank size is expected to have a positive link with changes in lending. Theoretically, larger banks have more assets to extend more loans than small ones (Olszak et al., 2016). Also, big banks can better insulate their lending growth from monetary policy or crisis shocks (Minni, 2016; Olszak et al., 2016). Similarly, bank size is expected to be positively related to changes in bank investment in government securities. Unlike small banks, larger banks are more likely to invest in government securities as they have larger deposits (Egesa et al., 2015). It is argued that government securities, such as treasury bonds, have a longer maturity, thus making it costly for small banks to invest in. The study by Olszak et al. (2016) in 27 EU countries finds the effect of capital ratio on lending to be higher for large and medium size banks than for small banks. Likewise, Ogawa and Imai (2014) find a positive and significant effect of bank size both on loans and bond holdings in Japan.

Macro-economic indicators

i) Real interest rates (rir)

This study includes the real interest rate (RIR) to control for lending interest rates. Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator (Minni, 2016; Gambacorta et al., 2011). As higher interest rates could increase a bank's profitability through the net interest margin (Reaz, 2005), it is expected to be positively related to changes in bank lending. However, the variable may be negatively related to changes in lending. Higher interest rates increase the cost of borrowing, thereby reducing the demand for loans. A study by Minni (2016) in Europe finds that a 1% increase in interest rate results in a 4.21% decrease in lending, controlling for GDP growth. Thus, as higher interest rates are likely to reduce loan demands, they may result in contraction in bank lending (Minni, 2016).

ii) Credit to private sector (cr_gdp)

This study also assesses the effect of credit provided to the private sector on investment in government securities. This variable indicates the size of the domestic credit markets and is measured by the ratio of private credit (provided by banks and other financial institutions) to GDP (Gennaioli et al., 2014; Beck et al. 2000). The study expects a negative relationship between credit to the private sector and changes in investment in government securities. In low financial-developed countries, an increase in credit to the private sector decrease the demand for government securities to hoard liquidity (Bouis, 2019). Some studies also find a negative relationship between credit-to GDP ratios and banks' holdings of government securities (e.g., Bouis, 2019; Dell'Ariccia et al., 2018; and Gennaioli et al., 2018). Examining the link between banks' holdings of domestic sovereign securities and credit growth to the private sector in emerging market and developing economies, Bouis (2019) finds higher credit to the private sector to be linked with a lower banks' holdings of government debt. Similarly, examining over 20,000 banks in 191 countries, Gennaioli et al. (2014) report that higher credit to the private sector is related to a reduction in banks' bond holdings in normal times. However, banks hoard more bonds in periods of default.

iii)Global Financial Crisis (crisis)

This study uses this variable to control for the effect of the 2008 financial crisis on changes in capital ratios, lending, and the investment in government securities of Tanzanian banks. Similar to

prior studies (e.g., Ayaydin and Karakaya, 2014; Ghosh, 2014; Berger and Bouwman, 2013), this study measures crisis by a dummy variable: 1 during the crisis period (i.e. 2007-2009), and 0, otherwise. A negative effect of the crisis on capital ratio is expected. In the crisis period, banks are likely to have higher NPLs, resulting in low profits and so a high cost of rising external capital (Akhigbe et al., 2012; Hanson et al., 2010; Albertazzi and Gambacorta, 2009). On the other hand, lending and investment in government securities are expected to decrease and increase, respectively. During a banking crisis, banks are likely to alter their asset portfolios by reducing their higher risk-assets (loans) (Francis and Osborne, 2012) and so they may shift to low-risk assets (government securities). Thus, Puri et al. (2011) show that German banks affected by the 2008 crisis rejected 11% more loan applications than unaffected ones. In developing countries, the study by, Chiuri et al. (2002) finds that the impact of capital requirements on lending is more adverse if the requirement is effected subsequent to a financial crisis. Gennaioli et al. (2014) argue that in banking crises, government security holdings increases as they are safer.

iv) Inflation rate (inf)

Inflation is calculated as the percentage annual change of consumer prices (Witowschi and Luca, 2016; Francis and Osborne, 2012; Ciarlone et al., 2007). As high inflation raises lending rates and so profits, it may increase bank capital through retained earnings. However, Francis and Osborne (2012) find a negative and significant link between inflation and capital growth. Also, inflation can reduce lending as it causes banks to increase lending rates to offset associated costs (Naceur and Omran, 2011). Inflation and changes in investment in government securities are expected to be negatively related. Higher inflation reflects economic instability, indicating adverse investment avenues. Higher inflation can thus reduce banks' demand for the securities. It may also make it harder to recover debts, so lowering new issues of government securities (Ciarlone et al., 2007).

v) GDP growth (GDP)

In this study, this variable is expressed as an annual GDP growth rate (Majumder and Li, 2018; Witowschi and Luca, 2016; Assibey and Bockarie, 2013; Francis and Osborne, 2012). This study anticipates a positive association between GDP growth and changes in capital ratios. During economic booms, banks increase earnings, so reducing the cost of capital (Francis and Osborne, 2012). A positive relationship between GDP and changes in lending is anticipated. Theoretically,

bank lending should follow business cycles (Gambacorta and Mistrulli, 2004). During cyclical upswings, borrowers' solvency is likely to increase, which eventually could increase loan demand, thus resulting in increased bank lending (Minni, 2016; Gambacorta and Mistrulli, 2004). In terms of investment in government securities, GDP growth is expected to have a negative coefficient. It is argued that during economic downturns, banks are more likely to invest in government securities (Bouis, 2019; Gennaioli et al., 2014; Ciarlone et al., 2007). For instance, Gennaioli et al. (2014) argue that government security holding may decrease with GDP growth.

Bank ownership type (own)

This study defines a bank as foreign if it has foreign ownership component exceeding 50%, and similarly a private-domestic and government bank (BoT, 2016). To examine the effect of bank ownership type on changes in bank capital ratios, bank lending, and bank investment in government securities, the study uses dummy variables which take the value of 1 if a bank is foreign (for), private-domestic (pvt), or government (gov) owned, and 0 otherwise, as also used by other authors (for example, Chronopoulos et al., 2020; Gupta and Mahakud, 2020; Pessarossi and Weill, 2015; Chernykh and Theodossiou, 2011). Unlike locally-owned (private and government) banks in developing countries which could be constrained by weak financial markets (Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002), foreign banks (mainly from developed countries) operating in these countries have greater access to developed financial markets (Claessens et al., 2001), thus, they can raise capital at low cost (Zheng et al., 2017; Admati et al., 2010) and provide more loans and buy government securities (Bonner, 2016; Egesa et al., 2015; Francis and Osborne, 2012) than their domestic counterparts. Also, as noted above, foreign banks can reduce risks and so be stable and endure greater lending (Akhtar et al., 2019; Chernykh and Theodossiou, 2011), as they have better risk management skills (Claessens et al., 2001; Berger, 2000). However, state banks can increase capital as they may have funding support from their governments, and extend more credit to the state, increasing their loan portfolio (Cull and Peria, 2013). Moreover, government banks are expected to increase investment in government securities, similar to prior findings (see, for instance, Becker and Ivashina, 2018; Marco and Macchiavelli, 2016; and Horváth et al., 2015). This could be due to moral suasion, where government banks may be forced to buy government securities, especially as governments can dictate the structure of these banks' security portfolios (Chronopoulos et al., 2020).

Table 2.1 below presents measurements of the study variables, following previous studies.

Table 2-1: Variable Measurements

Variable	Label	Measurement	Reference
Capital requirements (regulatory pressure)	*regu*	The difference between the regulatory minimum capital requirements and a bank's own capital ratio	Osei-Assibey and Asenso (2015)
Bank capital ratio	*car*	The ratio of total capital to risk-weighted assets and off-balance sheet exposures, as also defined by others	URT (2001); BCBS (2004); URT (2008)
Lending	*lend*	The ratio of total loans to total assets	Swai, 2019; Polat and Al-khalaf, 2014; Van Roy, 2008
Investment in government securities	*inv_gs*	The ratio of a bank's total holding of government securities to total assets	Swai (2019); Gennaioli et al. (2014)
Change in capital	*Δcar*	The difference between the current and the one-year lagged capital ratio	Minni (2016); Van Roy (2005); Rime (2001); Berger et al. (2008); Shrieves and Dahl (1992).
Change in lending	*Δlend*	The difference between the current and the one-year lagged lending	Minni (2016)
Change in investment government securities	*Δinv_gs*	The difference between the current and the one-year lagged investment in government securities	The definition takes from the definitions of previous two variables
Lag-capital	*lag_car*	One-year lagged value of capital ratio	Minni, 2016; Zhang (2008); Van Roy (2005); Rime (2001); Shrieves and Dahl (1992)
Lag-lending	*lag_lend*	One-year lagged value of lending	Minni (2016)
Lag-gov securities	*lag_inv_gs*	One-year lagged value of investment in government securities	Egesa et al. (2015); Alexandre and Bouaiss (2009)
Net int margin	*NIM*	The ratio of net interest income to total assets	Osei-Assibey and Asenso (2015); Ahmad et al. (2009); Naceur and Kandil (2009)
Liquidity	*LAD*	The ratio of liquid assets to total deposits	Roy et al. (2019); Ayaydin and Karakaya (2014); Ahmad et al. (2009)
Non-performing loans	*NPL*	The ratio of gross non-performing loans to total loans	Majumder and Li (2018); Zhang et al. (2013); Ahmad et al. (2009)
Bank size	*bank_size*	The natural logarithm of total assets	Chronopoulos et al. (2020); Egesa et al. (2015); Ahmad et al. (2009); Francis and Osborne (2012); Rime (2001)

Real interest rates	*RIR*	An annual change of interest rate (adjusted for inflation)	Minni (2016); Gambacorta et al. (2011)
Credit to private Sector	*cr_gdp*	The ratio of private credit (provided by banks and other financial institutions) to GDP	Gennaioli et al. (2014); Beck et al. (2000)
Crisis	*crisis*	A dummy variable 1 during the crisis period (i.e. 2007-2009), and 0, otherwise	Ayaydin and Karakaya (2014); Ghosh (2014); Berger and Bouwman (2013
Inflation rates	infl	The percentage annual change of consumer prices	Witowschi and Luca (2016); Francis and Osborne (2012); Ciarlone et al. (2007)
GDP growth	*GDP*	An annual GDP growth rate	Majumder and Li (2018); Assibey and Bockarie (2013); Francis and Osborne (2012)
Foreign ownership	for	A dummy variable 1, for a foreign owned bank, and 0 otherwise	Chronopoulos et al. (2020); Pessarossi and Weill (2015); Chernykh and Theodossiou (2011)
Private-domestic ownership	pvt	A dummy variable 1, for a private-domestic owned bank, and 0, otherwise	Chronopoulos et al. (2020)
Government ownership	gvt	A dummy variable 1, for a government owned bank, and 0 otherwise	Gupta and Mahakud (2020); Chernykh and Theodossiou (2011)

Source: Authors' compilation from the literature

2.4.3 Methodology and Empirical Models

This study uses the simultaneous model with partial adjustment framework to investigate how regulatory capital requirement is related to changes in bank capital ratios, lending, and investment in government securities; and further to examine the relationship between changes in bank capital ratios, and their lending and investment in government securities. The model was developed by Shrieves and Dahl (1992) and has been used in several other studies (e.g., Ashraf et al., 2016; Zhang et al., 2008; Barth et al., 2004; Aggarwal and Jacques, 2001; and Rime, 2001) to test the link between changes in capital ratio and changes in bank behaviour, such as risk. However, the current study incorporates bank lending and investment in government securities, which are vital activities to the banking sector and to the economy. The observed changes in the three variables, i.e. bank capital ratios, bank lending, and bank investment in government securities, can be modelled as shown below:

$$\Delta cap_{i,t} = \Delta^d cap_{i,t} + e_{i,t} \ldots\ldots (2.2)$$
$$\Delta lend_{i,t} = \Delta^d lend_{i,t} + s_{i,t} \ldots\ldots (2.3)$$
$$\Delta inv\_gs_{i,t} = \Delta^d inv\_gs_{i,t} + v_{i,t} \ldots\ldots (2.4)$$

Where: $\Delta cap_{i,t}$, $\Delta lend_{i,t}$ and $\Delta inv_{i,t}$, are the observed changes in bank capital ratio, bank lending, and bank investment in government securities (as defined in Section 2.4.1), respectively, for bank *i* in period *t*. $\Delta^d cap_{i,t}$, $\Delta^d lend_{i,t}$ and $\Delta^d inv\_gs_{i,t}$, are discretionary adjustments in capital ratio, lending, and investment in government securities, and $e_{i,t}$, $s_{i,t}$ and $v_{i,t}$ are the exogenous shocks. In addition to discretionary changes in bank capital ratio, lending, and investment in government securities, these variables can be influenced by factors external to the bank. Factors such as adjustment costs and market illiquidity can prevent banks from adjusting instantaneously to achieve desired targets.

Thus, discretionary changes in the variables ($\Delta^d cap_{i,t}$, $\Delta^d lend_{i,t}$ and $\Delta^d inv\_gs_{i,t}$) for bank *i* are relative to the difference between the target (optimal) level in period *t* ($cap^*_{i,t}$, $lend^*_{i,t}$, and $inv^*_{i,t}$) and the observed level in period *t*-1 ($cap_{i,t-1}$, $lend_{i,t-1}$, and $inv\_gs_{i,t-1}$) and are modelled using partial adjustment procedures (see, for example, Aggarwal and Jacques, 2001; Rime, 2001; and Shrieves and Dahl, 1992) as follows:

$$\Delta^d car_{i,t} = \alpha(car^*_{i,t} - car_{i,t-1}) \ldots\ldots (2.5)$$
$$\Delta^d lend_{i,t} = \beta (lend^*_{i,t} - lend_{i,t-1}) \ldots\ldots (2.6)$$
$$\Delta^d inv\_gs_{i,t} = \mu (inv\_gs^*_{i,t} - inv\_gs_{i,t-1}) \ldots\ldots (2.7)$$

where $cap^*_{i,t}$, $lend^*_{i,t}$, and $inv^*_{i,t}$, are the target capital, lending, and investment in government

security for bank i, respectively, and α, β and μ represent the rates of adjustment. Substituting Equations (2.5), (2.6), and (2.7) into Equations (2.2), (2.3), and (2.4), the observed changes in capital ratio ($\Delta car_{i,t}$), lending ($\Delta lend_{i,t}$), and investment in government securities ($\Delta inv\_gs_{i,t}$) can therefore be expressed as follows:

$$\Delta car_{i,t} = \alpha(car^*_{i,t} - car_{i,t-1}) + e_{i,t} \quad (2.8)$$

$$\Delta lend_{i,t} = \beta\,(lend^*_{i,t} - lend_{i,t-1}) + s_{i,t} \quad (2.9)$$

$$\Delta inv\_gs_{i,t} = \mu\,(inv^*_{i,t} - inv_i\_gs_{i,t-1}) + v_{i,t} \quad (2.10)$$

Estimation strategy

The literature above shows that bank capital ratios, lending, and investment in government securities are interrelated and so they can be jointly determined. When variables are jointly determined, they can be estimated by a simultaneous equation model (SEM) (Hill et al. 2011). However, in SEM, a simultaneity bias (a correlation between endogenous variables and error terms) can occur, causing endogeneity issues (Wooldridge, 2015). This can be solved by either the single-equation methods, e.g., the Two Stage Least Squares (2SLS) or the system technique, e.g., the Three-Stage Least Squares (3SLS), in which all equations are estimated simultaneously (Antonakis et al., 2014; Troòj 2012; Coles et al., 2006; Kennedy, 2003; Rime, 2001; Shrieves and Dahl, 1992).

Several studies suggest the use of 2SLS (e.g., Basmann, 1957; Theil, 1953; Shrieves and Dahl, 1992). However, in the two-stage least square (2SLS) method, the variables are regressed against predetermined variables, then the obtained theoretical values are regressed as an ordinary least square (OLS) (Wooldridge, 2008) regression. Therefore, the simultaneous error among the equations is overlooked, and so leads to inefficient estimates. Thus, this study uses the Three-Stage Least Squares (3SLS) estimator, which should result in improved efficient estimates. The 3SLS uses the 2SLS moment matrix to estimate the coefficients of the system simultaneously. In cases where the chosen instruments inadequately predict the endogenous regressor, 3SLS offers more efficient coefficient estimates than 2SLS estimates. However, as the 3SLS cannot correct for heteroscedasticity issues that can affect the standard errors (Hill et al. 2011), this study builds on a 3SLS, with the conditional mixed-process (CMP), which yields heteroscedastic-consistent standard errors (Roodman, 2007). Unlike the least square estimator (LSE), which identifies the

parameters that offer the most precise depiction of the data, CMP is estimated with a maximum–likelihood estimator (MLE) to identify parameters which are most likely to happen (Myung, 2003). Therefore, MLE is suitable in multi-level models such as simultaneous equations (Roodman 2011). The Stata routine *reg3* is implemented as it can estimate a system of structural equations where some equations contain endogenous variables among the explanatory variables (Zellner and Theil, 1962).

Thus, based on the analysis in sub-section 2.4.3 above, the model defined by equations (2.8), (2.9), and (2.10) is specified below (equations 2.11, 2.12, and 2.13):

$$\Delta car_{i,t}=\alpha_0+\alpha_1\Delta lend_{i,t}+\alpha_2\Delta inv\_gs_{i,t}+\alpha_3 reg_{i,t}+\alpha_4 roa+\alpha_5 npl_{i,t}+\alpha_6 size_{i,t}+\alpha_7 crisis_t+\alpha_8 inf_t+\alpha_9 gdp_t-\alpha_{10} car_{i,t-1}+\alpha_{11} own_{i,t}+e_{i,t} \quad (2.11)$$

$$\Delta lend_{i,t}=\beta_0+\beta_1\Delta car_{i,t}+\beta_2\Delta inv\_gs_{i,t}+\beta_3 reg_{i,t}+\beta_4 roa+\beta_5 nim_{i,t}+\beta_6 lad_{i,t}+\beta_7 npl_{i,t}+\beta_8 size_{i,t}+\beta_9 rir_t+\beta_{10} crisis_t+\beta_{11} inf_t+\beta_{12} gdp_t-\beta_{13} lend_{i,t-1}+\beta_{14} own_{i,t}+s_{i,t} \quad (2.12)$$

$$\Delta inv\_gs_{i,t}=\mu_0+\mu_1\Delta car_{i,t}+\mu_2\Delta lend_{i,t}+\mu_3 reg_{i,t}+\mu_4 roa_{i,t}+\mu_5 lad_{i,t}+\mu_6 npl_{i,t}+\mu_7 size_{i,t}+\mu_8 cr\_gdp_t+\mu_9 cisis_t+\mu_{10} inf_t+\mu_{11} gdp_t-\mu_{12} inv\_gs_{i,t-1}+\mu_{13} own_{i,t}+v_{i,t} \quad (2.13)$$

Regression assumptions and diagnostic tests

i) The Durbin–Wu–Hausman (DWH) test for endogeneity

To determine whether estimates obtained by an OLS or 3SLS estimator are consistent or not, this study uses an augmented regression test, a Durbin–Wu–Hausman (DWH) test for endogeneity. This test has a null hypothesis that a vector (*X1),* with one or more variables is not correlated with the error term (μ). While accepting the null suggests both OLS and the 3SLS estimates are consistent, rejecting it indicates that only the 3SLS estimator is consistent, suggesting that *X1* and μ are correlated, and so, *X1* is endogenous (Davidson and MacKinnon, 1993). This study thus tests whether one or more right-hand side variables in an equation may or may not be endogenous. Results in the Appendix Table 2A-2 show that changes in bank capital ratios, lending, and investment in government securities are all significantly correlated with the error term at 1%. Therefore, the results show a rejection of the null hypothesis of no endogeneity and conclude that these variables are endogenous, and therefore the OLS estimates are inconsistent. Thus, 3SLS can give efficient estimation by resolving endogeneity problems (Antonakis et al., 2014; Coles et al.,

2006; Kennedy, 2003). Other studies also use 3SLS estimates to examine the simultaneous models (e.g., Troòj 2012; Rime, 2001).

ii) Identification tests

For a simultaneous equation model (SEM) to be identified, it must satisfy the order and rank conditions (Wooldridge, 2008). If the number of excluded exogenous variables is greater than, or equal to, the number of included endogenous variables in the model, the order condition for identification is satisfied (Wooldridge, 2008). However, the equation is exactly identified or just identified when the number of excluded exogenous variables equals the number of included endogenous variables ($L = M$), and when the number of excluded instruments is less than the endogenous instruments, the model is not identified and it cannot be estimated (Hill et al. 2011). Moreover, while the order condition is a necessary but not adequate condition for identification, the rank condition is a necessary and adequate condition for an identification of the model (Wooldridge 2008). According to Gujarati and Porter (2009), in a model with M equations and m endogenous variables, an equation is said to be identified when at least one non-zero determinant of the order $(M-1)(m-1)$ can be formulated from the variables omitted from that equation but contained in other equations in the model. In other words, an equation is said to be identified if the rank of the matrix in the equation has a rank equal to the number of the included endogenous variables in the equation, less one.

Further, the Hansen-Sargan test, initially proposed by Sargan (1958) in the framework of 2SLS and later expanded by Hansen (1982) to GMM (called Hansen's J statistic), is used to test for over identified restrictions (Wooldridge, 2008). It is a test of the joint null hypothesis that the excluded instruments are valid instruments (that is, uncorrelated with the error term and correctly excluded from the estimated equation) (Baum et al. 2006). A rejection of the null hypothesis of the test implies that one should doubt the validity of the estimates.

iii) F-statistic/Wald test

The F-statistic is used to test whether the independent variables' coefficients are jointly significant in explaining the variables' variations in the model. This test determines the relevance of instruments. The F-statistic/Wald test has the null hypothesis that all instruments are jointly non-

significant. That is, the instruments are weak and irrelevant to the endogenous indicators. The F - test shows a p-value of 0.000, suggesting that the variables indeed have a significant effect.

iv) Autocorrelation and heteroscedasticity tests

In the presence of autocorrelation problems, the estimators remain unbiased and consistent. Serial correlation can thus cause the standard errors of the coefficients to be smaller than they actually are and higher R-squared. To test for the presence of autocorrelation problems, this study uses the Wooldridge test for autocorrelation in panel data. This is the Lagram-Multiplier test for serial correlation, a user-written program available in Stata. The test has the null hypothesis of no first order autocorrelation. Heteroscedasticity problems can arise when estimators are no longer of constant variance. This may affect the standard errors and so the coefficients of the estimates (Hill et al. 2011). This study uses the Breusch-Pagan/Cook-Weisberg Test to test for heteroscedasticity (Shehata, 2011), with a null hypothesis of homoscedastic or constant variance. Rejecting the null hypothesis indicates the presence of heteroscedasticity in the data (Breusch and Pagan, 1979).

2.5 Results and Analysis

2.5.1 Descriptive statistics

Tables 2-2 and 2-3 present the summary statistics and correlation matrix for the variables used in the study, respectively. Overall, the result indicates a very high variability of the study variables. The mean value for the regulatory pressure among Tanzanian banks is -14.56% and the mean score for the lagged capital (Car_{t-1}) is 25.85%. These results indicate that some banks in the country maintained a higher buffer (excess capital) above the BoT regulatory minimum capital requirement of 8% for the years 2006-2008, and 12% for 2009-2016, and so they have less regulatory pressure.

However, the results show a great variability of capital ratios as depicted by the minimum value, maximum value, and the standard deviation of 29.15%, suggesting that across the study period, while some banks are overcapitalised, others are undercapitalised, thus falling below the regulatory threshold. Thus, from Table 2.2 below, the negative[13] sign for the minimum value (-72.37%)

[13] From the study sample, banks with negative capital ratios include: Mbinga Community Bank Ltd, Njombe Community Bank Ltd, and Twiga Bancorp. These banks were much undercapitalised, and were among banks which were closed or merged (between 2017 and 2018) due to undercapitalisation and failure (BoT, 2018).

indicates that some Tanzanian banks are also undercapitalised and so could have higher regulatory pressure. This may be justified by the variability of the regulatory pressure variable, which ranges from -243.88% to 101.39%, with a standard deviation of 31.90%.

From Table 2A-1, foreign banks have the highest mean value of capital ratios (one-year lagged) (29.50%), with the lowest mean regulatory pressure of -19.34%, followed by state banks (22.9%), with the regulatory pressure of -9.60%, and then private-domestic banks with the lowest mean value of capital ratios (21.42%), but having the highest regulatory pressure of -9.42%. This is in line with the theoretical stance that, under regulatory capital requirement, undercapitalised banks are likely to have greater regulatory pressure, and vice-versa (Zhang et al., 2008; Rime, 2001).

Changes in capital ratios (*Δcar*), lending (*Δlend*), and investment in government securities (*Δinv_gs*) have mean scores of -3.71, 1.59, and 0.02, respectively. These indicate that, on average, Tanzanian banks increase their high risk weighted assets (loans) more than they increase their low risk-weighted assets (government securities). A negative value of changes in capital ratios may have been caused by an increase in lending for Tanzanian banks, as also depicted in Table 2.2, which could pull down the mean value for this variables

The mean value for return on assets (ROA) is -0.86%, ranging from -46.44% to 11.78%, with the standard deviation of 6.08%. The net interest margin (NIM) has an overall mean value of 15.34%, ranging from a minimum value of -8.94% to a maximum of 61.16%, with a standard deviation of and 9.09%. The results above suggest that bank profitability (ROA and NIM) varies greatly across Tanzanian banks over the study time. Liquidity ratio has the mean score of 58.38%. The minimum (4.28%) and maximum (595.48%) values of this ratio shows that Tanzanian banks vary greatly in terms of liquidity, as also evidenced by the standard deviation of 57.28. From Table 2A-1, foreign owned banks seem to be more liquid (67.80), followed by government owned banks (53.80), and then private-domestic owned banks (45.883). NPL has the mean score of 6.69%, ranging from 0.0% to 60.36%. However, on average, this ratio is above the country's maximum threshold of five percent (BoT, 2012). In terms of bank size, on average, foreign-owned banks are larger (19.08) than private-domestic owned (18.06) and government owned banks (18.23), as measured by the log of total assets.

In terms of the macro-economic indicators, real interest rate (RIR) displays a mean rate of 7.95%, with a minimum score of -1.20%, and a maximum value of 16.28%. While the minimum rate was in 2008, the maximum was in 2020, possibly due to the 2008 Global Financial Crisis and the Covid-19 pandemic, respectively. The result for credit to the private sector *(cr_gdp)* shows a mean value of 12.59%, ranging from a minimum value of 9.79% to a maximum score of 14.61%. While *cr_gdp* has the lowest value in 2006 (9.79%), it recorded the highest score in 2015 (14.61%). The standard deviation of 1.08% suggests a moderate variation of this indicator during the sample period. The mean value for inflation rate was 7.58%, with the lowest rate (3.29%) in 2016 and the highest rate (16.0%) in 2012. However, the rate rose to 12.14 % in 2009, from 7.0% in 2007. The mean score for a country's GDP growth rate is 6.41%, rising to 8.5% in 2007, from 4.7% in 2006. However, it decreased to 4.8 in 2020, probably due to the effect of the Covid-19 global pandemic.

Table 2-2: Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Med	Percentiles			
							5th	25th	75th	95th
Regulatory pressure (regu)	611	-14.563	31.853	-243.885	101.388	-8	-54.748	-17	-2.474	4.174
Change in capital (Δcar)	554	-3.714	17.224	-121.879	83.973	-0.896	-29	-5.382	2.16	11.486
Change in lending (Δlend)	554	1.59	10.725	-44.267	63	0.712	-14	-3.684	5.816	20
Change in gov sec (Δinv_gs)	554	-0.023	7.377	-32.725	27.92	0	-12.197	-2.473	2.586	11.966
Car_{t-1} (lag_car)	554	25.845	29.145	-72.371	254.252	19	7.853	14.392	28	69
$Lend_{t-1}$ (lag_lend)	554	50.282	15.027	0	87.204	51.786	21	42.944	60	72.211
Inv_gs_{t-1} (lag_inv_gs)	554	12.212	11.291	0	63.7	11.730	0	0	18.916	31.672
Return on assets (ROA)	611	-0.861	6.075	-46.437	11.779	0.971	-13.071	-1.295	2.1	3.408
Net interest margin (NIM)	611	15.336	9.09	-8.937	61.161	12.949	5.391	9.921	18.634	33.529
Liquidity (lad)	611	58.377	57.277	4.275	595.484	49.491	22.477	39.414	64	95
Non-perf. loans (NPLs)	611	6.698	8.978	0	60.362	4.164	0	0	8.513	26.049
Bank size (bank_size)	611	18.612	1.911	12.388	22.683	18.875	15.215	17.484	19.986	21.254
Real int rate (RIR)	611	7.946	4.576	-1.202	16.28	7.896	-1.202	4.675	9.656	16.279
Credit to pvt sector (cr_gdp)	15	12.592	1.084	9.79	14.614	12.7	9.79	11.911	13.164	14.614
Crisis (crisis)	15	0.173	.379	0	1	0	0	0	0	1
Inflation (infl)	15	7.584	3.672	3.29	16.001	6.2	3.29	5.175	10.278	16.001
GDP growth (GDP)	15	6.414	1.008	4.7	8.5	6.7	4.7	5.6	6.9	8.5

Table 2-3 below shows the association between the dependent and independent variables. Multicollinearity problems can exist if the independent variables co-vary, making it difficult to assess the significance of separate variables. Existence of multicollinearity can also inflate the standard errors and confidence intervals (Field, 2009). In more serious incidences of perfect correlations between regressor variables, multi-collinearity can suggest that a distinctive least squares regression model cannot be computed (Field, 2009). This study thus tests multicollinearity of the data using correlation analysis.

The results of correlation analysis (Table 2-3) show that regulatory pressure (*regu*) is positively and significant correlated with lagged lending, non-performing loans, bank size, real interest rates, credit to the private sector, and the private-domestic ownership. However, it is negatively and significantly correlated with changes in lending, changes in investment in government securities, lagged capital ratios, lagged investment in government securities, net interest margin, liquidity, crisis, and the foreign ownership. While changes in capital is positively and significantly correlated with changes in lending, lagged lending, return on asset, non-performing loan, and bank size, it is negatively and significantly correlated with changes in lending, the lagged capital ratio, and net interest margin.

Changes in lending is significantly and positively correlated with net interest margin and inflation. However, it is negatively and significantly correlated with changes in investment in government securities, lagged lending, bank size, NPLs, and real interest rates. A coefficient of -0.735 between regulatory pressure (*regu*) and lagged capital (*l.car*) could be because these variables are derived from the same variable (capital ratio), thus they share most of their data. While changes in investment is positive and significant correlated with lagged lending, liquidity, and NPL, it is negatively and significant correlated with the lagged investment in government securities. However, multicollinearity becomes an issue of concern if the correlation coefficient is above 0.8 (Kennedy, 2003).

Table 2-3: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
(1) Regu	1.000																			
(2) Δcar	-0.020	1.000																		
(3) Δ lend	-0.129*	-0.367*	1.000																	
(4) Δinv_gs	-0.080*	0.101*	-0.176*	1.000																
(5) L.car	-0.735*	-0.625*	0.318*	-0.021	1.000															
(6) L.lend	0.399*	0.326*	-0.529*	0.076*	-0.491*	1.000														
(7) L.inv_gs	-0.263*	0.017	0.060	-0.366*	0.182*	-0.364*	1.000													
(8) ROA	-0.029	0.343*	-0.026	-0.002	-0.052	0.059	0.178*	1.000												
(9) NIM	-0.370*	-0.120*	0.106*	0.030	0.344*	-0.189*	-0.044	-0.085*	1.000											
(10) LAD	-0.693*	-0.065	-0.015	0.102*	0.600*	-0.472*	0.357*	-0.077*	0.227*	1.000										
(11) NPL	0.163*	0.072*	-0.172*	0.102*	-0.141*	0.105*	-0.010	-0.103*	-0.071*	-0.093*	1.000									
(12) Size	0.119*	0.216*	-0.124*	-0.015	-0.120*	0.032	0.429*	0.430*	-0.314*	-0.072*	0.092*	1.000								
(13) RIR	0.052	0.032	-0.181*	0.060	-0.020	0.157*	0.078*	-0.026	-0.083*	0.015	0.264*	0.279*	1.000							
(14) cr_gdp	0.101*	0.062	-0.065	0.005	-0.110*	0.212*	-0.099*	-0.116*	-0.100*	-0.074*	0.091*	0.165*	0.253*	1.000						
(15) Crisis	-0.092*	0.014	0.006	-0.024	0.050	-0.122*	0.087*	0.117*	0.122*	0.094*	-0.118*	-0.153*	-0.439*	-0.444*	1.000					
(16) Infl	-0.043	-0.060	0.184*	-0.044	0.051	-0.133*	-0.070*	0.023	0.066	-0.015	-0.211*	-0.211*	-0.720*	-0.286*	0.293*	1.000				
(17) GDP	0.017	-0.013	0.008	0.031	-0.049	-0.017	-0.003	-0.003	0.019	-0.053	0.115*	0.026	-0.041	0.158*	0.008	-0.212*	1.000			
(18) Foreign	-0.155*	0.0067	-0.030	0.033	0.131*	-0.218*	0.313*	0.035	-0.093*	0.170*	0.065	0.254*	0.120*	0.013	-0.032	-0.086*	0.004	1.000		
(19)Private	0.114*	0.009	0.027	-0.006	-0.107*	0.156*	-0.321*	-0.002	0.049	-0.155*	-0.076*	-0.204*	-0.098*	-0.000	0.015	0.071*	0.001	0.730*	1.000	
(20) Govt	0.066	-0.021	0.007	-0.038	-0.043	0.099*	-0.015	-0.046	0.066	-0.034	0.008	-0.085*	-0.038	-0.017	0.025	0.027	-0.007	0.434*	0.298*	1.000

**** p<0.01, ** p<0.05, * p<0.1*

2.5.2 Regression results

This section presents the estimation results as shown in Table 2-4 and Table 2-5 below. Before presenting the results, the results of the pre- and post-diagnostic tests (which were discussed in detail under Section 2.4.3), are explained here. Over identifying restrictions are checked using the Hansen-Sargan test, which has the joint null hypothesis that the excluded instruments are valid instruments (Wooldridge, 2008). The Hansen-Sargan test for over identifying restrictions has a p-value of 0.126 on the 3SLS estimate (see Appendix Table 2A-4), suggesting that the results fail to reject the null hypothesis and thus conclude that the instruments are valid. In addition, the rank condition is examined, which is a necessary and an adequate condition for an identification of the model (Wooldridge, 2008). The results show that all three equations of the study are identified, indicating that the rank condition for the models is satisfied (see Appendix Table 2A-3).

To test whether the independent variables' coefficients are jointly significant in explaining the variables' variations, the Wald/F-statistic test, which has the null hypothesis that all instruments are jointly non-significant, is employed. The results (Table 2-4 and Table 2-5) show a rejection of the null hypotheses, suggesting that the independent variables are jointly significant. As regard autocorrelation problems, the study employs the Wooldridge Test for autocorrelation in panel data which has the null hypothesis of no serial correlation. The results indicate a rejection of the null hypotheses for all the models of this study, suggesting the presence of first order autocorrelation.

Overall system heteroscedasticity is checked for using the Breusch-Pagan LM Test which has the null hypothesis of homoscedastic or constant variance (Shehata, 2011). The results for the 3SLS Model reject the null-hypothesis of no overall system heteroscedasticity, indicating the presence of heteroskedasticity (see Appendix Table 2A-5). Therefore, as explained above, a 3SLS estimated by the conditional mixed-process (CMP) is added, a technique advocated by Roodman (2007) to estimate heteroscedastic-consistent standard errors (see Section 2.4 above).

Further, scatter graphs were used to check for outliers (Fig 2B-5). Moreover, as an additional check, all the variables except the macro-economic ones were winsorised at 5% (i.e., 2.5% each side). The results presented in Table 2A-6 indicate no significant difference from the results of the analysis using actual (non-winsorised) data.

Table 2-4: Simultaneous models estimates- capital, lending, and investment (3SLS and CMP)

	3sls			CMP		
Dependent variables →	**Δcar**	**Δlend**	**Δinv_gs**	**Δcar**	**Δlend**	**Δinv_gs**
↓ *Independent variables*	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Regulatory pressure	-0.6606***	-0.0854***	0.0042	-0.6595***	-0.0861***	0.0053
	(0.0160)	(0.0190)	(0.0166)	(0.1653)	(0.0264)	(0.0206)
Change in capital		-0.1586***	0.0894***		-0.1597***	0.0903**
		(0.0240)	(0.0235)		(0.0366)	(0.0451)
Change in lending	-0.2720***		0.0948	-0.2781*		0.0985
	(0.0433)		(0.0576)	(0.1465)		(0.0819)
Change in gov sec	0.1168*	0.0762		0.1249	0.0851	
	(0.0686)	(0.0983)		(0.0982)	(0.1168)	
Lag-capital	-0.7458***			-0.7444***		
	(0.0146)			(0.1244)		
Lag-lending		-0.4021***			-0.3999***	
		(0.0280)			(0.0563)	
Lag-gov securities			-0.3645***			-0.3625***
			(0.0300)			(0.0432)
ROA	0.3410***	0.2328***	-0.1000*	0.3418*	0.2322***	-0.0998
	(0.0478)	(0.0694)	(0.0583)	(0.1861)	(0.0834)	(0.0850)
Net int margin (NIM)		0.0254			0.0248	
		(0.0403)			(0.0508)	
Liquidity		-0.1269***	0.0657***		-0.1272***	0.0663***
		(0.0122)	(0.0104)		(0.0416)	(0.0122)
Non-perf. loans	-0.0077	-0.0943**	0.0813**	-0.0092	-0.0951**	0.0816**
	(0.0290)	(0.0404)	(0.0337)	(0.0286)	(0.0405)	(0.0385)
Bank size	-0.1613	-0.4907**	0.8462***	-0.1626	-0.4871**	0.8402***
	(0.1530)	(0.2236)	(0.2002)	(0.1385)	(0.2364)	(0.2179)
Real int. rates		0.9297			0.9194**	
		(0.7815)			(0.4506)	
Credit to pvt. sector			-0.6987			-0.7631
			(1.5145)			(0.7508)
Crisis	-2.5418	-3.3151	-2.5811	-2.5537	-3.3124	-2.5754
	(2.9191)	(4.6514)	(3.4163)	(1.6734)	(2.5679)	(1.9348)
Inflation rates	0.2016	0.0185	-0.3375	0.2006	0.0157	-0.3339
	(0.3768)	(0.6777)	(0.4380)	(0.2133)	(0.4395)	(0.3538)
GDP growth	-0.7739	-0.4164	2.4341*	-0.8035	-0.4542	2.4434**
	(1.2038)	(1.9277)	(1.3956)	(0.6268)	(0.9198)	(0.9505)
Constant	16.4276**	23.5890	-18.0023	16.5874***	23.7910*	-17.1425
	(7.1532)	(21.1604)	(21.9978)	(4.1364)	(12.6085)	(12.5659)
R-squared	0.8992	0.4822	0.2464	N/A	N/A	N/A
Prob > chi2	0.000	0.000	0.000	0.000	0.000	0.000
Observations	554	554	554	554	554	554
No. of banks	57	57	57	57	57	57

*Standard errors (robust for CMP) are in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Table 2-4 presents estimates of effect of regulatory pressure (caused by regulatory bank capital requirements), on changes in bank capital ratios, lending, and investment in government securities. The three dependent variables are changes in capital ratios, lending, and investment in government securities. Several estimations are performed. The first three columns present the three stage least squares (3SLS) estimates, and the last three columns show conditional mixed-processes (CMP) estimates (with the corrected standard errors).

Impact of regulatory pressures on changes in capital ratios, lending, and government securities

The results show a negative and significant relationship between regulatory pressure and changes in bank capital ratios for both the 3SLS (Model 1) and CMP (Model 4) estimates. For instance, holding other variables constant, a 1-percentage point increase in regulatory pressure is related to 66.06-percentage point decline in changes in bank capital ratios as shown in Columns 1 and 4, estimated by 3SLS and CMP, respectively. Similar observations were made by prior studies (e.g., Ding and Sickles, 2019; Minni, 2016; Ahmad et al., 2009). Thus, Tanzanian banks with higher regulatory pressure (which increases for banks with capital ratios below the minimum regulatory requirement or those with low excess capital) decrease their capital adjustment. For instance, this could save to explain as to why, following an increase in the minimum core capital to TZS (Tanzanian shillings) 15 billion From TZS 5 billion, the BoT closed five banks at the same time and put three banks on the watch list due to under-capitalisation and failure (BoT, 2018).

Consistency with hypothesis 2B, regulatory pressure and change in lending are negatively and significantly related (Models 2 and 5). For instance, other variables being constant, a 1-percentage point increase in regulatory pressure is related to an 8.5 and 8.6-percentage point decline in changes in lending in Columns 2 and 5, estimated by 3SLS and CMP models, respectively. These results suggest that Tanzanian banks with high regulatory pressure are likely to lower adjustments in high risk assets (e.g., loans). However, several studies find similar results (e.g., Catalan et al., 2017; Minni, 2016; Bridges et al., 2014; Assibey and Bockarie, 2013; Peek and Rosengren, 2000). This result conforms to the theoretical arguments discussed above that, since raising equity capital may be costly, particularly in less developed capital markets, due to information asymmetry and market imperfection (Baker and Wurgler, 2015; Ibrahim et al., 2012; Bolton and Freixas, 2006), these costs can be passed on to borrowers through higher lending rates or tighter lending standards, which may finally reduce bank lending (Francis and Osborne, 2012; Ibrahim et al., 2012).

Regulatory pressure and changes in investment in government securities have an expected positive relationship for both the 3SLS (Model 3) and CMP (Model 6) models, but it is non-significant. The positive coefficients conform to the theoretical arguments discussed above that banks may respond to the regulatory capital requirements by increasing their adjustments in less risky assets (e.g., government securities) or reduce those in higher risky assets (e.g., loans), and so increase risk-weighted capital ratios (Fuster and Vickery, 2018; Jacques, 2008), as they rebalance their portfolios towards low-risk assets (Bouis, 2019). However, the non-significant results may suggest that most government banks hold government securities at their nearest minimum, therefore there is less room for any significant change. Less developed security markets in Tanzania, like in other low developed countries, may result in regulatory pressure being less likely to influence banks to increase their government securities. In this vein, Ghosh et al. (2003) find that capital regulations in India do not influence bank decisions to buy low-risk government securities.

Simultaneous changes in bank capital ratios, lending, and investment in government securities

In the changes in capital equations (Models 1 and 4), changes in lending and in investment in government securities have a significant negative and positive link with changes in capital ratios, respectively. Thus, as expected, a change in lending results to a negative change in capital ratio for Tanzanian banks. This is consistent with the theoretical argument that a bank with more risky assets is expected to lower its capital ratios (Milne, 2002). In addition, Bank lending in Tanzania could be costly. Higher asymmetric information in developing countries increases lending costs, causing banks to lower their capital ratios (Polat and Al-khalaf, 2014; Abdioglu, 2011).

While a positive changes in higher risky assets (loans) leads to a negative changes in capital ratios, a positive changes in lower risk assets (government securities) results in a positive changes in capital ratios. Therefore, as government securities are less risky assets, their increase facilitates a switching regime from higher risk-weighted assets (such as loans), thus increasing adjustments in banks capital ratios. These results suggest that, under regulatory pressure to increase capital ratios, banks can be prompted to reduce their adjustments in higher risky assets (e.g., loans) and increase that in less risky assets. Theoretically, this could reflect a rebalancing of banks' portfolio towards lower risky assets (Juelsrud and Wold, 2020; Bouis, 2019).

Second, for the changes in lending equations (Models 2 and 5), while changes in capital ratios have a negative and statistically significant relationship with changes in lending (Columns 2 and 5), changes in investment in government securities have a positive and non-significant relationship with changes in lending for both models (Columns 3 and 6). The results indicate that, similar to the above findings, Tanzanian banks struggling to increase adjustments in capital ratios will reduce their higher risky assets, such as loans. Similar observations were made by Minni (2016) in thirteen European countries from 2004 to 2013, where the effect of bank capital ratio on loan growth was found to be negative and statistically significant.

Thirdly, for the changes in government securities' investment equations (Columns 3 and 6), changes in capital ratios have a significant positive relationship with changes in investment in government securities. As expected, this shows that greater adjustments in capital ratios could result in higher changes in government securities for Tanzanian banks. Other previous studies find a positive link between bank capital and government securities (e.g., Egesa et al., 2015; Maurin and Toivanen, 2012). However, changes in lending have positive and statistically non-significant coefficients. Interestingly, as Maurin and Toivanen (2012) find, the impact of changes in capital ratio is larger on changes in government security investment (0.0894) than on lending (-0.1586).

Results on bank specific and macro-economic variables

The lagged values of capital ratios, lending, and investment in government securities are negative and significant, with coefficients of magnitude 74.58%, 40.20%, and 36.45%, respectively. These results suggest that, if the past value of these indicators were low, then their value should be higher in the next period, and if the previous value was high, the value is lower in the next period. This is consistent with the idea that if, for example, a bank's capital ratio is lower, then it has to increase it to meet the regulatory requirements (Maurin and, 2012; Rime, 2001; Shrieves and Dahl, 1992). The results are similar to previous findings (see, for example, Van Roy 2005; Rime, 2001; Shrieves and Dahl, 1992). For instance, in Switzerland, Rime (2001) finds negative and significant coefficients, with the magnitude of 12% and 15% for the probabilistic and prompt collective action measures of regulatory pressure, respectively. In six G-10 countries, Van Roy (2005) finds negative and significant results on all sample categories. Using spatial fixed effect and GMM fixed effects estimates on a large sample of U.S. banks, Ding and Sickles (2019) find negative and statistically

significant results. In the euro area, Maurin and Toivanen (2012) find non-significant negative coefficients, namely, -31% and -41% for the lagged net loans and securities, respectively (see details in Section 2.3).

As expected, return on asset (ROA) has a positive and statistically significant relationship with changes in capital ratios (Columns 1 and 4). It was noted above that profitable banks can build up additional equity capital to safeguard against the possibility of liquidation. Moreover, current earnings can improve a bank's capital when it chooses to build up its equity through retained earnings instead of new equity issues (Rime, 2001). Similarly, ROA has an expected positive and statistically significant relationship with changes in lending (Columns 2 and 5). This result shows that Tanzanian banks with higher profit have greater adjustments in lending. As noted above, profitable banks have greater lending capacity. However, the link between the return on asset (ROA) and changes in government securities is negative for all models, being significant for Model 3. As noted above, higher profitability (especially from lending activities) will favour the issuance of loans compared to investing in government securities, and vice versa (Ogawa and Imai, 2014).

Net interest margin (NIM) and changes in lending are positively but non-statistically significantly related (Models 2 and 5). As discussed above, the positive sign may indicate that banks with higher NIM margins are likely to be more profitable (Reaz, 2005) and thus they can increase their adjustment in bank lending. Also, a higher NIM can increase loan supply as this may indicate increased lending practices (Khrawish, 2011).

Liquidity (LAD) has a negative and statistically significant relationship with changes in lending for both models (Columns 2 and 5). This result may indicate that Tanzanian banks under regulatory pressure retain liquidity for protective motives rather than increase their lending (Cantero-Saiz et al., 2014). As expected, liquidity has a positive and significant link with changes in investment in government securities, conforming to the theoretical view above, and is in line with other findings (e.g., Minni, 2016; and Ehrman et al., 2001).

Non-performing loans (NPLs) and changes in lending have a negative and statistically significant relationship for all the 3SLS and CMP models. It was discussed above that, as higher NPLs are often linked to poor loan management (Barrios and Blanco, 2003), higher NPLs can alert banks to reduce excessive risky lending (BoT, 2016). On the other hand, the relationship between NPLs and changes in investment in government securities is positive and statistically significant, suggesting that Tanzanian banks with higher NPLs may be induced to invest in low-risk assets, such as government securities. This finding is similar to previous results (see, for example, Bouis, 2019; Egesa et al., 2015; Ogawa and Imai, 2014) and conforms to the portfolio rebalancing hypothesis' argument that, as loan performance deteriorates, banks are likely to invest more in government securities, which offer less risky investment alternatives to safeguard their depositors' funds (Bouis, 2019; Egesa et al., 2015).

Bank size enters the regressions with a negative coefficient for all changes in capital and lending models, being significant for the changes in lending models. Studying Swiss banks, Rime (2001) reports a negative and significant link between bank size and capital. The negative and significant link with changes in lending (Columns 2 and 5) indicates that as total asset increases, lending adjustments reduces for Tanzanian banks. This could be that big banks have high interest expenses as they may borrow much to finance growth, thus reduce their lending capacity. Large banks may also have many branches and large management teams, thus being bureaucratic in decision-making (Francis and Osborne, 2012; Ahmad, 2009) which could potentially affect their lending decisions.

However, bank size and changes in investment in government securities have a positive and statistically significant relationship for both models (column 3 and 6). The results conform to the theoretical grounds discussed above that larger banks are more likely to invest in government securities as they have larger deposits (Egesa et al., 2015). It is argued that government securities, such as treasury bonds, have a longer maturity, thus making it costly for small banks to invest in. These results are similar to other findings (e.g., Olszak et al., 2016; Ogawa and Imai, 2014). Olszak et al. (2016) report the effect of capital ratio on lending to be higher for large and medium size banks than for small banks. Similarly, Ogawa and Imai (2014) find a positive and significant effect of bank size both on loans and bond holdings in Japan.

Table 2-4 presents the relationship between macro-economic variables and changes in capital ratios, lending, and investment in government securities. Real interest rate is positive but non-statistically significantly related to changes in lending. The positive relationship may suggest that higher rates of interest can motivate banks to increase their lending activities. It is argued that, as an increase in interest rates could increase a bank's profitability through net interest margin (Reaz, 2005) and so, in turn, profitability may result in higher changes bank lending.

The link between credit to the private sector and changes in investment in government securities is negative and statistically non-significant both for the 3SLS estimates, and CMP estimates. Thus, the expected negative coefficient result is similar to prior findings (e.g., Bouis, 2019; Dell'Ariccia et al., 2018; and Gennaioli et al., 2018). In less developed capital markets like Tanzania, greater credit extension to the private sector can reduce banks' demand for government securities.

The Global Financial Crisis enters the regressions with negative but non-statistically significant coefficients for all the changes in capital ratios, lending, and investment in government securities models (Columns 1, 2, 3, 4, 5 and 6). Theoretically, the negative coefficient with changes in capital ratio may be explained that, in the crisis period, banks are likely to have higher NPLs, resulting in low profitability and thus a high cost of rising external capital (Akhigbe et al., 2012; Hanson et al., 2010; Albertazzi and Gambacorta, 2009). On the other hand, an expected negative coefficient with changes in lending may suggest that, during a banking crisis, banks are likely to reduce their risk-assets, such as loans (see, for example, Gennaioli et al., 2014; Francis and Osborne, 2012; Puri et al., 2011; and Chiuri et al., 2002). However, the results show non-statistically significant coefficients, and therefore signifies only weak evidence in this respect.

GDP growth and changes in investment in government securities are positive and significantly related (Models 3 and 6). During economic booms, banks increase earnings (Francis and Osborne, 2012), thus increasing their capacity to buy government securities. However, GDP growth has negative but non-significant coefficients in all the changes in capital and lending models. The negative sign suggests that as economic booms improves the business environment, it may increase bank competition (Tan and Floros, 2012), thus lower capital and lending. Francis and Osborne (2012) also find a non-significant link between GDP growth and capital ratios for UK banks.

Effect of ownership types on changes in bank capital ratios, lending, and investment in government securities

Table 2-5 presents the three-stage least square (3SLS) estimates, including bank ownership types. Ownership dummies for foreign banks (Columns 1, 2, and 3), private-domestic banks (Columns 4, 5, and 6), and government banks (Columns 7, 8, and 9), are added to the regressions to test their effect on changes in bank capital ratios, lending, and investment in government securities. As can be seen in Table 2-5, the results for all other variables maintain the same sign as presented in Table 2-4. Thus, this section only focuses on the results of the bank ownership types.

Table 2-5: Model extension- estimates with ownership types

Dependent Variables→	***Δcar***	***Δlend***	***Δinv_gs***	***Δcar***	***Δlend***	***Δinv_gs***	***Δcar***	***Δlend***	***Δinv_gs***
↓ Independent variables	***(1)***	***(2)***	***(3)***	***(4)***	***(5)***	***(6)***	***(7)***	***(8)***	***(9)***
Regu	-0.6615***	-0.0880***	0.0042	-0.6607***	-0.0861***	0.0047	-0.6609***	-0.0863***	0.0044
	(0.0159)	(0.0190)	(0.0165)	(0.0160)	(0.0190)	(0.0165)	(0.0160)	(0.0190)	(0.0165)
Δcar		-0.1553***	0.0861***		-0.1567***	0.0892***		-0.1585***	0.0893***
		(0.0237)	(0.0232)		(0.0238)	(0.0234)		(0.0240)	(0.0234)
Δlend	-0.2694***		0.0801	-0.2714***		0.0916	-0.2698***		0.0941
	(0.0429)		(0.0565)	(0.0432)		(0.0572)	(0.0431)		(0.0573)
Δinv_gs	0.1097	0.0456		0.1138*	0.0497		0.1194*	0.0893	
	(0.0678)	(0.0961)		(0.0676)	(0.0962)		(0.0688)	(0.0987)	
Car_{t-1}	-0.7466***			-0.7461***			-0.7460***		
	(0.0145)			(0.0146)			(0.0146)		
$Lend_{t-1}$		-0.4108***			-0.4041***			-0.4064***	
		(0.0281)			(0.0279)			(0.0281)	
Inv_gs_{t-1}			-0.3749***			-0.3797***			-0.3641***
			(0.0302)			(0.0306)			(0.0301)
ROA	0.3404***	0.2200***	-0.0875	0.3421***	0.2247***	-0.0887	0.3409***	0.2347***	-0.0998*
	(0.0479)	(0.0690)	(0.0579)	(0.0480)	(0.0693)	(0.0582)	(0.0478)	(0.0694)	(0.0583)
Net int margin (NIM)		0.0155			0.0233			0.0203	
		(0.0407)			(0.0405)			(0.0404)	
Liquidity		-0.1238***	0.0626***		-0.1249***	0.0642***		-0.1272***	0.0657***
		(0.0121)	(0.0104)		(0.0121)	(0.0104)		(0.0122)	(0.0104)
NPLs	-0.0067	-0.0874**	0.0762**	-0.0078	-0.0894**	0.0763**	-0.0078	-0.0960**	0.0812**
	(0.0289)	(0.0400)	(0.0334)	(0.0290)	(0.0402)	(0.0335)	(0.0290)	(0.0404)	(0.0337)
Bank size	-0.1596	-0.3996*	0.7692***	-0.1690	-0.4504**	0.8030***	-0.1562	-0.4780**	0.8425***
	(0.1579)	(0.2267)	(0.2006)	(0.1564)	(0.2262)	(0.1998)	(0.1534)	(0.2238)	(0.2009)
Real int. rates		0.9551			0.9453			0.9332	
		(0.7818)			(0.7821)			(0.7810)	
Cr_GDP			-0.4986			-0.5163			-0.7165
			(1.5173)			(1.5128)			(1.5113)
Crisis	-2.5538	-3.3539	-2.5700	-2.5452	-3.4094	-2.4422	-2.5105	-3.1920	-2.5949
	(2.9094)	(4.6198)	(3.3855)	(2.9155)	(4.6339)	(3.3970)	(2.9183)	(4.6517)	(3.4149)
Inflation	0.2007	0.0225	-0.3495	0.2006	0.0207	-0.3485	0.2030	0.0211	-0.3371
	(0.3756)	(0.6741)	(0.4340)	(0.3763)	(0.6758)	(0.4354)	(0.3767)	(0.6775)	(0.4379)
GDP growth	-0.7540	-0.3313	2.4333*	-0.7647	-0.3411	2.4402*	-0.7786	-0.4489	2.4344*
	(1.1996)	(1.9142)	(1.3828)	(1.2020)	(1.9201)	(1.3871)	(1.2036)	(1.9277)	(1.3952)
Foreign	-0.0208	-1.5324**	1.3467**						
	(0.4944)	(0.7071)	(0.5833)						
Private				-0.1133	0.8263	-1.4113**			
				(0.5152)	(0.7276)	(0.6142)			
Government							0.2281	1.2997	-0.1166
							(0.6571)	(0.9323)	(0.7647)
Constant	16.3157**	22.1822	-19.5532	16.5736**	21.9022	-18.8355	16.3264**	23.5804	-17.6878
	(7.1403)	(21.1254)	(21.9826)	(7.1868)	(21.1734)	(21.9376)	(7.1541)	(21.1509)	(21.9519)
R-squared	554	554	554	554	554	554	554	554	554
Prob > chi2	0.8999	0.4921	0.2611	0.8995	0.4879	0.2558	0.8993	0.4820	0.2467
Observations									
No. of banks	57	57	57	57	57	57	57	57	57

*Standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

The dummy variable for foreign ownership has a negative (but statistically non-significant) link with changes in capital ratios (Model 1). The negative coefficient may suggest that as, on average, foreign banks have excess capital above the regulatory minimum requirement, they may not be induced by the regulatory pressure, and so they may reduce their changes in capital ratios without facing regulatory penalties However, foreign ownership has a negative and statistically significant relationship with changes in lending (Model 2). This result suggests that, on average, foreign owned banks operating in Tanzania reduce their changes in lending more than other types of banks, and is similar to the findings of Cull and Peria (2013) who find that foreign banks decrease credit supply in the CEE region. The reason could be that foreign-owned banks in developing countries may not be familiar with the local markets in which they are operating, thus becoming unable to mitigate risks appropriately (Berger and Bouwman, 2013).

Foreign ownership and changes in investment in government securities are positively and statistically significantly related (Model 3). This result indicates that, on average, foreign banks in Tanzanian increase their adjustments in government securities relative to other types of banks. It may be argued that as foreign banks, who are mostly from developed countries, have access to developed capital markets (Claessens et al., 2001), they can reduce their cost of funding, thus raise capital at lower cost and be able to buy government securities (Bonner, 2016; Egesa et al., 2015). As the results above show that foreign banks in Tanzania tend to reduce their higher risk-weighted asset (loans), they may increase their low risk-weighted assets (government securities), thus conforming to the Portfolio Rebalancing Hypothesis (Bouis, 2019).

Private ownership has negative associations with changes in capital ratios and investment in government securities (Models 4 and 6), being statistically significant for the investment in government securities model. However, it is positive and non-significantly related to changes in lending (Model 5). The results on Model 6 may suggest that under regulatory pressure, private-domestic banks in Tanzania can reduce their adjustments in investment in government securities more than other types of banks, perhaps because, as argued before, private-domestic banks in developing countries may have low capital due to less-developed capital markets, low levels of technology, and low risk management skills, thus limiting their investment potential (Berger et al., 2008; Barth et al., 2004; Mian, 2003; La Porta et al., 2002).

Finally, government ownership is positively but statistically non-significantly associated with changes in capital ratios and lending (Models 7 and 8). However, it is negative and non-statistically significantly related to changes in investment in government securities. The positive coefficient on capital ratios suggest that an increase in government ownership for Tanzanian banks, relative to other types of banks, may result in higher changes in bank capital ratios. This may be, as noted earlier, because state banks under higher regulatory requirement can have funding support from their governments (Gupta and Mahakud, 2020; Pessarossi and Weill, 2015). However, this result is not statistically significant, and therefore represents only weak evidence in this regard. As noted above, the non-significant results may equally suggest that these banks could be holding capital at their nearest minimum, therefore there is less room for any significant change.

2.6 Chapter summary

Using an unbalanced panel dataset of 57 Tanzanian banks over the period 2006 to 2020, this study examines the effect of regulatory pressure (resulting from regulatory capital requirements) on changes in bank capital ratios, lending and investment in government securities, specifically in a developed economy with a wide variety of bank ownership models. Further, using simultaneous models, the study tests the extent to which banks under regulatory pressure balance the simultaneous relations between changes in capital ratios, lending and investment in government securities. Descriptive results indicate that although on average the Tanzanian banking sector seems to hold excess capital (buffers) above the BoT regulatory minimum capital requirement, there is great variability amongst the banks, with some banks being over-capitalised and others undercapitalised and falling below the regulatory threshold.

Using the three stage least squares (3SLS) and conditional mixed-processes (CMP) estimates, the study finds a negative and significant relationship between regulatory pressure and changes in capital ratios. This empirical evidence is similar to other findings (see, for example, Ding and Sickles, 2019; Minni, 2016; Ahmad et al., 2009). For instance, the study by Ahmad et al. (2009) in Malaysian domestic financial institutions shows that higher regulatory pressure could have influenced banks to shrink their risk-weighted capital ratios. Using a sample of U.S. banks from 2001-2016, Ding and Sickles (2019) report a negative and statistically significant relationship between regulatory pressure and changes in bank capital ratios. Therefore, as noted above, higher regulatory pressure (which increases for Tanzanian banks with capital ratios below the minimum

regulatory requirement or those with low excess capital) results in lower bank capital adjustment. On the other hand, higher regulatory pressure is found to have a negative and statistically significant relationship with changes in lending for Tanzanian banks. This result may suggest that as raising capital could be costly for banks in developing countries, these costs can be passed on to borrowers through higher lending rates or tighter lending standards, which may finally reduce changes in bank lending (Francis and Osborne, 2012; Ibrahim et al., 2012).

Moreover, results on the simultaneous models show a feedback link between changes in capital ratios and both changes in lending and investment in government securities. A change in capital ratios has a negative and positive relationship with changes in lending and investment in government securities, respectively. On the other hand, while a change in lending is related to a negative change in capital ratios, a change in investment in government securities enables a switching regime from higher risky assets (e.g., loans), and thus resulting in a positive change in capital ratios. Thus, under regulatory pressure, a decrease in loans, and an increase in in government securities adjustment provides for a rebalancing of banks' portfolio towards lower risk and safer assets (Bouis, 2019).

In terms of bank ownership type, the findings indicate that while foreign ownership has a negative and statistically significant relationship with changes lending, it has positive and significant link with changes in investment in government securities. However, local banks are positively but non-significantly related with changes in lending and negatively related with changes in investment in government securities (being significant for private-domestic banks). Thus, while foreign banks tend to reduce their changes in higher risk-weighted asset (loans), they increase those in low risk-weighted assets (government securities), and is in line with the Portfolio Rebalancing Hypothesis.

The study proposes the following policy implications. First, as the results show that higher regulatory pressure induces banks to reduce their adjustments in capital ratios and lending, it suggests the need of very-well capitalized banks to maintain a large buffer stock of capital. In addition, as the result suggests a simultaneous link between changes in bank capital ratios, lending, and investment in government securities, banking regulations should be harmonised to accommodate such effects. Regulators should thus set capital standards that do not compromise lending and investment in government securities activities, as they are both vital to economic

growth. As noted above, since banks dominate the financial system, particularly in developing countries like Tanzania where financial markets are weak, they play a significant role in financial intermediation by converting deposits into loans, and channeling those funds from surplus to deficit units, thus, lowering economic disequilibrium and boost economic growth. Thus, if bank lending is compromised, it can restrain economic activities. On the other hand, as weak financial markets in developing countries may limit governments' funding options, bank investment in government securities supports economic growth by financing government expenditure. If banks' investments in government securities are compromised, this may also reduce the ability of governments to function properly, as by buying government securities they contribute to government funding.

In terms of bank ownership types, as foreign banks in Tanzania decrease their adjustments in lending relative to local banks, regulators need to set strategies that can encourage loan supply for these banks. In addition, as local banks in the country (state- and private-domestic-owned) exhibit low adjustments in investment in government securities relative to foreign banks, regulators should also find ways to motivate local banks to increase their holdings of government securities.

Generally, policy makers, especially in developing countries, should increase the minimum regulatory capital requirements and ensure that banks observe such regulatory requirements. Regulators may also strive to strengthen the financial markets, and the capital market in particular, and encourage as many banks as possible, especially locally (private and state) owned, to be listed. This can enable these banks to reduce funding costs, and thus be able to increase their capital adjustment, provide more loans, and invest in government securities.

Chapter 3: Bank capital ratios, ownership, and profitability: the role of board monitoring

3.1 Introduction

Profitability is key to the sustainability of the banking sector and the financial system, as it reflects the quality of bank management and owners' behaviour, efficiency, competitiveness of strategies, and risk management competencies (García-Herrero et al., 2009). Banks are the most vital financial institutions in almost all economies, as they provide financial intermediation to allocate resources to various sectors of the economy. Thus, their profitability is of great concern to banking regulators. To ensure that banks reduce risks and remain sustainable, international and country regulatory bodies have imposed stringent capital requirements. The Basel I Accord, which linked minimum capital requirements to the bank asset portfolio risk, was introduced in 1988 (BCBS, 1988). Subsequently, the Basel II and Basel III Accords were issued in 2004 and 2010, respectively. While Basel II considered market and operational risks, Basel III endorsed additional capital buffers and introduced liquidity standards (see Chapter 1). The BCBS also advocates for strong boards of directors in banks and emphasises the board as a key player in risk control and management (BCBS, 2006). Thus, in addition to capital regulations (external mechanisms), both developed and developing countries have also imposed internal mechanisms related to board monitoring (e.g., board size and board independence), and ownership reforms, so that banks operate profitably and are protected against the risk of failure (Trabelsi, 2010; BCBS, 2004).

However, empirical evidence on the effect of bank capital ratios on profitability provide contradictory results. Some studies suggest a positive link between bank capital ratios and profitability[14]. For instance, Beltratti and Stulz (2009) argue that a higher capital ratio reduces the expected cost of financial distress and so increases bank profits by lowering expenses. Since capital acts as a buffer to absorb earnings shocks, higher capital ratios also protects a bank from unexpected losses (Demirgüç-Kunt and Detragiache, 2010). In addition, higher capital to risk-weighted asset ratios can reduce the probability of bank insolvency, which may reduce the cost of funding and increase profits (Zheng et al., 2017).

[14] See, for example, Zheng et al. (2017), Majumder and Li (2018), Olszak et al. (2017), Berger and Bouwman (2013), Lee and Hsieh (2013), Mohammed and Gani (2012), Naceur and Omran (2011), Demirguc-Kunt and Detragiache (2010), Goddard, Molyneux, and Wilson (2010), Beltratti and Stulz (2009), and García-Herrero et al. (2009).

In contrast, other studies find a negative relationship between capital ratios and bank profitability[15]. For instance, Naceur and Kandil, (2009) argue that as raising equity to improve capital ratios increases banks' funding costs, this may induce them to pay low interest on deposits, and lend less in order to meet the required capital, thus constraining bank operations. Moreover, it has also been observed that well-capitalised banks can believe that they are "too-big-to-fail", resulting in riskier investments, which may result in low profitability and bank failure (Berger et al., 2008). For instance, the study by Berger and Patti (2006) in the US finds a negative link between capital ratios and bank efficiency. Further, in some instances, it is possible for a bank to be highly capitalised, to impress regulatory authorities without actually being profitable (Berge et al., 2008). VanHoose (2007) opine that mixed findings in the capital regulation literature suggest that executing more stringent capital requirements may be costly and unwanted.

In addition, regulators and policy makers have increased their focus on bank governance and monitoring, to ensure that banks have strong boards of directors. Weak boards may result in poor supervision and monitoring, which may lead to corporate scandals, as for example happened in the cases of companies like Enron, Tyco, and WorldCom (Rezaee, 2005). In the banking sector, an effective board of directors is a very important control mechanism as banking activities are typically opaque and extremely complex due to conflicts of interests that may simultaneously involve many parties, such as shareholders, managers, and debt holders (Tandelilin et al., 2007). As the external market may not directly discipline owners or managers of a bank, there is therefore a need for regulation of some aspects of banks' boards of directors (Tandelilin et al., 2007), such as the size and independence of the board. The US General Accounting Office (1989) suggests that most US bank failures observed from 1979 to 1987 were a result of poor board supervision or the presence of a dominant Chief Executive Officer (CEO) (Wolf, 1989). Therefore, board size and independence are central to the internal risk control mechanisms (Zabri et al., 2016; Adams and Mehran, 2012; Bonn et al. 2004). A smaller board of directors, and/or a board that has a high proportion of non-executive directors, can provide efficient monitoring and control to minimise risk-taking, thus protecting the interest of shareholders (Hermalin and Weisbach, 2003; Jensen, 1993), and increase profitability.

[15] See, for example, Ibrahim et al. (2012), Hoffmann (2011), Berge et al. (2008), VanHoose (2007), Berger and Patti (2006).

Thus, international organisations such as the IMF and the BCBS advocate for strong boards of directors in banks and the implementation of regulations on bank capital ratios as key internal and external risk control mechanisms. Therefore, capital adequacy regulations and board monitoring (board size and board independence) are considered to be complementary risk-management tools; consequently, it is important to understand their interactive effect (Hagendorff et al., 2010; Becher and Frye, 2009; Baxter, 2003). While higher capital ratios can be used to curb managers' risk-taking behaviour (Altunbas et al., 2007), the agency theory suggests that the presence of outside directors, who are less accountable to management, can improve monitoring and risk control (Hermalin and Weisbach, 2003), thus increase (or protect) bank profitability. Further, as a small and independent board may offer efficient monitoring and reduce bank risks, it can increase the confidence level of investors, resulting in lower cost of capital (Pathan and Skully, 2010), thereby increasing bank profitability. De Vita and Luo (2018) also emphasise the joint role of board monitoring and bank regulations in curbing risks.

Profitability plays a big role in determining the sustainability of the banking sector, as it reflects how efficient management is in using firm assets to generate earnings (Khatab et al., 2011; García-Herrero and Santabárbara, 2009). However, the link between bank capital ratios, board size and independence, and profitability is, to a large extent, not well explored. Available studies (see, for example, De Vita and Luo, 2018; El-Sood, 2017; and Hagendorff et al., 2010) are contradictory, and do not directly focus on this linkage. For instance, Abou-El-Sood (2017) investigates the effect of regulatory capital adequacy on the link between corporate governance and bank risk-taking, but does not directly examine the impact on bank profitability. Although Hagendorff et al. (2010) assess whether the interaction between board monitoring and capital adequacy regulations affect bank announcement returns, they also do not explicitly examine the extent to which this affects bank profitability. A study more closely related to the current one is that by De Vita and Luo (2018), who examine the impact of the interaction between board monitoring and regulation on bank risk taking. However, De Vita and Luo (2018) similarly do not focus on profitability.

Thus, although bank capital ratios, board size, and independence in the banking sector have received significant attention from regulators and researchers, there is limited evidence on the interactive effect of capital ratios, board size and independence and the extent to which they may

affect bank profitability. This study examines, among others, the extent to which board monitoring (board size and board independence) affect the link between bank capital ratios and profitability.

Further, many countries implemented banking sector reforms that aimed to diversify bank ownership to increase competition that could enhance bank profitability. Theoretically, a bank's profitability can be affected by its ownership type (e.g., foreign, private-domestic, or government), as its sources and cost of capital, technology, and risk control skills can vary with the ownership type (Claessens et al., 2001). According to the Agency Theory, the separation of ownership from control, and the divergence of interests between shareholders and managers, can result in an agency problem which can affect firm value (Brounen et al., 2004; Kim, Al-shammari, Kim, and Lee, 2009). To reduce conflicts of interest between bank owners (principals) and managers (agents), owners should exercise oversight control through an effective board of directors that must have the capacity and credibility to run the bank profitably. Bank owners can control risks and so enhance profits by choosing a proper board of directors. Thus, bank profitability can also vary with the ownership type as the owners can dictate the nature of boards of directors and the management. For instance, while the board members of state banks are often appointed for political reasons to fulfill a political agenda, and may therefore be incompetent and less independent (Chijoriga, 2000; Andrews, 2005), those for privately-owned banks may be mostly appointed on merit, and hence could be more likely to be competent and independent. Owners can also develop an appropriate incentive and compensation scheme. This is referred to as an internal governance mechanism through which the bank owners attempt to ensure that bank managers have the same motives and direction as owners in controlling risks to increase profits.

Despite the contradictions, most past studies in this field focus on developed countries, where most banks are typically well capitalised. Thus, their findings and conclusions may not be directly applicable to developing countries with underdeveloped financial markets, like Tanzania, where banks may be constrained by lack of capital (Griffith-Jones and Tyson, 2013). The few studies that focus on Tanzania (e.g., Lotto, 2018; Pastory and Mutaju, 2013; and Malimi, 2017) either do not explicitly examine the link between bank capital ratios, board size and independence, and profitability, or employ static estimation techniques, which ignore the dynamic interaction and potential endogeneity between the variables, as discussed below.

Therefore, to control for endogeneity and account for persistence in bank profitability, a dynamic estimation technique, the system-generalised method of moments (Sys-GMM), is employed in this study. Evidence suggests that economic relations are dynamic in their nature, therefore past bank profitability may have an impact on future profitability levels. This persistence in profit determines the degree of informational asymmetry and sensitivity of bank profits to macroeconomic factors (Goddard et al., 2011; Berger et. al., 2000). However, similar to other studies (for example, Wintoki et al., 2012; Laeven and Levine, 2009; Pasiouras and Kosmidou, 2007; De Andres and Vallelado, 2008; Goddard et al., 2004), this study also uses the static estimation methods, ordinary least square (OLS) and the fixed- or random-effect (FE or RE) panel regression methods. This approach is used to check the coefficients, since the coefficient of the lagged values under the OLS and FE models determines the bounds for the coefficient of the lagged value of the dependent variable for the sys-GMM estimates, and therefore the OLS and FE estimation techniques are used to assess the suitability of the sys-GMM model (Roodman, 2006).

This study examines the impact of bank capital ratios and ownership type on bank profitability in the context of Tanzania, and the extent to which effective board monitoring (board size and board independence) affects this relationship. The study attempts to answer the following questions:

i) What is the nature of the relationship between bank capital ratios and bank profitability?
ii) To what extent does board size and independence affect bank profitability? Does board size and independence moderate the bank capital ratios-profitability linkage?
iii) How does bank profitability vary across banks of different ownership types?

3.2 Theoretical and Empirical Literature

3.2.1 The Expected Bankruptcy Costs Hypothesis

The relationship between capital ratios and firm value can be explained by the Expected Bankruptcy Costs Hypothesis. Unlike the Modigliani and Miller (1958) proposition (M&M) that in a frictionless world, bankruptcy is costless as the debt holders can sell the bank's assets and recover the value of their investment, in the real world, bankruptcy is costly and the bank's value decreases with the likelihood of bankruptcy. In the event of bankruptcy, debt holders may not recover the full value of their outlay for various reasons, including transaction costs and information asymmetry. Bankruptcy is also costly as equity holders can pursue selfish strategies

against debt holders due to asymmetric information between these two groups of investors, thus reducing firm value (Jensen, 1986). With a lot of intangible assets, bankruptcy costs may also be substantial as it may be difficult to sell assets when a firm is no longer treated as a going concern.

Berger (1995) argues that, for a bank with capital below its equilibrium level, expected bankruptcy costs are relatively high, and an increase in capital ratios raises expected profits by lowering interest expenses on uninsured debts. The positive effect can be due to the fact that capital acts as hub to absorb earning shocks (Athanasoglou et al., 2008). However, for a bank with capital above its equilibrium level, capital ratio and bank profitability could be negatively related (Berger, 1995). Thus, based on the Expected Bankruptcy Costs Hypothesis, this study expects a significant relationship between capital ratios and bank profitability. Hence the first null hypothesis below:

Hypothesis 3A ($H3A_0$): Capital ratios and bank profitability are not significantly related

Empirical studies on the effect of capital ratios on bank profitability provide mixed evidence. Some studies support the positive link between capital ratios and profitability while others do not. One strand of such literature, based on the above theory, argues that bank capital ratios are likely to increase when there is a higher expected cost of distress. In this case, banks increase their capital ratios to give reassurance to investors and thus increase their profits by lowering interest expenses. For instance, Berger (1995) investigates the association between the capital-asset ratio (CAR) and after-tax return-on-equity (ROE) on insured commercial banks in the U.S between 1984 and 1989. The regression used included a lag of CAR and ROE for three years, several control variables, and bank and time dummies. The study reports a positive and significant association between CAR and profitability. Specifically, it is shown that earnings expanded over the few years following an increase in capital. This result supports the Expected Bankruptcy Cost Hypothesis, as it indicates that an increase in earnings following an increase in CAR is mainly a result of decreased interest rates on uninsured funds. However, the study finds negative causality during the later period.

In addition, banks that hold the level of capital in proportion to their asset risk are able to decrease the probability of insolvency. Bank solvency can increase the confidence level of the investors, reduce the cost of funding, and so increase profitability (Zheng et al., 2017). Berger and Bouwman (2013) investigate the impact of bank capital ratios on profitability, market share, and probability of survival, during normal and crisis times in the U.S for the period from 1984 to 2009, so as to

capture the two banking crises and three market crises that occurred during the study period. They find that, for all banks except medium-sized ones, higher capital increases profitability during a crisis. Moreover, the study shows that banks of all sizes that were highly capitalised before the crisis had an increased likelihood of survival and growing market share during banking crises. Thus, banks with higher capital ratios improve their long-term profitability, as they are able to survive financial and economic crises because capital acts as a buffer to absorb earnings shocks (Demirguc-Kunt et al., 2010).

This argument is also in line with the empirical findings by Beltratti and Stulz (2009) who examine factors for banks' poor performance during the Global Financial Crisis of 20070 to 2008. They use a sample of 164 large financial institutions with assets in excess of USD10 billion globally for the period 2007 to 2008 and find that large and higher capitalised banks perform better. They also show that banks from countries that imposed stringent bank capital restrictions before the crisis performed better during the crisis. Moreover, accounting for country fixed effects, their study shows that banks with higher ratio of loans to assets had better performance in the month subsequent to the Lehman bankruptcy.

Higher capital ratios may also enable banks to engage in prudent lending, thus increasing the stream of future profits (franchise value) through interest income. Olszak et al. (2017) investigate bank supervision and regulations, pro-cyclicality, income smoothing, and the effect of capital on lending, and determine the probable factors for diversity of such effect for the European Union (EU)'s large banks. These researchers report that loan growth is sensitive to capital ratios for banks with more pro-cyclical loan loss provisions and less income smoothing, and that more stringent official bank regulations and supervision lower the effect of capital ratio on lending. Thus, as capital is a significant factor for loan supply, it may enable a higher capitalised bank to provide more loans and so, increase interest income, resulting in higher profitability.

In another European study, Goddard et al. (2013) investigate the causes and convergence of bank profitability in the European Union (EU). The study covered all savings, cooperatives, and commercial banks from eight EU member states for the period 1992 to 2007. Using dynamic techniques, the study reports a positive link between capital levels and bank profitability. More

specifically, it is found that there is an average higher profitability for strongly capitalised, highly diversified and cost-efficient banks. Similarly, Goddard et al. (2004) also use dynamic estimation models to examine the determinants of bank profitability for 665 banks from six EU countries (Denmark, France, Germany, Italy, Spain and the UK) for the period 1992 to 1998. They find a positive relationship between the capital-asset ratio and bank profitability. Further, both Goddard et al. (2013) and Goddard et al. (2004) report that profits are persistent, suggesting that current levels of profitability have a significant effect on future profitability levels. However, to also account for the bank ownership reforms discussed in Chapter 1, the current study classifies banks in terms of foreign-, private domestic-, and government ownership.

Kosmidou et al. (2005) examine the profitability of commercial banks in the United Kingdom (UK) for the period 1995 to 2002. Using fixed effects regression, the investigation finds a positive relationship between capitalisation and bank profitability. Similarly, Athanasoglou et al. (2008) assess the impact of banking and macroeconomic variables on the profitability of the Greek banks for the period 1985 to 2001, and show that productivity, capital ratios, inflation and growth are positive and statistically significantly related to profitability. However, operating expenses and credit risk are negatively related to bank profitability. Assessing the profitability of Spanish banks between 1999 and 2009, Trujillo-Ponce (2013) further finds that higher capitalisation has a positive impact on the return of assets, but it has a negative impact on the return of equity.

Studies that focus on emerging and developing markets include that of Majumder and Li (2018) who explore the effect of capital requirements on the performance and risk of 30 banks in Bangladesh between 2000 and 2015. Using the GMM estimation technique on an unbalanced panel of 413 bank-years, a positive and significant impact of both the risk-based capital ratio (regulatory) and non-risk-based capital ratio (total shareholders' equity to total assets) on bank performance is found. However, a negative and significant relationship between capital requirements and risk is reported. Thus, as banks in developing countries are constrained by a lack of capital due to weak and underdeveloped capital markets, higher bank capital ratios in these countries can protect banks from risks, thus increasing their profitability. The literature suggests that when required to increase capital, undercapitalised banks may increase capital and reduce risks, thus increasing profitability (Rime, 2001).

The argument above is also supported by the study of Lee and Hsieh (2013), who assess the effect of capital (equity-to-total-assets) on bank profitability (return on assets (ROA), return on equity (ROE), net interest margin (NIM), and net interest revenue and risk (variance of ROA, variance of ROE, and loan loss reserves-LLR) in 42 Asian countries over the period 1994 to 2008. Employing the generalised method of moments (GMM) technique on the whole financial system (cooperative banks, commercial banks, and investment banks), a positive and significant relationship is found between capital and profitability. However, the relationship between capital and risk is negative and statistically significant. Further, banks in low-income countries are found to have a higher capital effect on profitability, compared to those in lower-middle and in higher-income countries.

Likewise, Doliente (2005) investigates the determinants of net interest margins (NIM) in Southeast Asian countries. The study finds capital to be among the bank specific factors which explain NIM. Other factors are loan quality, liquid assets, operating expenses, and collateral. This signifies that higher capitalised banks are able to provide loans and so they can improve profitability (NIM) through interest income. In this regard, Naceur and Omran (2011) also assess the effect of capital on bank performance in the MENA countries for the period from 1988 to 2005 and report that well-capitalised banks have sufficient funds for credit supply, and that capitalisation has a positive impact on bank profitability, cost efficiency and NIM.

In Egypt, Naceur and Kandil (2009) assess the impact of capital regulations on intermediation costs and profitability of 28 banks for the period 1989 to 2004. They find a positive and significant relationship between the capital ratio and both the cost of intermediations and profitability. The literature suggests that higher intermediation costs should reduce bank performance. However, an increase in bank profitability, despite an increase in intermediation costs, could have been attributed to, among others, a reduction in implicit cost and the increase in management efficiency. Assessing the factors for low profitability of banks in China for the period 1997 to 2004, García-Herrero et al. (2009) find that well capitalised banks are more profitable. These authors argue that holding more capital provides an indication of creditworthiness and so, when depositors wield market discipline, higher capitalised banks can lower their funding costs. Therefore, a higher capitalised bank may require less borrowing to afford a given level of assets. This is particularly important in less developed capital markets where borrowing ability may be subject to abrupt halts.

In the context of Tanzania, bank capital studies have focused on capital adequacy and asset quality (Pastory and Mutaju, 2013), and capital adequacy and operating efficiency (Lotto, 2018). For instance, Lotto (2018) examines the effect of capital regulation on the operating efficiency of Tanzanian banks. Using bank level data for the period 2009 to 2015, the study finds a positive and significant association between bank capital adequacy ratio and operating efficiency. The author argues that stringent capital requirements could help Tanzanian banks to be efficient. However, these studies do not investigate the relationship between bank capital ratios and bank profitability (ROA and NIM) and the extent to which board size and board independence affect this relationship.

Despite the positive relationship reported above, other studies have found a negative link between capital ratios and bank profitability. The literature suggests that higher required capital ratios could compel banks to take more risks, increase bank costs, ignore profitable investment opportunities, induce banks to pay little on deposits and lend less in order to meet the required high capital, thus constraining bank operations. It is argued that to meet the higher risk-weighted capital ratios, banks may try to reduce the effect by increasing risky assets, ultimately resulting in reduced bank profitability (Sharma, 2001). For instance, examining a sample of EU banks with a focus on the 2008 crisis, Camara et al. (2010) find that before the crisis, over-capitalised banks took more risks.

The Moral Hazard Hypothesis also argues that banks may exploit deposit insurance schemes by increasing risks (Lee and Hsieh, 2013; Altunbas et al., 2007; Sharma, 2001), which may result in reduced bank profitability. This can lower a bank's likelihood of survival. Osei-Assibey and Asenso (2015) find capital requirement and NPLs to be positively related. Higher NPL can increase default rates, resulting in a lower probability of survival (Calomiris and Kahn, 1991). In addition, higher capital ratios may lead to higher funding costs and so increase intermediation costs. This may be reflected in the credit supply decision, which could result in a reduction of lending. For instance, Peek and Rosengren (2000) show that, in response to unexpected drops in capital, higher capital levels may cause lending to shrink more quickly. Similarly, in the US, Furfine (2001) finds that increased capital reduced both the banks' credit supply and loan growth. In turn, lower credit demand may result in reduced bank profitability. In Nigeria, Ibrahim et al. (2012) investigate the post- and pre-recapitalisation effects on time series data for the period 2000 to 2009. Employing an independent t-test, they report a significant increase in funding cost and net interest margin

during the post-recapitalisation period. However, they show that, after the recapitalisation period, return on assets decreased significantly. Similarly, Adegbaju and Olokoyo (2008) examine the impact of the 2001 regulatory increase in capital on bank profitability in Nigeria and, using a t-test, find that the recapitalisation had a negative impact on bank profitability.

As noted above, higher capital ratios may compel banks to avoid some investments due to increased funding costs or a need to meet regulatory requirements. Thus, Hoffmann (2011) investigates bank profitability determinants in the US during the period 1995-2007. Using the system-GMM estimator to test the risk-return hypothesis, the study finds a negative relationship between capital ratio and profitability. This suggests that, when having to operate within a regulatory capital requirement, banks operate cautiously and ignore profitable investment opportunities. In the US, Berger et al. (2008) find that, in some instances, a bank might be highly capitalised to impress regulators, without actually being profitable. These authors show that the recapitalisation may cause banks to encounter liquidity crises. However, they argue that in highly concentrated markets, banks with higher capital can believe that they are "too-big-to- fail", and so take on riskier investments which may then result in bank failure.

The above empirical studies (mostly in developed countries) are contradictory. However, considering the theoretical arguments above that higher capital ratio reduces the expected cost of financial distress and so increases bank profits by lowering expenses, capital ratios and bank profitability are expected to be positively related. The theoretical and empirical literature on board monitoring (board size and board independence), as well that relevant to the influence of bank ownership types, is discussed in the section that follows.

3.2.2 The Agency Theory

The Agency Theory discusses the separation of ownership from control (Kim, Al-shammari, Kim, and Lee, 2009). It stems from the agency relationship where agents (managers) are hired as representatives and business developers by principals (owners). This theory, as proposed by Jensen and Meckling (1976), explains the divergence of interests between shareholders, managers, and debt holders. Thus, agency costs arise from the conflicts either between managers and shareholders (agency costs of equity), or between shareholders and debt holders (agency costs of debt) (Brounen et al., 2004). It is argued that, in some instances, managers may strive to maximise their own wealth

at the expense of shareholders' value through excessive self-remuneration; making decisions that focus on short-term performance rather than long-term growth, and avoiding long-term risky projects (Psaros, 2009), so increasing agency cost.

Thus, while the Agency Theory addresses the reduction of conflict of interest between the principals and the agents, these efforts result in agency costs such as monitoring costs, bonding costs and residual loss. Agency costs are incurred to enable all stakeholders to share the profits equitably and to their satisfaction (Mallin, 2004). Agency costs may cause a conflict which entices shareholders to accept high risk projects which transfer wealth from bondholders to shareholders (King and Wen, 2011).

As banks and the banking activities are considered to be opaque and extremely complex, they have more complex agency problems. Since conflicts of interest in banks may simultaneously involve more than two stakeholders, the external market may not discipline bank owners or managers (Tandelilin et al., 2007). The Agency Theory suggests the use of external and internal mechanisms which are intended to protect shareholders' interests, minimise agency costs, and align the principal-agent relationship (Roberts et al., 2005; Weir et al., 2002). In order to make firms more accountable to owners, it is suggested that, among others, there should be a smaller number of the board of directors, most of whom are independent (Sun et al., 2009; Chowdary, 2002). Jensen (1993) opines that as the board of directors grows in size, it becomes less effective.

While the Agency Theory assumes the existence of conflict or problems between the principal and agent (Beaudoin, 2008), the Stewardship Theory sees managers as good stewards who act in the best interest of the owners. Also, unlike the Agency Theory, the Stewardship Theory emphasises trust as regard to the agents and affection to moral behaviours aimed at enhancing performance of the firm (Clarke, 2004). The theory advocates that where shareholders′ wealth is maximised, the steward′s utilities are maximised too, because organisational success will serve most requirements and the stewards will have a clear mission (Smallman, 2004). A steward who improves profitability successfully, satisfies most stakeholder groups in an organisation when these groups have interests that are well served by increasing organisational wealth. According to Psaros (2009), managers do not start out with the intention of maximising their own utility at the expense of the

interests of other stakeholders. Kiel and Nicholson (2003) state that 'underlying this rationale is the assertion that since managers are naturally trustworthy there is no major agency costs.' Thus, stewardship theory supports a majority of specialist executive directors on a firm's board, rather than non-executive directors (Clarke, 2004).

Therefore, as the Agency Theory above suggests that board monitoring (e.g., board size and board independence) can have an impact on bank profitability, null Hypotheses 2 and 3 are proposed as follows:

Hypothesis 3B ($H3B_0$): Board size is not significantly related to bank profitability.
Hypothesis 3C ($H3C_0$): Board independence is not significantly related to bank profitability

Board size and bank profitability-empirical review

The Agency Theory suggests that an effective board improves performance by reducing agency problems. The theory argues that a smaller board of directors can provide for efficient bank monitoring and control, thus protecting the interest of shareholders (Jensen, 1993). However, empirical evidence on the relationship between board size and bank profitability provides contradictory evidence, whereas some suggest large boards are good, others show that small boards are more effective. Some studies in support of smaller boards argue that a smaller board is effective, as large boards could lead to ineffective interpersonal communications, co-ordination and coherency, resulting in organisational conflicts (Wang et al., 2012; Agoraki et al. 2010; Pathan, 2009; Hermalin and Weisbach 2003) and so poor performance. For instance, Wang et al. (2012) show a negative association between board size and bank performance, arguing that increasing the board size is unfavourable to banks' operations.

In addition, a smaller board could improve profitability, as larger boards are argued to bring with them higher agency cost. This is especially possible when the incentives of individual directors to obtain information and control managers decreases. Pathan and Skully (2010) explain that stricter regulation and strong penalty charges might disincentivise qualified and experienced personnel from serving on banks' boards of directors. However, Coles et al. (2007) opine that the association between board size and performance will depend on the economic situation of a firm.

In contrast, other empirical literature in support of larger boards show a positive relationship between board size and bank profitability, arguing that larger boards can reduce the domination of the chief executive officer (CEO), thus rendering him or her unable to effect contracts that are not in the interest of shareholders. This improves monitoring, which may result in increased bank performance (Pathan, 2009).

In addition, another strand of the literature in support of larger boards show that larger boards are likely to offer strong financial supervision as they can formulate more dedicated committees with a wider diversity of expertise, knowledge and experiences. A study by Van de Berghe and Levrau (2004) on 30 Belgian firms show that larger boards improve bank efficiency due to diversified committees' skills and experience to provide for an effective financial oversight.

Similarly, Adams and Mehran (2012) assess the link between corporate governance and the performance of 35 US banks for the period 1964 to 1985, and report a positive association between board size and performance, and also that large boards increase bank value due to members' diversity and networking, and that a director adds in value only if she/he is a subsidiary member.

Huang and Wang (2015) advocate larger boards, as smaller ones may fail to adequately provide risk oversight leading to riskier investments, resulting in performance variability. Dong et al. (2017) examine the effect of board structures such as composition, size, and functioning on the efficiency and risk taking in the Chinese banking sector. They suggest that, compared to loan quality, board characteristics have a higher impact on banks' profit and cost efficiency. Huq et al. (2018) investigate, globally, the impact of corporate governance on the performance and risk-taking of banks during the financial crisis of 2007-2008. They show that corporate governance offers positive influence in terms of profitability and risk-taking.

The above findings are contradictory. However, based on the Agency Theory, it can be argued that as larger boards can result in higher agency cost and information asymmetry, it can reduce bank profitability. Thus, this study also expects a negative relationship between board size and bank profitability.

Board independence and bank profitability

Empirical evidence on the relationship between board independence and bank profitability is also contradictory. Some studies in support of a positive correlation argue that outside directors can introduce a diversity of nationalities, expertise, skills, and experience which could lower funding costs, and so improve performance (Mak and Kusnadi, 2005; Weir and Laing, 2001). Ashbaugh-Skaife et al. (2006a) show that independent boards lower systematic risk and idiosyncratic risk, resulting in lower cost of equity.

Moreover, others show that non-executive directors may assist to increase earnings quality and offer suitable compensation to the management (Cornett et al. 2009; Mishra and Nielsen 2000). Also, non-executive directors can help a bank to lower the cost of debt financing (Anderson et al., 2004). Ashbaugh-Skaife et al. (2006b) show that banks with independent boards have higher credit ratings. Further, as they are less accountable to management, non-executive directors can better exercise their monitoring role, and so better represent the shareholders' interests (Hermalin and Weisbach, 2003).

However, other empirical studies challenge the benefits of non-executive directors. They contend that non-executive directors have no interest in the bank as they may be appointed from outside. They favour inside directors who "live" in the firm they govern, and who know the firm better than outside directors, and so can make better decisions (Nicholson and Kiel, 2007). Therefore, it is argued that non-executive directors may lack a day-to-day inside knowledge and so reduce the control role in the firm due to information asymmetry between inside and outside directors (Rashid et al., 2010); may fail to perform due to lack of appropriate support by the inside directors (Rashid et al., 2010); and may not be competent to perform their assigned tasks in that they are part-timers and do not have inside information of the firm (Cho and Kim, 2007; and Brennan and Solomon, 2008).

Wang et al. (2012) find a negative relationship between board independence and bank performance of US banking holding companies (BHCs). Morck (2007) shows that outside directors seldom blow the whistle on mishandling of firms' resources committed by inside directors. This may result in fraud and lower profitability.

Surprisingly, others find U-shaped or insignificant relationships. For instance, employing two-step system GMM estimation on a sample of 69 commercial banks in six OECD countries (Canada, France, Italy, Spain, the UK, and the US), De Andres and Vallelado (2008) find a positive but curvilinear association between board independence and bank performance. They also show that, unlike inside directors, outside directors may find it hard to get information. However, their pooled-ordinary least square (OLS) and fixed effect (FE) estimates contradict their GMM estimates. On the other hand, Berger et al. (2012) and Erkens et al. (2012) report a statistically non-significant relationship between board independence and bank performance. Therefore, given the mixed empirical evidence above, whether larger boards with non-executive directors will perform well in monitoring management and whether they could reflect an increase or decrease in bank performance is still an empirical debate (Yammeesri and Herath, 2010).

The literature above so far has also provided contradictory results. However, as discussed above, non-executive directors can lessen the conflict of interests between parties, reduce risks, and reduce agency and equity costs. Therefore, studies based on the Agency Theory suggest that a bank with a more independent board of directors will have greater profitability. However, the literature in support of the Stewardship Theory show that an independent board is not important.

Capital ratios, board size and independence, and profitability

The empirical evidence above examine the separate effects of bank capital, board size and board independence, on profitability. However, the effects of capital ratios on bank behaviour (e.g., risk and profitability) may vary, depending on the board size and independence (De Vita and Luo, 2018; Cabo et al., 2012; Laeven and Levine, 2009). According to the Agency Theory, as the board of directors and company management are agents acting on behalf of the principals (owners), they have the powers amongst others, to control risks and raise capital (Jensen, 1993). Thus, as bank capital may vary with the characteristic of the board or its members, the bank capital ratios-profitability linkage could be affected by such characteristics. For instance, a smaller and independent board can minimise the agency costs (Jensen and Meckling, 1976), resulting in low cost of capital (Pathan and Skully. 2010) and increased profitability. The size of the board may promote shareholder interests, thus affecting bank capitalisation (Anginer et al., 2016). Thus, a bank with a more independent board can increase funders' confidence, resulting in low cost of

capital and higher profitability. However, an independent board may favour more risk taking, resulting in low bank capitalisation (Anginer et al., 2016) and reduced profitability. Thus, as the size and independence of the board can influence bank capitalisation, this could affect the link between capital ratios and bank profitability.

In addition, the Resource Dependency Theory of Pfeffer and Salancik (1978) claims that boards are selected to maximise the delivery of central resources (such as capital) to a firm (Hillman and Dalziel, 2003). The directors are seen as resource providers who can link a firm with the external environment, and their advisory role and linkage helps it access external capital. This linkage, however, depends on the characteristic of the board members (Ferreira, 2010). According to the theory, firms formulate boards that integrate outside directors who may have different expertise and linkages (Pearce and Zahra, 1992). For instance, outside directors can facilitate a bank's access to lower cost capital due to their external ties (Erkens et al., 2012), thus increasing profits. A board with more outside directors can also use its dominant links to reduce credit risks (Peng 2004; Hillman and Dalziel 2003), thus enhancing capital ratios and increasing bank profitability.

Unfortunately, the influence of board size and independence on the bank capital ratio-profitability linkage is largely unexplored. Studies on this linkage, despite being contradictory, do not consider how board size and independence may affect the relationship between capital ratios and bank profitability. For instance, using a sample of 204 European and US bidding banks, Hagendorff et al. (2010) examine whether board monitoring mechanisms (CEO duality, board independence, and board diversity) moderate the relationship between bank regulatory regimes of varying strictness and the performance (announcement returns) of bank mergers and acquisitions (M&A). They find that the combination of strict regulation and board monitoring (independence and diversity) significantly enhances the returns.

De Vita and Luo (2018) use a panel of 493 banks from 54 countries over the period 2001 to 2015 to examine the association between bank regulations (capital requirements, market discipline, and supervisory power) and risk-taking (proxied by z-scores, non-performing loans, and volatility of equity return) and assess whether board monitoring features (board size, board independence, and gender diversity) moderate the association. Using GMM estimations, it is found that the impact of

separate regressors (such as capital requirement, board size, board independence, supervisory power, and foreign ownership) on bank risk-taking is largely statistically non-significant. However, board size is found to have a negative and positive significant relationship on z-scores and non-performing loans (NPLs), respectively. Further, the interaction term between board size and capital requirement is found to be significant, suggesting that for well-capitalised banks, large boards significantly reduce bank risk-taking. However, no significant relationship was found with the interaction term between board independence and capital requirement.

Although De Vita and Luo (2018) do not consider the bank capital ratio-profitability nexus, their findings suggest that risk-taking is conditional on board size and bank capital requirement, therefore, bank profitability can vary with the interaction between bank capital ratios and the size of the board. Therefore, good governance can enhance bank capitalisation. As capital ratios and board structure are related, board structure can influence the effect of capital ratios on bank profitability.

Anginer et al. (2016) also investigate the effect of banks' corporate governance (board size, board independence, and anti-takeover provisions) and executive compensation schemes on capitalisation (Tier 1 capital, common equity, tangible capital, and market value) using banks from an international sample for the period 2003 to 2011. The study finds that, while the link between board size and total capital is negative and significant, it is, however, positive with the other measures of capital. Board independence has a negative and non-significant coefficient, except for the market value. The positive link between board independence and the market value indicates that, on average, banks with more independent boards, have higher market values. This would support the theoretical view that low capitalisation could serve the interest of owners as banks can shift risks towards the creditors or financial safety net.

In addition, the choice of a capital ratio may conflict with the interests of shareholders, debt holders, and managers. While shareholders may be interested in raising equity capital, debt holders could be inclined to increase debt capital. Unfortunately, managers may act either on the interests of shareholders or debt holders, thus hurting debt holders or shareholders, respectively (Jensen and Meckling, 1976). The presence of an independent board may strike a balance and optimise the

level of capital, thus improving profitability. Some studies follow this approach (e.g., Ngatno et al., 2021; and Jiang and Wong, 2004). For instance, Ngatno et al. (2021) test whether corporate governance moderates the link between capital structure and the performance (ROA and ROE) of 506 rural banks in Indonesia. Using the Moderated Regression Analysis at the end of 2019, it is found that, while non-executive directors moderate the capital-performance linkage, ownership concentration and board size have no moderating effect on the capital–performance association.

Moreover, as internal (board size and independence) and external (e.g., capital) mechanisms are complementary (Hagendorff et al., 2010; Becher and Frye, 2009; Baxter, 2003) in reducing bank risks, their interaction can have a greater effect on bank profitability. On the other hand, bank capital complements the internal governance, as it is an external risk control mechanism (Andries and Mutu, 2016; Buch and DeLong, 2008). The Agency Theory argues that a smaller board with more outside directors (who are less accountable to management) can reduce managers' risk-taking (Hermalin and Weisbach, 2003). Higher capital ratios, on the other hand, act as cushion to absorb bank risks and serve as a buffer against unexpected losses (Ayaydin and Karakaya, 2014; BCBS, 2004).

Thus, theoretically, the interaction between board size and independence, and capital ratios, could have a great impact in controlling bank risks and so, their joint effect on bank profitability could be much higher that the independent effects. Examining the effect of corporate governance and bank regulations on systematic risks in ten countries from Central Eastern European (CEE), Andries and Mutu (2016) observe that the effect of corporate governance on systemic risk is influenced by the strictness of capital requirements, activity restrictions, and supervisory power.

Likewise, on a sample of US banking holding companies (BHCs) over the period 2002 to 2014, Abou-El-Sood (2017) investigates the impact of regulatory capital adequacy on the relationship between corporate governance and bank risk-taking, as proxied by the risk-weighted assets portfolio (RWA), the risk-weighted loan positions (RWL), and the risk-weighted derivatives and off-balance sheet items (OBS). The study finds board size and independence to have a positive and significant relationship with risk taking, and that banks with comparatively higher Tier 1 capital have higher risks. Assessing the joint effect of corporate governance and capital on bank

risk taking, they show that both the interaction terms (board size x total capital), and (outside directors x total capital) are positively related with risk-taking. Thus, the higher the capital, the more positive the link between board size (and independence) and risk taking, However, like the studies above, Abou-El-Sood (2017) also does not focus on bank profitability.

Similarly, using a sample of 38 Domestic Systemically Important Banks (D-SIBs) from the European Economic Area (EEA), Addo et al. (2017) assess the interaction between corporate governance and regulatory reforms (the Capital Requirement Directive IV-CRD IV)[16] on bank performance, proxied by return on equity (ROE), Tobin's Q and economic value added (EVA), from 2011 to 2015. Using fixed and random effects models, the study reports that board size and board independence are negatively related to bank performance. Assessing whether the introduction of the CRD IV affected the relation between board structure and bank performance, it is found that board diversity, the presence of basic board committees, and directors' experience have no significant relation with performance, mainly during the post-CRD IV periods.

Macro-prudential and capital related regulations can also affect the relationship between board structures and bank behaviour. For instance, Gaganis et al. (2020) use 356 banks from 50 countries over the period 2002 to 2017 to investigate the interaction between corporate governance and macro prudential policies [17] on shaping bank risks. This study finds that the interaction between corporate governance and macro-prudential policies have a statistically significant impact on bank risks.

The empirical studies above are contradictory. However, the Agency Theory also suggests that a smaller and independent board can minimise agency costs (Jensen and Meckling, 1976), resulting in reduced cost of capital (Pathan and Skully2010) and increased profitability. Moreover, The

[16] The CRD IV, aimed at implementing Basel III in the European Union (EU), oversees the prudential regulations and supervision of banks and investment companies in the region. Among others, the CRD IV specifically provides for how much and in what form capital should be held (Moloney, 2016; Ojo, 2015)

[17] An index comprising of: leverage ratio, debt-to-income ratio, loan-to-value ratio, general countercyclical capital requirement, time-varying/dynamic loan-loss provisioning, capital surcharges on systemically important financial institutions, limits on the fraction of assets held by a limited number of borrowers, limits on interbank exposures, limits on foreign currency loans, limits on domestic currency loans, levy/tax on financial institutions, forex and/or countercyclical reserve requirements.

Resource Dependence Theory argues that, under higher capital needs, outside directors can help a bank's access to capital due to their external linkages (Erkens et al., 2012). Bank capital ratios and board characteristics are also complementary in controlling risk taking. Overlooking board characteristics, specifically board size and independence, could result in flawed inferences about the effect of capital on bank behaviour (De Vita and Luo, 2018).

Therefore, this study further investigates the influence of board monitoring (board size and board independence) on the relationship between bank capital ratio and the profitability of Tanzanian banks, and expects a significant effect. Hence, the relevant null hypotheses are as follows:

Hypothesis 3D ($H3D_o$): Board size does not significantly moderate the relationship between bank capital ratios and profitability

Hypothesis 3E ($H3E_o$): Board independence does not significantly moderate the relationship between bank capital ratios and profitability

Ownership type and bank profitability

This study also examines the effect of bank ownership type on the profitability of banks in Tanzania. Ownership types, in terms of shareholding identity, can be classified into government, private-domestic, and foreign banks (Berger et al, 2005; Mian, 2003). It is argued that the separation of ownership from control and the divergence of interests between bank owners and management can result in an agency problem, and so harm firm value (Kim et al., 2009; Brounen et al., 2004). Thus, ownership type can align the interests of managers and shareholders and increase firm profitability (Dalton, et. al, 2003). Theoretically, the global advantage hypothesis suggests that foreign banks operating in developing countries are more profitable and stable than their counterparts (Laidroo, 2016; Havrylchyk and Jurzyk, 2011). According to Claessens et al. (2001) and Clarke et al. (2000), foreign owned banks in emerging economies perform better as they have access to developed markets and are vested with higher management skills and technology compared to their local counterparts. However, foreign-owned banks are comparatively less risk averse (De Nicolò and Loukoianova, 2007). Berger and Bouwman (2013) show that small foreign banks with a greater portion of their services in metropolitan markets are less likely to survive.

On the other hand, the Home Advantage Hypothesis argues that local banks could perform better than foreign banks as they may have easy access to local information (Berger et al., 2003). Also, private domestic banks could have aggressive lending strategy and so increase their loan base, resulting in higher profitably. In this regard, Mian (2003) shows that private-domestic banks have the ability to offer more lending activities, as they can maintain more assets. Unfortunately, aggressive lending may increase risk and reduce bank profitability. In addition, private domestic-owned banks, like other local banks, may be unprofitable due to increased interest expenses from deposits (Mian, 2003).

In general, government-owned banks, particularly in developing countries, are found to be unprofitable. One of the reasons is that in developing countries state owned banks experience management incompetence and low skills on risk management (Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002; Andrews, 2005; Chijoriga, 2000). In addition, in some countries government-owned banks may be used to fulfill political objectives and experience government intervention, and so ignore profitable investment opportunities, thus going against the principle of "shareholder value maximisation" (Andrews, 2005; Chijoriga, 2000; García-Herrero et al. 2009). Government-owned banks may also not properly comply with the banking regulations as they are both the owner of such banks and the regulator (the "dual-agency" role) (Andrews, 2005).

However, government-owned banks could be profitable as, unlike the foreign- and private-domestic- owned banks, they can benefit from government support, such as capital injections and bank bailouts (Andrews, 2005), thus reducing interest expenses on the cost of funding and so, increasing profitability. Moreover, as civil servants in Tanzania should bank with some state banks for salary disbursements and receive favourable loan terms, this may increase the banks' deposits, lending, and enhance profitability through interest income.

Thus, as bank owners are more concerned with the banks' risk management to ensure performance bank profitability may vary, depending on its ownership type. This study expects bank profitability to vary with the type of bank ownership. Hence the null hypothesis below:

Hypothesis 3F ($H3F_o$): Bank ownership type is not related to the profitability of Tanzanian banks

Literature Gaps

Existing theoretical and empirical evidence on the effects of capital ratios on bank profitability are contradictory. For instance, while the Expected Bankruptcy Costs Hypothesis may advocates a positive effect, other theories, based on agency costs, suggest a negative effect. It is discussed under the literature review above that, while some studies report a positive relationship between bank capital and profitability, others show that high capital requirements lead to greater moral hazards, increased intermediation cost, and reduced bank profitability.

With regards to the Agency and the Stewardship theories reviewed, however, there is no one theory that has a complete explanation for the effect of board structures on profitability (Kiel and Nicholson, 2003). There is a link between agency and stewardship theories as, when there is a conflict of interest (agency theory) in the bank, then the objectives of the other theories cannot be achieved (Psaros, 2009). Moreover, studies on the effect of board size and independence on bank profitability are also contradictory. While some authors find a positive effect of board size and independence on bank profitability, others find a negative relationship. Moreover, studies do not link capital ratios, board size and independence, with bank profitability. In terms of bank ownership type, studies also show contradictory evidence, with several studies reporting positive effects, and others reporting negative effects.

Therefore, due to the contradictory empirical evidence provided by previous studies and the lack of studies on the link between capital ratios, board size and independence, and bank profitability, this study examines the effect of capital ratios on bank profitability and tests the extent to which board size and independence moderate the effect of capital ratios on bank profitability. This is because available bank capital studies (including those in the context of Tanzania) have also not explored how the interaction between capital ratios and board size and independence could influence bank profitability. Moreover, the study examines whether and how bank ownership types effect bank profitability. It should be noted that, as most studies have been done in developing countries, and that, as the capital markets in developing countries are still weak to the extent that higher capital levels may have adverse effects, the current study is done in Tanzania, a developing country, due to the country's background in terms of financial reforms and bank ownership diversity (see Chapter 1).

3.3 Data and Methodology

3.3.1 Research design and data

The main objective of this study is to examine the effect of capital ratios and ownership on bank profitability in the context of Tanzania, and the extent to which board monitoring influences the capital ratios-profitability linkage. This study uses an unbalanced panel dataset of 57[18] Tanzanian banks, covering the period 2006 to 2020. Multiple sources of data are used, namely the audited annual reports of banks' operations in Tanzania, a report by the Tanzania Banking Sector Performance Review published by Ernst and Young (2010), Capital Regulations issued by the Bank of Tanzania (BoT), and the 2008 Guidelines for Boards of Directors of Tanzanian Banks and Financial Institutions. Macro-economic indicators are obtained from the World Development Indicator (WDI) database provided by the World Bank.

3.3.2 Methodology and Empirical Models

This study uses panel data regressions to examine the effect of capital ratios on bank profitability. As the dataset contains both cross-sectional and time series characteristics, panel data is chosen as it enables observations of the behavior of entities across time (Brooks, 2008). To account for persistence of profitability and the endogeneity in variables, as discussed below, this study employs the dynamic estimation method (the system generalised method of moments, Sys-GMM). However, as noted above, the static estimation methods (ordinary least square-OLS and the fixed effect-FE or random effect-RE) are also used to check coefficients and thus, enable the analysis of findings across several estimation techniques (see, Wintoki et al., 2012; Bond, 2002). In addition, the OLS and FE estimation methods are used to determine the suitability of the sys-GMM model. The lagged OLS and lagged FE determine the required bound for coefficient of lagged dependent variable on the sys-GMM (Roodman, 2006). Thus, several other related studies use OLS, FE, and sys-GMM (see, for example, Wintoki et al., 2012; Laeven and Levine, 2009; Pasiouras and Kosmidou, 2007; De Andres and Vallelado, 2008; Goddard et al., 2004).

[18] Owing to bank failures, merging, and new entrants, the number of banking institutions in the country has varied. For instance, between 2017 and 2018, The Bank of Tanzania (BoT) revoked the licenses of seven banks due to persistent undercapitalisation and liquidity problems. These included: Mbinga Community Bank Plc, Covenant Bank for Women Ltd., Njombe Community Bank Ltd. Efatha Bank Ltd., Kagera Farmers' Cooperative Bank Ltd., and Meru Community Bank Ltd. Also, in 2018, three state owned banks were merged, namely, Twiga Bancorp Ltd., Tanzania Women's Bank Plc., and TPB Bank Plc. (BoT, 2017; 2018). Thus, the number of banking institutions in the country decreased to 46 in 2020 from 59 in 2016 (BoT, 2020).

3.3.3 Dynamic Models - Sys GMM

This study uses the system generalised method of moments (Sys-GMM) technique as the main estimator. The Sys-GMM is chosen as it can be used to account for persistence of the dependent variable and the endogeneity in variables. Persistence in bank profitability may arise from such issues as the cyclicality. In addition, there is potential endogeneity between bank capital ratios and bank profitability. Endogeneity problems can result from omitted variables, measurement error, and simultaneity (Wooldridge, 2002). The Sys-GMM estimation can mitigate these econometric problems. This method, unlike the commonly used static estimation techniques, can resolve persistence and endogeneity problems by instrumenting for the dependent variable and employing lagged dependent variables; it uses instrumental variables from within the dataset (Liang et al., 2013; Adams and Mehran, 2012; Goddard et al., 2011; Berger et. al., 2000).

The Sys-GMM is an extension of the difference GMM estimation, initially developed by Arellano and Bond (1991). Arellano and Bover (1995) and Blundell and Bond (1998) later augmented the estimator and thus developed the so called system GMM. This study employs the Sys-GMM instead of the difference GMM as it more efficient; it improves on the differenced GMM model in terms of bias and root mean squared error (Arellano and Bond, 1991; Roodman, 2009).

Therefore, as endogenous variables are instrumented by both lags of their own levels and lags of their own first differences, the Sys-GMM generates a higher number of moment conditions. The greater number of moment conditions in the model is more likely the number of valid instruments, resulting in an efficient dynamic estimation (Bond, 2002), and so making the “system” GMM a more efficient estimator compared to the “difference” GMM (Roodman, 2009). Unfortunately, the higher number of moment conditions may sometimes produce too many instruments which may affect the validity of instruments, leading to biased estimates, particularly in finite samples (Roodman, 2009). As a rule of thumb, the number of instruments should always be lower than the number of groups, if not, one may *collapse* some instruments and thus reduce the number. In the current study, the number of instruments, after *collapsing* them, is always lower than the 57 groups in all the models. In addition, the Sys-GMM provides efficient estimates, especially when indicators are non-stationary in levels (Arellano and Bover, 1995). Thus, another advantage of the Sys-GMM is that it removes the impact of panel unit roots (if any), and therefore it is not necessary to test for panel stationarity.

Moreover, the system GMM is preferred against the difference GMM as it allows for the inclusion of time invariant regressors in the model, while the later differences them out (Roodman, 2009). Further, as the GMM estimator is mainly applicable for datasets with a large cross-sectional (*N*) and a short time-series (T), it is considered appropriate for this study, which uses a dataset of N=57 (number of banks) and T=15 (period in years). Thus, an option *small* is used, which requests small-sample corrections to the covariance matrix estimate, resulting in an F-test instead of a Wald $\chi 2$ test for overall fit in t-test instead of z-test statistics for the coefficients (Roodman, 2009).

Based on the literature, this study uses the model below (Equation. 3.1) to determine the relationship between capital ratios and bank profitability (variables for this study are defined in Section 3.3.6)

$$Prof_{i,t} = \alpha_i + Prof_{i,t-1} + \sum_{d=1}^{d} \beta_d D_{i,t}^{d} + \sum_{k=1}^{k} \gamma_k X_{i,t}^{k} + \sum_{m=1}^{m} \lambda_m M_t^k + \mu_{i,t} \ldots\ldots\ldots\ldots\ldots (3.1)$$

- Where:
  - *i,t* represent bank, i at time period, t,
  - α_i is a constant coefficient,
  - $\beta_d, \gamma_{k,}\ and\ \lambda_m$ represent the coefficients for the independent, bank specific, and macro-economic variables, respectively
  - $\mu_{i,t.}$ represents the error term
  - $Prof_{i.t}$ represents bank level profitability,
  - $Prof_{i,t-1}$ is a one period lagged values of *Prof* that measures the degree of persistence in bank profitability,
  - *X* represents bank specific control variables that can affect bank profitability.
  - *D* denotes dummy variables, and
  - *M* represents macroeconomic control variables that can affect bank profitability.

3.3.4 Static models

As noted above, the analysis of this study also uses the static estimation methods (OLS and fixed- or random-effects) to determine the suitability of the sys-GMM model. However, OLS estimates rely on the pre-tests for example, multicollinearity, heteroscedasticity, and autocorrelations (Hutcheson, 2011). Moreover, it was noted above that panel data takes into account time effects and controls for individual heterogeneity; it gives more useful information by combining time series and cross-section data, so reducing collinearity and increasing variability, degrees of freedom and efficiency (Baltagi, 2013; Gujarati and Porter, 2009). If ignored, these issues may result in biased estimations. Therefore, this study also uses the fixed or random effects models which can capture bank specific effects (Brooks, 2008).

The fixed-effect (FE) estimation techniques are used to explore the association between predictor variables and outcomes within an entity (bank, person, country, etc.). The FE estimate assumes that individual characteristics may affect the predictor variables and so, there is a need to control for it. It is on this basis that the FE technique assumes a correlation between an entity's error term and the predictor variables (Gujarati and Porter, 2009). Therefore, the effects of time-invariant features can be removed by the FE estimates so that the net impact of the predictor variables can be analysed. Moreover, the FE estimation method assumes that the time-invariant behaviors are specific to the individual and so its error term and the constant are not correlated with the other entity. Therefore, econometrically, the fixed-effect (FE) model is expressed in the following equation (Equation 3.2) (see, Koop, 2008).

$$Y_{it} = \alpha_i + \beta_1 X_{it} + u_{it} \quad \text{..... (3.2)}$$

Where: Y_{it} represents a dependent variable; with i = bank and t = time

α_i (i=1…n) represents a dependent variable; with i = bank and t = time

X_{it} represents one independent variable

β_1 represents the coefficient for the independent variable

u_{it} is the error term

As noted above, since the FE technique controls for time-invariant variances between entities, the coefficients of the FE method cannot be biased due to omitted time-invariant characteristics (Kohler et al., 2009). However, if the error terms are correlated, then the FE model is not

appropriate as inferences may not be precise and so, preferably, a random-effects estimate is used. Unlike the FE model, in the random-effect (RE) model, the variation across individuals is assumed to be random and uncorrelated with the predictor variables. According to Green (2008), the critical difference between FE and RE is not whether the unobserved individual effects are stochastic or not, but whether they are correlated with the regressors in the model. The assumption behind the random effects models is that an entity's error term is not correlated with the predictor variables, thus, time-invariant variables can function as explanatory variables. Thus, the random effects model is given by the following expression:

$$Y_{it} = \alpha_i + \beta_1 X_{it} + u_{it} + \varepsilon_{it} \quad \text{..... (3.3)}$$

Where:

Y_{it} represents a dependent variable; with i = bank and t = time.

α_i (i=1…. n) represents a different (unknown) intercept for each bank

X_{it} represents one independent variable

β_1 represents the coefficient for the independent variable

u_{it} = between-entity error

ε_{it}= within-entity error

Therefore, unlike the fixed-effect (FE), the error term in the random-effect (RE) model comprises of two items: an entity's specific portion, which does not fluctuate over time, and a residue portion, which is presumed to be uncorrelated across time (Verbeek, 2008; Brooks, 2008).

3.3.5 Model specifications and study variables

Based on the theoretical and empirical literature, this study uses the following empirical specifications -baseline Equations 3.4 and 3.5 for the dynamic and static models, respectively.

$$Prof_{i,t} = \alpha_i + \gamma_1 Prof_{i,t-1} + \gamma_2 car_{i,t} + \gamma_3 lend_{i,t} + \gamma_4 npl_{i,t} + \gamma_5 bank\_size_{,t} + \lambda_2 infl_t + \lambda_3 gdp_t + \mu_{i,t} \text{.....(3.4)}$$

$$Prof_{i\,t} = \alpha_i + \gamma_1 car_{i,t} + \gamma_2 lend_{i,t} + \gamma_3 npl_{i,t} + \gamma_4 bank\_size_{i,t} + \lambda_1 infl_t + \lambda_2 gdp_t + \mu_{i,t} \text{……..(3.5)}$$

The variables used in this study are defined below.

Profitability (ROA, NIM)

Different indicators are used for measuring profitability, such as return on assets, Tobin's index, investment return, return on equity, economic value added and earnings per share (Dalvi and Baghi, 2014). Profitability is linked to firm value. Qureshi (2007) identifies four different approaches to firm value: the financial management approach, which focuses on the estimation of cash flows and investment levels; the capital structure approach, which studies the impact of capital structure changes on the value of a firm; the resource-based approach, which explains the value of firm as an outcome of firm's resources; and the sustainable growth approach, which is a summary of the above three approaches to firm value. This study uses the most used accounting based-measures, namely return on assets (ROA) and net interest margin (NIM). Although accounting-based measures report a more backward focus, can easily be manipulated through accounting methods, exclude risks, investment requirements, and time value of money, and are difficult to compare across industries (Khrawish, 2011), they are widely used indicators of bank profitability (see, for example, Lee and Hsieh, 2013; Ibrahim et al., 2012; and Doliente, 2005).

Return on assets (ROA) gives an idea as to how efficient management is in using firm assets to generate earnings (Khatab et al., 2011). As managers are responsible for the operation of the business and utilisation of the firm's assets, ROA is a measure that allows users to assess how well a firm's financial decisions and governance system is working in securing and motivating efficiency of the firm's management (Epps and Cereola 2008). This study defines ROA as the ratio of profit after tax to total assets, similar to other studies (e.g., Naceur and Kandil, 2009; Rime, 2001). Alternatively, ROA can be obtained by dividing earnings before interest and tax (EBIT) by total assets (Pandey, 2004). Several studies employ ROA as a proxy for bank profitability (see, for example, Lee and Hsieh, 2013; Ibrahim et al., 2012; Naceur and Kandil, 2009; and Rime, 2001).

Net interest margin- NIM is measured as the ratio of net interest income to total assets (Naceur and Kandil, 2009). NIM measures the bank's ability to cover intermediation costs. A low NIM suggests high interest expenses, while higher margins predict profitability (Reaz, 2005). However, if NIM is too large banks could be charging exorbitant interest rates. Thus, a higher NIM may also indicate risky lending practices that may result in significant provision for loan losses (Khrawish, 2011).

Capital ratio (car)

This variable is used to represents a bank's own capital ratio. It is measured as the ratio of total capital to risk-weighted assets plus off-balance sheet exposures (see, for example, Bitar et al., 2016; BoT, 2012; BoT, 2008; BCBS, 2004; Rime, 2001; and URT, 2001), and is computed as:

$$Car = \frac{Tier\ 1\ capital + Tier\ 2\ capital}{Total\ risk\ weighted\ assets + OBS} \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$

Where: Tier 1 capital comprises of shareholders' equity and disclosed reserves (BCBS, 2004); Tier 2 capital includes undisclosed reserves, revaluation reserves, hybrid capital instruments and subordinated term debt (BCBS, 2004); Total risk-weighted assets are the sum of asset book value and their related risk weights; and OBS are off-balance sheet exposures (see Chapter 2).

The capital ratio is expected to have a positive effect on bank profitability. Studies in support of the positive relationship show that, when expected bankruptcy costs are relatively high, an increase in capital ratios raises expected profits due to lower interest expenses (Altunbas et al., 2007; Rime, 2001; Berger, 1995). Other studies show that capital provides a reserve fund which acts as a 'buffer stock' to absorb unexpected losses and decrease insolvency risk, thus reducing funding costs and increasing profitability (Zheng et al., 2017; Olszak et al., 2017; Naceur and Omran, 2011; García-Herrero et al., 2009). However, a negative effect may arise as higher capital may motivate banks to take on more risks (Sharma, 2001), increase bank costs, reduce lending, and ignore profitable investments (Ayaydin and Karakaya, 2014; Hoffmann, 2011; Berge et al., 2008; Berger and Patti, 2006). For instance, the study of Ayaydin and Karakaya (2014) in Turkey suggests that the association between capital and profit could be positive or negative.

Board Size (bd_size)

Board size is an important internal board monitoring mechanism for effective bank performance. In theory, a smaller board size is expected to provide for efficient monitoring as it limits the opportunistic conduct of the bank management (Pathan, 2009). However, previous literature is inconclusive on what number of board members would constitute an effective board size. The formulator of Agency Theory, Jensen (1993), suggests that a board size beyond seven or eight members could be ineffective in monitoring management as it may increase agency cost and

information asymmetry. However, Lorsch (1997) notes that a board with 12 members could result in an effective dialogue, allowing for active board committee staffing. Surprisingly, De Andres and Vallelado (2008) find 19 members to be an optimal board size. This study measures board size by the total number of directors in the board (Anginer et al., 2016; Adams and Mehran, 2012). This study expects a negative relationship between board size and bank profitability. From the theoretical underpinnings, larger boards can result in higher agency cost due to information asymmetry (Pathan, 2009). An increase in board size could lead to ineffective co-ordination, coherence, and communications, which may result in interpersonal conflicts (Wang et al., 2012; Pathan, 2009), and so undermine bank profitability. Several studies have reported a negative relationship between board size and bank profitability (see, for example, Wang et al., 2012; Agoraki et al. 2010; Pathan, 2009; Coles et al., 2007; Hermalin and Weisbach 2003). However, other studies have found a positive relationship (e.g., Huq et al., 2018; Dong et al., 2017; Huang and Wang, 2015; Adams and Mehran, 2012). These studies argue that larger boards can reduce CEO domination and so provide for efficient monitoring to protect the interest of shareholders and increase members' diversity and skills, thus resulting in enhanced bank profitability.

Board independence (bd_ind)

There is scant literature on the determinants of optimal board composition (Hermalin and Weisbach, 2003). Although it is strongly argued that boards should be comprised predominantly, if not exclusively, of outside directors (Brown and Caylor, 2009), others suggest that, for effective working of a board and for unbiased control, a board consisting of at least one third of outside directors is preferred (Khan and Awan, 2012). Thus, this study measures board independence as the proportion of non-executive directors to the total number of directors in the board. This measure has also been widely used by other studies on similar topics (see, for example, Pathan, 2013; Erkens et al., 2012).

The study expects a positive relationship between board independence and bank profitability, as outside directors can lessen the conflict of interests between parties and reduce the agency problem (Liang et al. (2013), decrease systematic risk, idiosyncratic risk, and cost of equity (Ashbaugh-Skaife et al., 2006a), increase earnings quality and offer suitable compensation to the management (Cornett et al. 2009; Mishra and Nielsen 2000), lower the cost of debt financing (Anderson et al.,

2004), and increase a bank's credit ratings (Ashbaugh-Skaife et al., 2006b). Moreover, outside directors can bring specialised expertise and a wealth of knowledge for effective monitoring (Liang et al., 2013). However, independent boards may reduce bank profitability as they may reduce the control role of the non-executive directors in the bank due to information asymmetry between inside and outside directors; may fail to perform due to lack of appropriate support by the inside directors; and may not be competent to perform their assigned tasks as they are part-timers who do not have inside information of the firm (Brennan and Solomon, 2008; Cho and Kim, 2007).

These variables, among others, reflect the 2008 Guidelines for Boards of Directors of Banks in Tanzania, and are also used by several scholars. For instance, Adams and Mehran (2012) note that, arguably, these two variables are central to internal corporate governance mechanisms. To test the extent to which board size and independence can affect the capital ratios-bank profitability relationship, each of these variables is interacted with capital ratios as depicted on the empirical models (Equations 3.7 and 3.8) below.

Bank specific control variables

Lending (lend)

This is given by the ratio of total loans to total assets. The study expects a positive relationship between lending and bank profitability. A higher lending ratio indicates that a bank is specialising in lending as it enjoys informational advantages that could lower costs of intermediation, thus increase profitability through interest income (Dietrich and Wanzenreid, 2011). However, higher lending ratios may signify loose loan supply conditions, which may result in increased credit risk and low profitability (Naceur and Omran, 2011; Amidu and Hinson, 2006).

Non-performing loans (npl)

This variable, as a measure of asset quality, is used to control for the riskiness of the loans. In this study, NPL is measured as the ratio of gross non-performing loans to total loans (Majumder and Li, 2018; Zhang et al., 2013). This variable is expected to have a negative effect on profitability as higher NPLs indicate more loan defaults (Zhang et al., 2013). Difficulties with a bank's asset quality are presumed to reduce profits, as NPLs may compel a bank to lose interest income and thus lower bank earnings (Ozili, 2015; Grow et al., 2014; Baselga-Pascual et al., 2015). However,

the relationship may be positive. It is argued that a chase for profit may encourage risk-taking behaviour (Durand, 2019). For instance, a study by Garciya-Marco and Robles-Fernandez (2008) in Spain show a positive relationship between profitability and risk. Their study shows that the profit maximisation policy is associated with higher risks.

Bank Size (size)

Bank size is measured by the natural log of the bank's assets (Heffernan and Fu, 2008; Naceur and Goaied, 2008). It controls for the fact that bigger banks are likely to be more profitable as large banks could have low funding costs, technological efficiencies, greater market power, and greater diversification (Berger et al. 2009; Strahan; 2006; Rime, 2001; Goddard et al., 2004). Moreover, large banks may be more profitable as they can use their economies of scale and control their portfolio asset risks efficiently. However, banks that are too large may have many branches and large management teams, thus being bureaucratic in terms of communications and decision making, leading to inefficiency (Growe et al., 2014; Micco et al., 2007). Pasiouras and Kosmidou (2007) show that size may negatively affect performance as diversification may raise costs. Therefore, the relationship between bank size and profitability is uncertain.

Macro-economic control variables

Inflation (infl)

This variable is measured as the consumer price index (CPI) and is used to control for inflation rate as during inflation, banks can increase their lending rates to offset associated costs (Naceur and Omran, 2011), thus increasing their profitability. Several studies also find a positive and significant association (e.g., Pasiouoras and Kosmidou, 2007; Claessens et al., 2001). However, where bank costs increase faster than revenues, a negative coefficient is expected (Naceur and Kandil, 2009; Sufian and Chong, 2008; Afanasieffet al., 2002). Naceur and Kandil (2009) argue that higher inflation could cause uncertainty and so lower credit demand.

GDP growth (gdp)

This study measures this variable as the annual GDP growth rate (Majumder and Li, 2018) and expects it to be positively related with bank profitability. During economic upswings, borrowers' solvency may become higher, causing an increase for loan demand, thus enabling banks to increase

profits through interest income (Albertazzi and Gambacorta, 2009; Athanasoglou *et* al., 2008). However, others report a negative relationship (e.g., Tan and Floros, 2012; Uhde and Heimeshoff, 2009; Demirguc-Kunt et al., 2004). Tan and Floros (2012) opine that economic growth improves the business environment, thus increasing bank competition, which may lower bank profitability.

Based on the literature, the study extends Equations 3.4 and 3.5 above to Equations 3.7 and 3.8 below. The definition and measurement of the study variables are given under Section 3.3.5 above.

$$Prof_{i,t}=\alpha_i+\gamma_1 Prof_{i,t-1}+\gamma_2 car_{i,t}+\gamma_3 bd\_size_{i,t}+\gamma_4 bd\_ind_{i,t}+\gamma_5 lend_{i,t}+\gamma_6 npl_{i,t}+\gamma_7 bank\_size_{i,t}+\gamma_8(bd\_size_{i,t}\ x\ car_{i,t})+\gamma_9(bd\_ind_{i,t}\ x\ car_{i,t})+\lambda_1 inf_t+\lambda_2 gdp_t+\mu_{i,t} \quad \ldots\ldots(3.7)$$

$$Prof_{i,t}=\alpha_i+\gamma_1 car_{i,t}+\gamma_2 bd\_size_{i,t}+\gamma_3 bd\_ind_{i,t}+\gamma_4 lend_{i,t}+\gamma_5 npl_{i,t}+\gamma_6 bank\_size_{i,t}+\gamma_7(bd\_size_{i,t}\ x\ car_{i,t})+\gamma_8(bd\_ind_{i,t}\ x\ car_{i,t})+\lambda_1 inf_t+\lambda_2 gdp_t+\mu_{i,t} \quad \ldots\ldots(3.8)$$

Bank Ownership Type- Dummy (own)

Based on the theoretical evidence above (see section 3.2.2), this study expects bank profitability to vary, depending on a bank's ownership type. For instance, foreign banks in Tanzania are expected to be more profitable, relative to government and private, as they have access to developed markets, and potentially have better developed management skills and technology than their local counterparts (Claessens et al., 2001; Berger, 2000; Clarke et al., 2000). On the other hand, domestic private and state banks may be less profitable due to underdeveloped capital markets, low technologies, and low risk management skills (Berger et al., 2008; Barth et al., 2004; Mian, 2003; La Porta et al., 2002). To examine the effect of ownership type on bank profitability, this study uses three dummy variables for the three bank ownership forms – one variable each for foreign (for), private-domestic (pvt), or government (gov) owned – with the associated dummy taking on a value of 1 if the bank ownership structure corresponds to it, and 0 otherwise. This approach is also used by other authors (for example, Chronopoulos et al., 2020; Gupta and Mahakud, 2020; Pessarossi and Weill, 2015; Chernykh and Theodossiou, 2011). Thus, *for*, *pvt*, and *gvt* ownership types are estimated using Equations 3.9, 3.10, and 3.11 below, respectively.

$$Prof_{i,t}=\alpha_{i_1}+\gamma_1 Prof_{i,t-1}+\gamma_2 car_{i,t}+\gamma_3 lend_{i,t}+\gamma_4 npl_{i,t}+\gamma_5 bank\_size_{i,t}+\beta_1 for_{i,t}+\lambda_1 infl_t+\lambda_2 gdp_t+\mu_{i,} \ldots(3.9)$$

$$Prof_{i,t}=\alpha_{i_1}+\gamma_1 Prof_{i,t-1}+\gamma_2 car_{i,t}+\gamma_3 lend_{i,t}+\gamma_4 npl_{i,t}+\gamma_5 bank\_size_{i,t}+\beta_2 pvt_{i,t}+\lambda_1 infl_t+\lambda_2 gdp_t+\mu_{i,t} \ldots(3.10)$$

$$Prof_{i,t}=\alpha_{i_1}+\gamma_1 Prof_{i,t-1}+\gamma_2 car_{i,t}+\gamma_3 lend_{i,t}+\gamma_4 npl_{i,t}+\gamma_5 bank\_size_{i,t}+\beta_3 gvt_{i,t}+\lambda_1 infl_t+\lambda_2 gdp_t+\mu_{i,t} \ldots(3.11)$$

3.3.6 Diagnostic tests

Correlation analysis is used to test for multicollinearity, which exists if the independent variables tend to co-vary, making it hard to assess the significance of separate variables. It also inflates the standard errors and confidence intervals (Field, 2009). A coefficient of more than 0.8 indicates a serious multicollinearity (Guajarati, 2003; Kennedy, 2003). Also, the test for variance inflation factor (VIF) indicates an absence of multicollinearity in all the variables, and shows a mean VIF to be within the threshold of 10 (Torres-Reyna, 2007). Thus, these results suggest that there is no problem of multi-collinearity amongst the variables of this study. To check for the presence of autocorrelation, the Wooldridge test for autocorrelation in panel data is used. It has the null of no serial correlation. Failure to reject the null hypothesis indicates that the data does not have first-order autocorrelation (Wooldridge, 2002). To test for heteroskedasticity, the Breusch-Pagan/Cook-Weisberg Test is used, which has the null of homoscedastic or constant variance. Rejecting the null hypothesis indicates the presence of heteroscedasticity in the data (Breusch and Pagan, 1979).

The Hausman-test (Hausman, 1978) is used to decide between the fixed-effect (FE) and random-effects (RE) regression approaches. The test has the null hypothesis (H_0) that the unique errors (u_i) are correlated with the predictors, while the alternative hypothesis is that they are not (Green, 2008). The underlying assumption is that if 'H_0' (the individual effect is uncorrelated with any of the regressor variables) is true, then both the FE and RE models are consistent and deliver comparatively similar outcomes. However, in the case where 'H_0' is rejected, RE will be unsuitable, while FE will be interpreted (Koop, 2008). F/Wald Tests are used to see whether the independent variables are jointly significant in explaining the dependent variable's variations. The tests have a null that all the coefficients are jointly equal to zero (García-Herrero et al., 2009).

To test if capital ratios and control variables are related to past profitability, first, the dynamic OLS estimate is also run to check if the lagged dependent variable (profitability) is significant, and whether there is an increase in adjusted R^2 from static to dynamic OLS models (Wintoki et al., 2012). Results show that the link between capital ratios and profitability is dynamic (see details in Section 3.4.2). Second, the Wooldridge test for strict exogeneity is executed. The test is implemented by first running a FE regression and then testing for strict exogeneity (Wooldridge, 2012). That is, FE model: $y_{i,t} = \alpha + \gamma Xi_{,t} + \beta F_{i,t+2} + \acute{\eta}_i + \varepsilon_{it}, \; t = 1, 2, 3, \ldots, T$ ……. *(3.9),*

where, $F_{,t+1}$ is a future values of capital ratios and control variables. The null of strict exogeneity is $\beta = 0$, i.e., future capital ratios and control variables are not related to current profitability. Results presented in Tables 3A-18 and 3A-19 show that capital ratios and several control variables are not strictly exogenous (see Section 3.4.2).

Before GMM estimations are executed, it is important to determine the number of lags of the dependent variable, in this case, bank profitability. This is because if all effects of the past on the present are not captured, it may mean that there is an omitted variable bias, and so the model is miss-specified (Wintoki et al., 2012). In addition, all deeper lags can be treated as instruments that are exogenous with regard to the present residuals (Wintoki et al., 2012; Roodman, 2009). The use of one lag is mandatory in dynamic panel models, but one can use more lags to determine proper instruments. However, many lags can reduce the data set (Arellano and Bond (1991). Similar to Wintoki et al. (2012), this study determines the number of lags by regressing the current profitability on eight lags of past profitability, controlling for capital ratios and control variables. Results show that the first lag for all the models is suitable (see Section 3.4.2). This study thus uses the 1st lag of profitability in the dynamic model, and the 2nd or deeper lags as instruments.

Thus, this study uses the two-step Sys-GMM, employing the Stata command *xtabond2* by Roodman (2009). One of the benefits of this command is that it allows specific lags to be incorporated in estimation, instead of relying on the default approach (Roodman, 2009). As noted above, in this study, all variables are thus lagged two or more periods as *gmmstyle* instruments except for the dummy variables, unless otherwise specified. The Windmeijer-corrected standard errors, small-sample adjustments, and orthogonal deviations are also implemented (see Roodman, 2009). The ‘‘collapse’’ option is invoked to generate one instrument for each variable and lag distance, instead of one for each variable, period, and lag distance (Wintoki et al., 2012,), thus limiting instrument proliferation (Roodman, 2009). The Hansen J-test of the overidentifying restrictions is used for the GMM Models. Under this test, the null hypothesis is that the group of instruments are exogenous. Also, the Arellano-Bond tests for the first order autocorrelation –AR (1) and for no second order autocorrelations –AR (2) are performed. Each of the tests has the null hypothesis of no serial correlation. While the AR (1) test should be significant, the AR (2) test should be non-significant (Arellano and Bond, 1991). See results for these tests in Section 3.4.2.

3.4 Empirical Results and Analysis

This section addresses the study estimations. These include the descriptive results of the study variables, the results for the effect of capital ratios on bank profitability, and additional estimations, which test the link between board size and independence, and ownership type on bank profitability.

3.4.1 Descriptive statistics

Table 3-1 below presents the summary statistics for the variables used in the study. The overall mean value for bank profitability, in terms of the return on asset (ROA), is -0.86%, ranging from -46.44% to 11.78%, with a standard deviation of 6.08%.

Table 3-1: Summary statistics

Variable	Obs	Mean	Std. Dev	Min	Max	Med	Percentile			
							5th	25th	75th	95th
Return on assets	611	-0.861	6.075	-46.437	11.779	0.971	-13.071	-1.295	2.1	3.408
Net interest margin	611	15.336	9.09	-8.937	61.161	12.949	5.391	9.921	18.634	33.529
Capital ratio	611	25.482	30.48	-89.388	254.252	18.937	7.397	14.007	27.443	66.748
Board size	611	7.786	2.04	5	13	8	5	6	8	12
Board independence	611	0.851	0.11	0.5	1	0.625	0.625	0.8	0.9	1
Lending	611	50.412	14.909	0	87.204	51.851	23.349	42.981	60.000	72.176
Non-performing loans	611	6.698	8.978	0	60.362	12.949	5.391	9.921	18.634	33.529
Bank size	611	18.612	1.911	12.388	22.683	18.875	15.215	17.484	19.986	21.254
Inflation	15	7.584	3.672	3.29	16.001	6.2	3.29	5.175	10.278	16.001
GDP growth	15	6.414	1.008	4.7	8.5	6.7	4.7	5.6	6.9	8.5
Foreign	315	0.516	0.5	0	1	1	0	0	1	1
Private_domestic	204	0.334	0.472	0	1	0	0	0	1	1
Government	92	0.151	0.358	0	1	0	0	0	1	1

In terms of the net interest margin (NIM), the overall average value is 15.34%, with the minimum, maximum, and standard deviation of -8.94%, 61.16%, and 9.09%, respectively. The results suggest that bank profitability varies greatly across Tanzanian banks over the study time. Further, Appendix Table 3A-24 shows that, in terms of return on assets (ROA), foreign owned banks are generally the most profitable, with the least profitable being the state banks. Literature suggests that foreign owned banks operating in developing markets enjoy higher profits due to access to high-level technologies, better risk management practices, and their access to developed markets (Claessens et al., 2001). However, in terms of net interest margin-NIM, local banks have the highest score, indicating that these banks may generate most income from administration costs, or charge higher interest rates on loans (Demirgüç-Kunt and Huizinga, 2000).

The capital ratio (car) for all banks in the study shows an average value of 25.48%. As this figure

is higher than the regulatory requirement ratio of 8% or 12%, it indicates that, on average, Tanzanian banks were adequately capitalised over the study period. However, the results indicate that the sector includes both under-capitalised and over-capitalised banks, as shown by the minimum and maximum values of -89.39 and 254.25, respectively. Thus, the sector's capital ratio varied across banks, as indicated by the standard deviation of 30.48%. While foreign banks have the highest mean capital ratios (30.01%), private domestic and government banks show lower values of 20.56% and 20.91%, respectively (Table 3A-24). The reason may be that, in Tanzania, domestic owned banks suffer from lack of capital, as compared to foreign owned banks, which have access to developed capital markets. Local banks in developing economies many be undercapitalised due to underdeveloped capital markets (Claessens et al., 2001).

The mean value for the board size is 8, with a minimum of 5 and a maximum of 13. This conforms to the recommendations of the developer of agency theory, Jensen (1993) that a board should comprise of seven or eight members for effective monitoring and reduction of CEO domination. The board independence has the mean ratio of 0.85, indicating that over the study period, on average, the boards of Tanzanian banks comprise an 85-percent of non-executive directors. The data further shows that foreign banks (in Tanzania) had the greatest number of both the board size and non-executive directors, followed by government banks and private-domestic banks. Generally, the mean result indicates that over the study period, on average, the Tanzanian banks meet the 2008 Guidelines on Boards of Directors of Banks which require a board of directors to be composed of not less than five members, the majority of whom must be non-executive directors (BoT, 2008).

The mean value for the lending ratio (lend) is 50.41%, ranging from 0% to 87.20%. Private-domestic banks have the highest lending ratios, followed by the government banks, with foreign banks being the last in this respect (see appendix Table 3A-24). The reason may be that private-domestic banks provide loans to many small and medium enterprises (SMEs). On the other hand, state banks in Tanzania are mostly involved in the provision of government related huge loans to parastatals organisations for large development and agricultural projects. Thus, private-domestic and state banks are much involved in market-based lending. However, without thorough loan scrutiny and credit risk control, lending could result in higher credit risks (Naceur and Omran,

2011). The ratio of non-performing loans to total loans (NPL) range from 0.0% to 60.36%, with a mean ratio of 6.69%, indicating that Tanzanian banks experienced higher credit risks which are, on average, above the country's maximum threshold of five percent (BoT, 2012). In terms of size, foreign owned banks are the largest, followed by government owned banks and private-domestic owned banks (see appendix Table 3A-24).

As for Tanzania's macro-economic indicators, the mean inflation rate was 7.58%, with the lowest rate (3.29%) in 2016 and the highest rate (16%) in 2012. Surprisingly, the rate increased from 7.0% in 2007 to 12.14 % in 2009. The mean country's GDP growth rate is 6.41%, raising from 4.7% in 2006 to 8.5% in 2007. However, following the Covid-19 global pandemic, it fell to 4.8% in 2020.

Table 3-2 below presents the correlation matrix of the variables used in this study. An examination of the correlations of the variables gives an indication of the rationality of the models. High correlation of the independent variables may indicate that the estimates of the regression could be biased due to multi-collinearity as both represent essentially the same thing. In other words, multi-collinearity indicates that the independent variables are redundant, thus cannot add any statistical value over each other. From the table, return on assets (ROA) is positive and significant correlated with board independence, lending and bank size, but negatively with net interest margin (NIM) and non-performing loans. NIM is positive and significantly correlated with capital ratios, but negatively and significant with lending, bank size, and the foreign ownership.

Capital ratio is positively and significantly correlated with board size and the foreign ownership, but negatively and significant with board independence, lending, NPL, bank size, and private-ownership. Board size is positive and significantly correlated with bank size and foreign ownership, but negatively with lending, inflation rate, and the private ownership. Board independence is significant and positively correlated with lending and bank size. Bank ownership types are negatively and significant correlated with each other. Multicollinearity is deemed to be an issue of concern when the correlation coefficient is above 0.8 (Kennedy, 2003). However, the correlation coefficients in this study are all substantially below 0.8, thus suggesting that there is no problem of multi-collinearity amongst the study variables.

Table 3-2: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Return on asset	1.000												
(2) Net interest. margin	-0.085*	1.000											
(3) Capital ratio	0.027	0.355*	1.000										
(4) Board size	0.059	-0.003	0.152*	1.000									
(5) Board indep.	0.158*	-0.042	-0.111*	-0.018	1.000								
(6) Lending	0.120*	-0.198*	-0.482*	-0.141*	0.206*	1.000							
(7) Non performing loans	-0.103*	-0.071	-0.156*	-0.030	0.036	0.040	1.000						
(8) Bank size	0.430*	-0.314*	-0.115*	0.381*	0.252*	0.050	0.092*	1.000					
(9) Inflation	0.023	0.066	0.044	-0.101*	0.019	-0.057	-0.211*	-0.211*	1.000				
(10) GDP growth	-0.003	0.019	-0.015	-0.018	0.007	0.023	0.115*	0.026	-0.212*	1.000			
(11) Foreign	0.034	-0.093*	0.153*	0.091*	0.018	-0.238*	0.065	0.254*	-0.086*	0.004	1.000		
(12) Private-domestic	-0.002	0.049	-0.114*	-0.075	-0.019	0.178*	-0.076	-0.204*	0.071	0.001	-0.730*	1.000	
(13) Government	-0.046	0.066	-0.063	-0.028	-0.001	0.098*	0.008	-0.085*	0.027	-0.007	-0.434*	-0.298*	1.000

*** *p<0.01,* ** *p<0.05,* * *p<0.1*

3.4.2 Regression results

This section is devoted to the study's estimation results. The dependent variable is bank profitability proxied by the return on assets (*roa*) and net interest margin (*nim*). The key independent variable is the risk-based capital ratio *(car)*. Several pre- and post-diagnostics are performed. For the regressions based on either the fixed- or random-effect models, the Hausman test to select the appropriate specification between the fixed or random effects is used. Based on the assumptions discussed under Section 3.3.6 above, the null hypotheses indicate the appropriate model to be interpreted, as presented in Tables 3-3 and 3-4 below.

To check for the presence of autocorrelation on the OLS, FE or RE estimates, the study uses the Wooldridge test for autocorrelation in panel data, which has the null of no serial correlation (Wooldridge, 2002). Moreover, to test for heteroskedasticity problems, the study uses the standard Breusch-Pagan/Cook-Weisberg test. From the Stata outputs, the null hypotheses were rejected, indicating the presence of autocorrelations and heteroskedasticity. The Windmeijer-corrected standard errors is added to correct for the heteroskedasticity and autocorrelation problems, as it produces estimates which can be efficient, unbiased and consistent (Wooldridge, 2019). R-squared (R-sq) measure is used to show the variations of variables in panel data. The R-sq (within) indicates that the variations in bank profitability are due to changes within individual banks over time, as well as due to changes between the banks. The results for interclass correlation (rho) show larger coefficients, indicating that the variances in bank profitability are largely caused by the differences across the banks. The results for the F test or Wald test of joint significance (Tables 3-3, 3-4, and 3-5) show a rejection of the null, indicating that the independent variables are jointly significant.

This study also runs models with the lagged OLS and FE to check if they are biased and determine the required bound for coefficient of lagged profitability on the GMM. For instance, Table 3A-20 confirms that while the first lags of ROA on OLS are upward biased (0.5906), those of FE are downward biased (0.2709) (Baltagi, 2008; Bond, 2002; and Nickell, 1981). The first lagged ROA of GMM (0.574) lie between those of OLS and FE, thus are in the suitable recommended range (Roodman, 2009). As seen in Table 3A-17, the results for the dynamic OLS estimate show that the lagged dependent variable (ROA) is significant, and the adjusted R^2 increases from the static to dynamic OLS models, i.e., from 0.3754 to 0.657, and 0.2346 to 0.3085, for the ROA and NIM

models, respectively, signifying a dynamic link between capital ratios and profitability (Wintoki et al., 2012). The Wooldridge tests for strict exogeneity (Tables 3A-18 and 19) show that the coefficients of future values of capital ratios and some control variables are significantly different from zero, rejecting the null. Also, an F-test for the joint significance of the coefficient of all the future values is significant. Thus, capital ratios and control variables are not strictly exogenous.

This study then determines the number of lags for the dependent variable, bank profitability (ROA and NIM), as briefly explained in Section 3.3.6 above. Thus, the dynamic OLS technique is used to estimate Equation 3.1. Similar to Wintoki et al. (2012), this study tests the number of lags as shown in the appendix Table 3A-22 and Table 3A-23 for the dependent variables ROA and NIM, respectively. Thus, nine models are estimated - while the first to the eighth models include the first to the eighth lags, respectively, the ninth model includes all eight lags in a single equation. Results on the ROA models show that several lags are statistically significant, with the first lag having the highest coefficient (0.591). Including all lags in a single equation, only the first, fourth, and seventh lags become statistically significant. However, the coefficient for the first lag is higher (0.612) than that for the fourth (0.171) and seventh (0.191) lags. For the NIM models, all the lags are significant, with the first lag exhibiting the highest coefficient (0.549). Including all lags in Column 9, only the first (0.459) and fifth (0.249) lags are significant, the first lag displaying a higher coefficient. These findings indicate that the first lag could best capture the persistency of bank profitability. Thus, this study uses the first lags of profitability in the dynamic model, and second or deeper lags as instruments. Glen et al. (2001) posit that two lags are adequate to capture the profit persistency. Several studies use one- or two-period lagged independent variables as instruments (e.g., Francis and Osborne, 2012; Lemmon and Zender, 2008; Mackay and Phillips, 2005; and Ozkan, 2001).

Results for the Hansen J-test, the AR(1) and AR(2) tests, and for the profit persistence are presented in each of the Tables 3-3, 3-4, and 3-5 below. The Hansen J-test fails to reject the null of exogeneity, indicating that the models are not over-identified in all estimations. While the AR(1) test rejects the null hypothesis of no first order autocorrelation, the AR(2) test fails to reject the null hypothesis of no second order autocorrelation of residuals. The lagged (once) dependent variables are positive and significant, indicating that the profitability of Tanzanian banks is highly persistent.

Table 3-3: Regression outputs- capital ratios and bank profitability (baseline model)

Variables	Return on asset (ROA)			Net interest margin (NIM)		
	OLS	FE	GMM	OLS	FE	GMM
	(1)	(2)	(3)	(4)	(5)	(6)
Lag-profitability			*0.79****			*0.379****
			(0.143)			*(0.082)*
Capital ratio	*0.034***	*0.074***	*0.045**	*0.09****	*0.055*	*0.082**
	(0.017)	*(0.032)*	*(0.026)*	*(0.028)*	*(0.052)*	*(0.044)*
Lending	*0.097****	*0.069***	*-0.029*	*-0.023*	*-0.139****	*-0.15****
	(0.024)	*(0.031)*	*(0.076)*	*(0.034)*	*(0.047)*	*(0.047)*
Non-perf loans	*-0.054***	*0.005*	*-0.098**	*0.002*	*-0.02*	*-0.036*
	(0.026)	*(0.035)*	*(0.052)*	*(0.038)*	*(0.045)*	*(0.026)*
Bank size	*1.66****	*5.317****	*-.0506*	*-1.326****	*-0.053*	*-1.218***
	(0.212)	*(1.260)*	*(0.905)*	*(0.244)*	*(1.84)*	*(0.54)*
Inflation	*-0.086*	*-0.034*	*-0.27*	*0.145*	*0.078*	*-0.216*
	(0.121)	*(0.071)*	*(1.776)*	*(0.509)*	*(0.076)*	*(0.213)*
GDP growth	*0.039*	*0.266**	*-2.845*	*-0.164*	*-0.104*	*-0.021*
	(0.328)	*(0.136)*	*(4.481)*	*(1.263)*	*(0.183)*	*(1.377)*
Constant	*-38.727****	*-109.535****	*32.252*	*37.986****	*19.419*	*40.27***
	(5.76)	*(26.217)*	*(32.112)*	*(9.184)*	*(36.919)*	*(15.247)*
Time effects	*Yes*	*Yes*	*Yes*	*Ye*	*Yes*	*Yes*
F-/Wald (p-value)	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
R-squared-within		*0.3065*			*0.2062*	
-between		*0.2827*			*0.0979*	
-overall	*0.3165*	*0.2680*		*0.2152*	*0.1203*	
RMSE	*5.1068*			*8.1886*		
Rho		*0.8443*			*0.5750*	
Hausman-test		*0.0000*			*0.0416*	
Fixed/Random		*fe*			*fe*	
Test for AR (1)			*0.048*			*0.008*
Test for AR (2)			*0.708*			*0.950*
Hansen-overid (p-value)			*0.217*			*0.472*
Observations	*611*	*611*	*554*	*611*	*611*	*554*
No. of instruments			*35*			*42*
No. of banks	*57*	*57*	*57*	*57*	*57*	*57*

*Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Capital ratios and bank and profitability

Table 3-3 presents regression outputs for the effect of capital ratio on the profitability of Tanzanian banks. The table has two columns, each divided into three sub-columns to represent the estimations used - the ordinary least square, fixed effect, and Sys-GMM, respectively. Several estimations are thus performed as shown in the table. Models 1, 2, and 3 present the relationship between capital ratios and bank profitability, proxied by the return on asset (ROA). Models 4, 5, and 6 provide the relationship between capital ratios and bank profitability, proxied by the net interest margin (NIM).

Consistent with the hypothesis 3A that capital ratios and bank profitability are significantly related, the results show a positive relationship between capital ratio and profitability for all the models and is significant except for Model 5, indicating that Tanzanian banks with higher capital ratios are more profitable. For instance, in the Sys-GMM Models (Columns 3 and 6), holding other variables constant, a percentage point increase in capital ratio is related to a 4.5 and 8.2 percentage point increase in banks' returns on assets and net interest margins, respectively. Others also find a similar result (see, for example, Zheng et al., 2017; Olszak et al., 2017; Naceur and Omran, 2011; and García-Herrero et al., 2009). The result conforms to the Bankruptcy Cost Hypothesis, which argues that banks holding more capital avoid periods of distress, and so increase expected profits through lowering interest expenses (Altunbas et al., 2007; Rime, 2001).

Focusing on the bank specific variables, the static (OLS and FE) models show that lending is positively and negatively related to the return on asset (ROA) ratio and net interest margin (NIM) , respectively, being significant for Models 1, 2 and 5. Theoretically, an increase in lending increases the profitability (ROA) of banks. Banks with higher loan ratios are said to enjoy informational advantages that could lower costs of intermediation, thus increasing profits (Dietrich and Wanzenreid, 2011). However, considering the dynamic (sys-GMM) estimations the link between lending and profitability is consistently negative across the models (Columns 3 and 6), being significant for Model 6, indicating that an increase in loan supply can decrease the profitability of banks, a result that has been reported by prior studies (e.g., Naceur and Omran, 2011; Amidu and Hinson, 2006; Maudos and Guevara, 2004). It could be that Tanzanian banks implement unhealthy lending policies. Unhealthy lending policies may increase NPLs, resulting in lower profits (Maudos and Guevara, 2004). Nguyen et al. (2012) show that increased lending to less creditworthy customers may lead to higher NPLs, resulting in reduced bank profitability. The NPL ratio is negatively related to profitability for all the static and dynamic models, except Models 2 and 4, being significant for Models 1 and 3. Higher NPLs lower banks' interest income and so reduce profits (Ozili, 2015; Grow et al., 2014; Zhang et al., 2013). An increase in the Tanzanian banking sector's NPLs and a consecutive fall in ROA (2013 to 2017) could reflect these findings.

Bank size enters the regressions positively or negatively, being statistically significant for all the models except Model 3. However, employing the sys-GMM estimation method, bank size show

consistent negative coefficients in ROA and NIM models, being statistically significant in Model 4. Similarly, the study by Heffernan and Fu (2008) in China finds a negative relationship between bank size and both ROAA and NIM, being significant for the later. Pasiouras and Kosmidou (2007) show that bank size may negatively affect performance, as diversification may increase costs. This suggests that big banks have high interest expenses as they may borrow much to finance growth. Also, as larger banks may have many branches and/or large management teams, they could be bureaucratic in communications and decision-making, which may result in low performance (Growe et al., 2014; Micco et al., 2007). The rate of inflation has non-significant negative coefficients for all the static and dynamic models, except Models 4 and 5. Theoretically, higher inflation may cause uncertainty and so lower credit demands and reduce bank profits (Naceur and Kandil, 2009). The results for the static methods show GDP growth to have positive and negative coefficients for the ROA and NIM models, respectively, being statistically significant in Model 2. However, using the dynamic models (sys-GMM), the results show that GDP and profitability have a consistent negative but non-statistically significant relationship. Theoretically, while higher GDP growth increases bank profitability (Albertazzi and Gambacorta, 2009; Athanasoglou *et* al., 2008), it may also reduce it (Uhde and Heimeshoff, 2009; Demirguc-Kunt et al., 2004). As noted above, higher GDP growth may improve the business environment, leading to increased bank competition and so, this may reduce bank profitability (Tan and Floros, 2012).

Capital and profitability: moderating effect of board size and independence

Table 3-4 below presents the regression results for the relationship between capital and profitability, with board size and independence as the moderating variables. While the main independent variable is capital ratio (car), the dependent variable is bank profitability (ROA) (Models 1 to 3) and net interest income (NIM) (Models 4 to 6). As indicated, Models 1 and 4, 2 and 5, and 3 and 6, are estimated by the OLS, FE/RE, and Sys-GMM, respectively. All the models add in board size and board independence. From the table, except for the link between capital ratio and net interest margin (Models 4, 5, and 6), which show a reverse result (to be discussed later), all other variables maintain the same sign of coefficients as in Table 3-3.

Table 3-4: Capital and profitability: moderating influence of board size and independence

Variables	Return on asset (ROA)			Net interest margin (NIM)		
	OLS	FE/RE	GMM	OLS	FE/RE	GMM
	(1)	(2)	(3)	(4)	(5)	(6)
Lag-profitability			0.574***			0.5156***
			(0.1288)			(0.1472)
Capital ratio	0.3802***	0.2151	0.8108**	-0.1027	-0.2653	-0.8469*
	(0.118)	(0.1478)	(0.3513)	(0.2037)	(0.3328)	(0.5014)
Lending	0.0874***	0.0622**	-0.022	-0.0295	-0.1468***	-0.0069
	(0.0247)	(0.0297)	(0.0371)	(0.035)	(0.0455)	(0.0723)
Non-perf. loans	-0.0614**	0.0001	-0.0619	0.0053	-0.0194	-0.0341
	(0.0247)	(0.0329)	(0.0553)	(0.0363)	(0.0417)	(0.0637)
Bank size	1.6156***	5.1938***	0.8414	-1.4451***	0.2804	-0.005
	(0.2041)	(1.1907)	(0.6086)	(0.2659)	(1.6524)	(0.5934)
Board size	0.2467	0.1298	0.5945	-0.1099	0.1393	-0.2607
	(0.1942)	(0.1771)	(0.5391)	(0.3197)	(0.4251)	(0.5228)
Board ind	5.655**	2.9748	24.7519**	5.1716	-6.0435	-41.5822**
	(2.7709)	(4.7742)	(9.4662)	(5.6261)	(8.8361)	(16.9067)
Car x board size	-0.0192***	-0.0113**	-0.0303*	0.013	-0.0016	0.0088
	(0.0061)	(0.0046)	(0.0181)	(0.0092)	(0.0125)	(0.0204)
Car x board ind	-0.2389***	-0.0668	-0.7291***	0.1054	0.3936	1.0823**
	(0.0917)	(0.1692)	(0.2694)	(0.2024)	(0.3002)	(0.5261)
Inflation	-0.0802	-0.0388	-1.4725	0.1088	0.0802	-0.6265
	(0.1095)	(0.0712)	(1.4907)	(0.5315)	(0.078)	(1.1383)
GDP growth	0.0289	0.228	-9.3251	-0.3534	-0.0205	1.4675
	(0.2975)	(0.1753)	(10.0778)	(1.2949)	(0.2305)	(3.4057)
Constant	-43.6472***	-110.0107***	32.8071	37.8876***	16.9029	35.666
	(5.4104)	(24.0973)	(77.6308)	(10.0137)	(37.1271)	(28.9576)
Time effects	Yes	Yes	Yes	Yes	Yes	Yes
F-test (p-value)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared -within		0.3291			0.2227	
-between		0.2870			0.0880	
-overall	0.3754	0.2899		0.2346	0.0362	
RMSE	4.8987			8.1142		
Rho		0.8418			0.6903	
Hausman-test		0.0003			0.0152	
Fixed/Random		fe			fe	
Test for AR (1)			0.023			0.016
Test for AR (2)			0.908			0.917
Hansen-overid (p-value)			0.490			0.557
Observations	611	611	554	611	611	554
Instruments			47			50
No. of banks	57	57	57	57	57	57

*Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

While board size has a non-significant positive relationship with bank returns on assets (ROAs) for all models, it has a non-significant negative relationship with net interest margin (NIM). Theoretically, while large boards can increase banks' diversity and skills, reduce the domination of CEO and so provide for an efficiency monitoring to protect the interest of shareholders (Huq et al., 2018; Dong et al., 2017; Huang and Wang, 2015; Adams and Mehran, 2012), it may also lead to ineffective communications, co-ordination, and coherence, resulting in interpersonal conflicts

and higher agency costs (Wang et al., 2012; Agoraki et al. 2010; Pathan, 2009; Coles et al., 2007; Hermalin and Weisbach 2003). The non-significant result is similar to that of De Vita and Luo (2018), who also (in their study covering 54 countries) find that the relationship between board size and bank risk-taking is statistically non-significant.

With regards to board independence, consistent with Hypothesis 3C, this study finds a positive relationship between board independence and ROA in all ROA models except Model 2 and significantly so for Models 1 and 3, indicating that an increase of non-executive directors on the board increases the profitability of Tanzanian banks. However, the variable has a negative relationship with NIM in all NIM models, except Model 4, being statistically significant for the Sys-GMM model (Column 6).

Therefore, although a more independent board enhances ROA, it may lower bank NIM. As discussed above, a board with more non-executive directors may be out of touch and thus lose control of the firm' activities due to information asymmetry between inside and outside directors (Brennan and Solomon, 2008; Cho and Kim, 2007). This can affect their decision making, resulting in low net interest margin. It is further argued that, in an ownership diversified banking sector with state banks (like Tanzania), non-executive directors may end up acting in the interest of outsiders (Gelter, 2010), such as political authorities (Andrews, 2005).

Further, the study investigates whether and how the effect of capital ratio on bank profitability could be influenced by a bank's board size and the number of non-executive members on the board. To achieve this, the variables board size and board independence are each interacted with the capital ratio (i.e., capital x board size, and capital x board independence) to capture their influence (if any) on the capital-profitability relationship.

Consistency with Hypothesis 3D, the results show a negative and significant relationship between the interaction term capital x board size and bank profitability (Models 1 to 3). On the other hand, while the relationship between the interaction term capital x board independence and ROA is negative for all ROA models, being significant in Models 1 and 3, it is positive for all NIM models, being significant for Model 6, thus supporting Hypothesis 3E.

Interestingly, while all other variables maintain the same sign of coefficients as in Table 3-3, capital ratios show an inverse result after controlling for board size and independence in Table 3-4 (Model 6). Thus, these results show that the link between capital ratio and bank profitability is influenced by board independence.

The interaction results above indicate that increasing capital ratios, while also increasing the board size can result in reduces profitability (ROA) for Tanzanian banks. Similarly, increasing capital ratios, while also increasing the number of non-executive directors, reduces ROA. This may suggest that, as the results on Table 3-3 show a positive relationship between capital ratios and bank profitability, highly capitalized banks can thrive without larger boards and/or more non-executive directors, and vice-versa. However, the positive results for NIM may suggest that a smaller and independent board can minimise risks and agency costs (Jensen and Meckling, 1976), resulting in low cost of capital (Pathan and Skully, 2010) and increased profitability.

The findings above conform to the Agency Theory which suggests that, unlike the executive directors, non-executive directors can effectively monitor the management's risk-taking motives. It was noted above that under higher capital requirement, bank managers can react by increasing bank risk (Lee and Hsieh, 2013; Sharma, 2001). Thus, non-executive directors can minimise risk-taking (Hermalin and Weisbach, 2003), and so increase profitability. In addition, non-executive directors can minimise agency costs (Jensen and Meckling, 1976), resulting in lower cost of capital (Pathan and Skully, 2010) and higher profits.

From the Resource Dependence Theory, outside directors can help a bank (under capital requirement) to access external funding due to their external linkages (Erkens et al., 2012). An independent board can thus enable a bank to benefit from external resources, such as capital (Adams and Mehran, 2012; Ferreira, 2010). Thus, as Cabo et al. (2012) note, the effect of capital on bank risk and profitability depends on the structure of the board.

Table 3-5: Sys-GMM Regressions - bank capital ratios and profitability with ownership types

Variable	ROA			NIM		
	(1)	(2)	(3)	(4)	(5)	(6)
Lag- profitability	*0.774****	*0.593****	*0.545****	*0.36****	*0.37****	*0.387****
	(0.153)	*(0.134)*	*(0.125)*	*(0.112)*	*(0.075)*	*(0.088)*
Capital ratio	*0.044**	*0.05**	*0.037*	*0.113**	*0.094***	*0.08**
	(0.026)	*(0.026)*	*(0.026)*	*(0.057)*	*(0.042)*	*(0.042)*
Lending	*-0.025*	*0.029*	*0.047**	*-0.155****	*-0.155****	*-0.15****
	(0.075)	*(0.043)*	*(0.027)*	*(0.058)*	*(0.043)*	*(0.049)*
Non-perf. loans	*-0.096**	*-0.008*	*-0.01*	*-0.043*	*-0.033*	*-0.042*
	(0.054)	*(0.025)*	*(0.025)*	*(0.038)*	*(0.024)*	*(0.027)*
Bank size	*-0.387*	*1.23***	*1.246***	*-1.158*	*-1.139***	*-1.083**
	(1.001)	*(0.562)*	*(0.601)*	*(0.966)*	*(0.512)*	*(0.578)*
Inflation	*-0.331*	*-0.113*	*-0.306*	*-0.441*	*-0.282*	*-0.241*
	(1.902)	*(0.26)*	*(0.383)*	*(0.723)*	*(0.235)*	*(0.206)*
GDP growth	*-3.049*	*-0.223*	*-0.5*	*-1.93*	*-0.517*	*-0.146*
	(4.693)	*(0.644)*	*(1.016)*	*(4.938)*	*(1.52)*	*(1.379)*
Foreign	*-0.084*			*-3.196***		
	(0.344)			*(1.547)*		
Private-domestic		*1.132*			*2.229**	
		(1.047)			*(1.218)*	
Government			*-0.094*			*2.304*
			(0.682)			*(1.443)*
Constant	*31.598*	*-23.797**	*-22.255*	*54.77*	*41.847***	*38.07***
	(32.26)	*(13.316)*	*(13.894)*	*(56.041)*	*(15.979)*	*(15.171)*
Time effects	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
F-test (p-value)	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Test for AR (1)	*0.051*	*0.046*	*0.050*	*0.050*	*0.008*	*0.009*
Test for AR (2)	*0.711*	*0.678*	*0.693*	*0.693*	*0.979*	*0.954*
Hansen-overid (p-value)	*0.205*	*0.408*	*0.354*	*0.354*	*0.671*	*0.391*
Observations	*554*	*554*	*554*	*554*	*554*	*554*
Instruments	*36*	*51*	*50*	*36*	*43*	*43*
No. of banks	*57*	*57*	*57*	*57*	*57*	*57*

Robust standard errors are in parentheses
*** p<0.01, ** p<0.05, * p<0.1*

Capital and bank profitability - with ownership types

Table 3-5 presents the results for the link between bank ownership type and profitability-ROA and NIM. From the table, the capital ratio and all other variables continue to maintain the same signs as in Table 3-3. The results in Table 3-5 show that while foreign ownership has a negative coefficient with return on asset-ROA, being statistically non-significant (Model 1), it has a negative and statistically significant relationship with net interest margin-NIM (Model 4).

On the other hand, while private domestic ownership has a positive but non-statistically significant relationship with bank profitability-ROA (Model 2), government ownership shows a negative coefficient (Model 3). However, private-domestic and government ownership have a positive relationship with bank profitability-NIM (Models 5 and 6), being statistically significant for the private-domestic ownership (Model 5).

The low NIM for foreign-owned banks (mostly from developed countries), relative to other ownership types, may reflect high operating costs. For instance, a study by Demirgüç-Kunt and Huizinga (2000) involving 44 developed and developing countries show that lowest values of net margins to total assets are obtained by several developed countries. On the other hand, higher NIM for private-domestic banks, relative to their counterparts, may indicates a weakness within the banking system in developing countries, as these banks could generate most income from administration costs such as ATM fees, loan origination costs, or banks may be charging higher interest rates (Demirgüç-Kunt and Huizinga, 2000). Unfortunately, banks that charge higher interest rates are likely to encounter high loan default rates (Demirgüç-Kunt and Huizinga, 2000).

3.5 Chapter summary

This chapter examines the association between the bank capital ratios and profitability using unbalanced bank-level data for 57 Tanzanian banks over a period of fifteen years (2006 to 2020). Over the study period, bank profitability varied greatly across Tanzanian banks. In addition, although on average the banking sector is adequately capitalised, the results show a high variability in the capital ratios. Employing the static (ordinary least square and fixed effects) and dynamic (Sys-GMM) techniques, and controlling for different ownership types, the results show that the relationship between capital ratio and bank profitability (ROA and NIM) is positive and

statistically significant for both the static and dynamic models. In line with the bankruptcy cost hypothesis, the result suggests that increasing capital ratio potentially leads to an increase in the profitability of Tanzanian banks. Similar evidence has been found in other countries (e.g., Olszak et al., 2017; Zheng et al., 2017; Naceur and Omran, 2011; García-Herrero et al., 2009)

In addition, while board size has a non-significant positive relationship with bank returns on assets (ROAs) for all models, it has a non-significant negative relationship with net interest margin (NIM). However, the study of De Vita and Luo (2018) in 54 countries show that the relationship between board size and bank risk-taking is statistically non-significant. In terms of board independence, the study finds a positive relationship between board independence and ROA, consistent with Hypothesis 3C, which proposes a positive relationship between board independence and bank profitability measured in terms of ROA. Thus, an increase in the proportion of non-executive directors on the board results in higher profitability (ROA) for Tanzanian banks. However, the variable has a negative and significant relationship with NIM for the Sys-GMM model. Thus, although a bank with more non-executive directors improves return on asset, it may however lower its net interest margin, probably because non-executive directors may be out of touch with operations and lose control of activities due to information asymmetry between inside and outside directors (Brennan and Solomon, 2008; Cho and Kim, 2007).

Moreover, the results on the interaction terms show a negative and significant relationship between the interaction term (capital x board size) and ROA, consistency with Hypothesis 3D. On the other hand, while the link between the interaction term (capital x board independence) and ROA is negative and significant, it is positive and significant for NIM, thus supporting Hypothesis 3E which proposes that board independence significantly affects the capital ratio-profitability linkage. Thus increasing capital ratios, while also increasing the board size and independence reduces bank profitability (ROA), suggesting that, highly capitalized banks can thrive without larger boards and/or more non-executive directors, and vice-versa. However, increasing capital ratios, while also increasing the number of non-executive directors increases NIM for Tanzanian banks, conforming to the Agency Theory which suggests that, non-executive directors can improve profitability, probably via effective monitoring which potentially reduces management's risk-taking motives.

Further, while the relationship between foreign ownership on bank profitability (NIM) is negative and statistically significant, that for private domestic ownership is positive and statistically significant. Thus, in terms of net interest margin, the results show that, while foreign owned banks seem to reduce net interest margin (NIM) relative to their counterparts, local banks (private-domestic) increase NIM. This suggests that foreign banks may have high operating costs, while local banks could be charging higher interest rates (Demirgüç-Kunt and Huizinga, 2000).

The empirical evidence of this study suggest several policy recommendations to bank owners and management, regulators, and policy-makers. Firstly, as the empirical results suggest that banks with higher capital ratios are able to increase profitability, and that this is independent of bank ownership type, bank shareholders and managers should strive to increase bank capital for improved profitability. In addition, as the results also show that smaller and more independent boards could lead to higher bank profitability, banks and regulations should focus not only on stringent capital requirements, but also on smaller boards with more non-executive directors which could efficiently monitor risk-taking to enhance bank profitability. Since the results also indicate that the relationship between capital ratio and bank profitability could be influenced by a bank's board size and independence, it suggests a need to consider the role of board size and independence in monitoring managers' decisions with regard to increased bank capital ratios.

Further, as the findings show that Tanzanian banks' profitability may vary across bank of different ownership type, regulators should make decisions which embrace all banking ownership types. For instance, the empirical results in Chapter 2 suggest that Tanzanian locally-owned banks are relatively less capitalised than foreign-owned banks (mostly from developed economies), which may be caused by underdeveloped capital markets. As noted above, for the first time in history, following the 2012 increase in equity capital requirements, the BoT closed five banks at the same time and put three banks on the watch list due to under-capitalisation and failure (BoT, 2018). Thus, different owned banking institutions in the country, especially local banks, should attempt to increase their capital ratios. In this regard, policy makers in developing countries should also endeavor to strengthen the capital regulations while also encouraging all banking institutions, especially local banks, to implement such regulations for enhanced bank capitalisation. To that end, increased bank capitalisation could result in enhanced bank profitability.

Chapter 4: Capital ratios, ownership type, and bank stability

4.1 Introduction

Banking stability is a complex phenomenon and difficult to define, as it is often an outcome of dynamic interactions between various structures within the banking system, and the economy as a whole (Houben et al. 2004; Truman, 2003). Borio and Drehman (2009) define financial (or bank)[19] stability as the vulnerability of the banking system to internal shocks. It is also defined in terms of the strength of the financial system to external shocks. For instance, Allen and Wood (2006) suggest financial stability to be a state of affairs in which financial instability is unlikely to occur, so that the whole financial system is not in distress. Therefore, bank stability refers to the well-functioning of the banking system. As the main function of the financial intermediaries (banks) is to allocate resources across the various sectors of the economy in a way that ensures financial and monetary stability, bank instability can result in resource misallocation, and hamper savings and investments. Consequently, bank instability can have a contagion effect on other sectors of the economy (Davis, 2001; Bean, 2004), resulting in economic and financial crises.

Banking crises over the past three decades have increased the need for bank regulations to control systemic risks and enhance financial stability. This is because banks are subject to adverse selection and moral hazard problems that require monitoring (Lee and Hsieh, 2013). However, the presence of deposit insurance in some countries may reduce investors'/depositors' incentives to monitor banks (Peresetsky, 2008), and encourage more risk-taking, resulting in financial instability. Banking is thus probably the most regulated sector in most economies, and capital requirements are one of the most popular risk-management tools employed by financial sector regulatory authorities. Theoretically, adequate capital should be sufficient to protect the activities of a bank. According to Rose and Hudgin (2008), higher bank capital ratios can: i) serve as a cushion to absorb losses and protect a bank against the risk of failure, ii) provide start-up funding, iii) promote public confidence and reassure stakeholders on the financial strength of a bank, iv) ensure bank growth and sustainability in the long run, and, v) protect governments' insurance deposits from losses where this is applicable.

[19] In this study, financial stability is used interchangeably with bank stability. In most countries, especially in developing ones, the financial sector is dominated by banks, and therefore the stability of the banking sector is taken to represent the stability of the entire financial system.

However, although higher bank capital ratios are intended to enhance bank stability by protecting banks from the risk of failure, there is conflicting evidence on the effect of capital ratios on bank stability. The Regulatory Hypothesis suggests that to enhance bank stability, regulators should require banks to raise capital commensurately with the risk undertaken. Some studies in support of the positive role of higher capital ratios argue that higher capital ratios enable banks to withstand shocks by minimising the loss of default, thus enhancing stability[20]. In contrast, others argue that higher capital ratios may lead to increased risks, resulting in financial instability.[21] It is argued that, when required to increase capital ratios, banks may react by undertaking more risky activities, thus increasing the proportion of risky assets, such as more non-performing loans, in their portfolios (Altunbas et al., 2007), resulting in reduced bank stability. Others argue that the presence of government guarantee schemes such as deposit insurance, may also lead to moral hazard problems and increased risk-taking, similarly reducing bank stability (DemirgüçKunt and Kane, 2002; Altunbas et al., 2007; Agusmanet al., 2008).

Moreover, banking sector liberalisation in many countries, especially developing ones, allowed banks of different types of ownership to join the industry, in an attempt to build well-diversified, competitive, and stable financial systems (Rutihinda, 1993). Bank ownership type refers to the character of shareholders - such as foreign, private-domestic, or government ownership (Sant'Ana, 2016; Mian, 2003). However, theoretical and empirical literature is contradictory on how bank ownership type affects bank performance and stability. For instance, the Global Advantage Hypothesis argues that foreign-owned banks (mostly based in developed countries) operating in developing countries may be more efficient and stable than their locally-owned counterparts, as they have access to developed capital markets, better risk management skills, and higher technology to gather and analyse information (Laidroo, 2016; Havrylchyk and Jurzyk, 2011; Claessens et al., 2001; Berger, 2000; Clarke et al., 2000). In contrast, the Home Advantage Hypothesis suggests that locally owned banks (both private and government) could perform better than the foreign-owned banks, as they have access to information associated with the local setting (Berger et al., 2003; Lensink and Naaborg, 2007).

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[20] See, for example, Ashraf et al. (2016); Gambacorta and Mistrulli (2014); Klomp and De Haan (2012); Berger and Bouwman (2013); Sufian and Chong (2008); Oshinsky and Olin (2006); and Santos (2001)

[21] See, for example, Lee and Hsieh (2013); Berger and Patti (2006); Rime (2001) and Sharma (2001).

Further, as the cost of raising capital may differ across banks of different ownership types, the effect of the capital ratio on bank stability may vary with ownership type. For instance, foreign banks (mostly from developed economies) operating in developing countries may have greater access to developed capital markets, thus reduce the cost of capital, leading to higher profitability and stability in operations (Zheng et al., 2017; Admati et al., 2010; Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002: Claessens et al., 2001).

However, unlike foreign and private-domestic banks, state-owned banks may get funding support from their government, and be able to raise additional capital easily and at lower cost (Gupta and Mahakud, 2020; Pessarossi and Weill, 2015). Unfortunately, there is a "dual-agency" role in that, unlike other types of banks, the government's role is both as regulator and owner of the government-owned banks. This may raise a conflict of interest and result in state banks being less thoroughly regulated (Andrews, 2005). Government guarantees, bail outs and insurance deposits, are more noticeable with the state banks (Andrews, 2005), and may lead to inefficient supervision and motivate banks to take more risks, resulting in agency costs and instability (Williams and Nguyen, 2005). Further, the belief of "too-big to fail" may allow big (mostly foreign or state owned) but inefficient banks to go unregulated. Thus, although higher capital standards have been at the heart of international and national regulations (BCBS, 2004), its impact on bank stability may vary across banks of different ownership type.

The interaction between ownership type and the capital ratio in influencing the risk-taking behaviour, and so bank stability, has not received much attention in academic literature. This is despite most developing countries over the last twenty years or so embarking on financial sector liberalisation, including banking sector privatisation and other reforms aimed at increasing competition and stability (PSRC, 2000). For instance, in the 1990's Tanzania liberalised its economy and by December 2016, the country had 59 banking institutions of which 30 (50.8%) were foreign, 22 (37.3%) private-domestic, and 7 (11.9%) were state owned (BoT, 2016). However, privatisation may not prevent bank failures. In Tanzania, for instance, between 2017 and 2018, three state banks were merged and licenses of seven non-government-owned banks were revoked (one foreign and six private-domestic) due to under-capitalisation. Thus, as at December 2020, the total number of banking institutions had decreased to 46, of which 27 (58.7%)

were foreign owned and 19 (41.3%) were locally (government and private) owned (BoT, 2020). This raises a concern on the benefit of ownership reforms, and the extent to which bank ownership type affects the relationship between bank capital ratios and stability.

Thus, given the above arguments, this study seeks to address three key issues, as highlighted below. First, previous studies are contradictory and mostly focus on developed countries. Given the wide cross-country variations on the role of bank capital on stability, this study examines the relationship between capital ratios and bank stability in Tanzania, due to the country's history of economic and financial reforms (see Chapter 1). Secondly, based on the banking sector reforms and related interventions in Tanzania, this study seeks to evaluate the extent to which the different bank ownership types affect bank stability.

Third, most studies on this topic consider bank capital ratios or ownership type separately. However, as discussed above, the Global and Home Advantage Hypotheses, the "Dual Agency" role, and the belief of "too-big-to fail" may cause banks of different ownership type to differ in terms of their sources and cost of capital, and implementation of bank capital regulations. This can lead to differences in capital ratios, which may potentially affect bank stability. In addition, as the interests of bank owners may differ between banks with different ownership forms from those of regulators, their objectives in terms of capital and risk management may also differ, resulting in bank stability variations. For instance, while regulators may require banks to increase capital ratios to curb risks and enhance stability, some banks (e.g., privately owned ones) may motivate managers to take more risk through incentive and compensation schemes which may reduce bank capital ratios (Tandelilin et al., 2007), and others (e.g., state banks) may be more involved in fulfilling socio-political agendas (Berger et al 2005), or fail to implement the capital requirements due to the "Dual Agency" role of governments. As discussed above, ignoring ownership type may result in inadequate and wrong inferences on the effectiveness of bank regulations (such as capital ratios) (Laeven and Levine, 2009). Therefore, this study investigates the extent to which bank ownership type influences the relationship between bank capital ratios and bank stability.

4.2 Theoretical and empirical considerations

4.2.1 Regulatory Hypothesis and the Capital-Stability view

According to the theories of economic regulation, bank regulations necessitate effective government intervention to reduce market failures in the banking industry. Although there is no consensus on the objectives of bank regulation, there is a strong argument that bank regulation helps to ensure the safety and stability of individual banks, with positive ramifications on the entire banking system. To achieve these objectives, regulatory authorities use a number of measures, and the introduction and implementation of minimum bank capital ratio requirements are one of the most commonly used instruments. Under the regulatory theory, capital and risk are negatively related, thus, regulatory bodies require banks to increase their capital commensurably with the risk they take (Altnubas et al., 2007 and Agusman et al., 2008). This increases the prudence of banks when selecting risky activities. Thus, the main function of strict capital ratio requirements is to force banks to absorb a greater part of their losses and so reduce moral hazard (Rime, 2001). By so doing, bank capital protects all the asset quality and off-balance sheet exposures, thus improving banks' and the banking system's stability (Vasquez and Federico, 2012; Episcopos, 2008).

However, studies offer contradictory evidence on the impact of bank capital ratios on financial stability. Several studies suggest the existence of a positive relationship between bank capital ratios and financial stability. One strand of such literature argues that capital acts as a cushion to absorb banks' risks and serves as a buffer against unexpected losses, thus enhancing financial stability. For instance, Oshinsky and Olin (2006) study 1,996 banks on the Federal Deposit Insurance Corporation (FDIC) troubled-bank list in the US over the period 1990 to 2002 and found that an increase in risk-based capital improves bank recovery from failure. These authors further argue that low capital, among other factors, is the main cause for bank failure. Similarly, Santos (2001) analyses the methodologies for restructuring the 1988 Basel Accord on capital standards, and established that low capital raises the probability of bank failures, therefore, increasing the required minimum capital may increase bank stability.

In addition, another line of the literature claim that higher capital improves financial stability as it motivates banks to limit excessive risk-taking and thus improve risk management. Well-capitalised banks often have good risk management and borrower screening mechanisms, which decreases the

possibility of bank runs and enhance financial stability. To examine the impact of risk-based capital requirements on bank risk-taking behavior, Ashraf, Arshad, and Hu (2016) use a dataset of 21 banks in Pakistan from 2005 to 2012, and show that all banks have their portfolio risk reduced as a result of strict risk-based capital regulations.

In their study of 200 banks in 21 OECD countries, Klomp and De Haan (2012) find that capital regulations, on average, significantly decrease bank risks. However, their results indicate that the impact of regulations and supervision vary across banks - that is, while most bank regulation and supervision do not have much impact on low-risk banks, they have a highly significant impact on high-risk banks. These findings are in line with the argument of Freixas and Rochet (2008) that higher capital enables a bank to select portfolios that are less risky.

Berger and Bouwman (2013) investigate the effect of capital on the survival and market share of US banks, and how it differs across normal and crisis (market and banking crises), over the period 1984 to 2009. They find that a higher capital level increases the likelihood of survival and market share of small banks in both normal and crisis periods. Further, they show that, during periods of banking crises, greater capital ratios improve the performance of large and medium banks.

Likewise, Sufian and Chong (2008), in their study of Philippine banks, note that banks need strong capital for protection during periods of financial crises and/or economic turbulence. Allen and Gale (2005) also argue that proper capital regulations may lower banks' systemic risk. Similarly, Baker and Wurgler (2015) affirm that both idiosyncratic and systematic risks are lower for well-capitalised banks. Employing aggregate balance sheet data of more than 2,600 banks in the EU-25 for the period from 1997 to 2005, Uhde and Heimeshoff (2009) conduct a study to examine the effect of national banking market concentration on financial stability within the banking sector, as measured by the Z-score and its components. In their study, a capital regulatory index is included as one of the bank specific variables and it is found that capital regulations have a positive impact on the financial stability of both the Eastern and Western EU banking sectors. This conforms to the theoretical view that higher bank capitalisation is related to better financial soundness and bank managers' prudential behavior.

Using both stock price information and accounting data in Europe, De Jonghe (2010) examines banks' diversification and specialisation strategies, and their ability to endure banking systemic risk, the latter proxied by tail beta[22]. In terms of capital, it is found that higher-capitalised banks are able to strongly resist adverse shocks. The study thus reveals that higher capital ratios reduce bank vulnerability to systemic risk. These findings are in line with the argument by Kaufman and Scott (2003) that higher capital has the ability to counterweight a given banking sector's exposure to macro tremors. However, this could be determined by real drivers of the crisis (BCBS, 2019).

Miles, Yang, and Marcheggiano (2012) employ the Capital Asset Pricing Model (CAPM) to assess banks' risks and how capital secures against those risks. Using data from 31 countries from 1821 to 2008, the study finds that higher capital levels decrease the likelihood of banking sector crises. It is argued that banks should maintain more capital than before, even above the Basel III requirements. Martinez-Miera and Suarez (2014) argue that banks under capital requirement can trade-off the values of capital buffers and the gains from risk shifting. Regulatory capital can thus help banks to decrease systemic risk and so reduce the frequency and cost of systemic crises.

Further, in connection with banks' resistance to financial tremors, higher capital ratios improve bank stability, as well-capitalised banks have the capacity to undergo with credit supply, regardless of an economic shocks or a fall in deposits. For instance, in their study of banks in Italy for the period from 1992 to 2001, Gambacorta and Mistrulli (2004) examine the lending responses to economic shocks and changes in monetary policy caused by capital ratios differences. They report that well-capitalised banks absorb short-term loan distress from their borrowers and are able to maintain a long-term lender-borrower relationship. Also, higher capital enables stable lending during recessions. This argument is based on the premise that such banks can continue to supply loans during monetary shocks because of their access to non-insured funds.

A study by Albertazzi and Marchetti (2010) in Italy over the period 2007 to 2009 finds that, as opposed to higher-capitalisation, a shrinkage in loan supply is related to banks with lower capital.

[22] De Jonghe (2010) defines a tail-beta (tail-β) as a systemic risk over a period of time, measured by a probability, between [0,1], of a crash in a bank's stock conditional on a crash in a European banking sector stock price index.

Similarly, in Spain Jimenez et al. (2012) show that a 1% increase in interest rates reduces credit supplied by lower-capitalised banks by 3.9% more than those supplied by higher-capitalised banks. They note that the effect of short-term rises in interest rates (as a result of economic shocks or monetary policy) on lending is higher for under-capitalised banks than for over-capitalised banks.

In contrast, other studies report a negative association between bank capital and financial stability. One strand of such literature show that higher bank capital can undermine banking activities, resulting in lower profits, which in turn decreases the stream of future profits (franchise value) of a bank. Decreased franchise value reduces shareholder value and so compels risk-taking motives. This can undermine the effect of capital regulation (Repullo, 2004). In addition, Fronseca and González (2010) note that as raising capital is very costly, banks required to meet a specific capital ratio tomorrow, may possibly tend to increase their capital by increasing their current investments in risky assets today. Consequently, such a decision may result in higher likelihoods of default.

Moreover, although higher capital can help a bank withstand financial or economic crises (as reported by the above studies), it may however have a negative or non-significant impact. For instance, focusing on the 2008 crisis, Camara et al. (2010) conduct a study for a sample of EU banks, and find that well-capitalised banks took more risk before the crisis than their under-capitalised counterparts. However, using data for OECD countries, Huang and Ratnovski (2009) report no association between pre-crisis capital, and bank performance throughout the crisis. Similarly, a study by Barth et al. (2004) involving 107 countries reveals that, although stringent capital requirement reduces NPLs, there is no significant relationship between higher capital and banking crises. Thus, Demirgüç-Kunt and Detragiache (2010) argue that capital requirements have no significant relationship with Z-scores (a bank's measure of financial stability). Martinez-Miera and Suarez (2014) use dynamic equilibrium techniques to assess the effect of macro-prudential regulation (capital requirement) on systemic risk in Spain, and show that capital can reduce output and credit, and so produce trade-offs of non-trivial welfare. Thus, systemic risk may worsen if capital requirements are counter-cyclically altered.

In the context of Tanzania, capital regulatory studies investigate the association between the capital adequacy and asset quality (Pastory and Mutaju, 2013); the effect of capital adequacy, profitability, and loan growth on non-performing loans-NPL (Malimi, 2017); and the impact of regulatory

capital requirements on operating efficiency (Lotto, 2018). Thus, Tanzanian studies also do not examine the relationship between capital ratios, ownership (discussed below), and bank stability. Further, the studies do not account for endogeneity and persistency in bank stability.

Thus, the above empirical evidence on the effect of capital on bank stability are inconclusive. While some studies find a positive effect[23], others report a negative, non-significant, or no relationship[24]. Moreover, most of the studies do not account for endogeneity and persistency, and do not test how banks' ownership types could affect the relationship, as discussed below. However, according to the Regulatory Hypothesis discussed above, this study expects a significant relationship between capital ratios and bank stability, thus, proposes the following null hypothesis:

Hypothesis 4A ($H4A_0$): Capital ratios and bank stability are not significantly related

4.2.2 Global/Home Advantage Hypothesis, bank ownership, and stability

The empirical evidence above focuses on the relationship between capital ratios and bank stability. However, as the risk taking may vary among different bank ownership types, a bank's stability may depend on its ownership type (Laeven and Levine, 2009). Also, as the cost of raising capital may differ across banks of different ownership types (Zheng et al., 2017; Claessens et al., 2001), the effect of capital ratios on bank stability may differ according to a bank's ownership type. Literature that examines the impact of bank ownership can be categorised into two areas of focus: ownership concentration (which refers to the proportion of bank shares held by a small number of shareholders) and ownership identity/type (referring to the character of shareholders, such as foreign, private-domestic, and government) (Sant'Ana, 2016; Mian, 2003). Due to banking sector liberalisation in Tanzania (see Chapter one), this study considers the ownership identity to examine the effect of ownership type on bank stability in the country, and whether and how the relationship between capital ratios and bank stability could be influenced by a bank's ownership type. Therefore, in this section, the relationship between bank ownership type and bank stability is first discussed, followed by the joint effect of bank capital ratios and ownership type.

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[23] See, for example, Ashraf et al. (2016), Gambacorta and Mistrulli, (2014), Klomp and De Haan, (2012), Berger and Bouwman, (2013), Sufian and Chong, (2008), Oshinsky and Olin, (2006), and Santos, (2001)

[24] See, for example, Lee and Hsieh, (2013), Demirgüç-Kunt and Detragiache, (2010), Camara et al. (2010), Huang and Ratnovski, (2009), Berger and Patti, (2006), and Rime, (2001)

Following the 1990's economic reforms and financial sector liberalisation in Tanzania, a number of foreign and private-domestic-owned banks joined the industry. This aimed at creating a well-diversified, competitive, and stable financial sector that would boost economic growth (Rutihinda, 1993). However, contradicting theoretical and empirical views exist on the role of ownership type in influencing bank stability. For instance, as discussed above, while the Global Advantage Hypothesis suggests that foreign banks (especially from developed economies) operating in developing countries are more efficient and stable than their locally-owned counterparts (Laidroo, 2016; Havrylchyk and Jurzyk, 2011; Claessens et al., 2001; Berger, 2000; Clarke et al., 2000), the Home-Field Advantage Hypothesis argues that locally owned banks (both private-domestic and government) could be more stable than the foreign owned banks operating in developing countries (Berger et al., 2003; Lensink and Naaborg, 2007). Moreover, while private domestic banks may be concerned with shareholder value maximisation, foreign banks may focus on value maximisation at an international perspective. On the other hand, state banks may be more involved in fulfilling socio-political agendas (Berger et al., 2005). Studies show that, in developing countries, foreign banks (especially from developed economies) perform better than locally-owned banks (Berger, 2000), as they have access to developed capital markets and high-level technologies (Claessens et al., 2001; Clarke et al., 2000). According to Claessens et al. (2001), foreign banks in these countries have higher interest margins and profits than local banks and are more stable, as they are vested with higher management skills and technology than their local counterparts.

However, in developing countries, foreign-owned banks may be less efficient (Berger, 2000) and so, be unstable. According to De Nicolò and Loukoianova (2007), foreign-owned banks in developing countries may exhibit higher risk-taking behavior due to lower bankruptcy costs because of the guarantees arising from their relationships with their parent banks in developed countries. Another reason could be that foreign-owned banks in developing countries may not be familiar with the local markets in which they are operating, therefore may fail to mitigate risks. Berger and Bouwman (2013) investigate the effect of capital on US banks' market share and survival over the period 1984 to 2009, which includes normal periods, as well as both market and banking crises. The study finds a negative and statistically significant relationship between foreign ownership and survival. The study also notes that small foreign-owned banks with a greater portion of their services in metropolitan markets are less likely to survive.

Private domestic banks, on the other hand, may display different features compared to foreign-owned banks. They may operate profitably due to their home field advantage which could enable them to create an aggressive loan strategy, thus, become more stable than their counterparts. A comparative study by Mian (2003) on 1600 banks in emerging economies reveal that private-domestic banks gain higher returns (and so enhance stability), as they supply loans more aggressively, maintain a low level of liquidity, and keep more assets, than foreign banks. Moreover, some private-domestic banks (e.g., community and municipal owned) have government affiliations and so, can have government support in times of distress. Thus, given the same default, these banks can be more stable than foreign owned banks which do not qualify for such support. However, domestic banks in developing countries underperform due to weak capital markets and low levels of technology (Claessens et al., 2001). In addition, as Mian (2003) observes, private domestic banks may have higher rates of interest expenses on deposits. Higher rates of interest expenses are likely to reduce bank profitability and may thus lead to bank financial instability.

On the other hand, government-owned banks, especially in developing countries, may be unstable due to management incompetence, operational incompetence, and low risk management skills. It is argued that in most developing economies, government-owned banks may occupy a large market share resulting in low access to credit due to underdeveloped financial markets and low economic growth (Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002). In some countries, government owned banks may be used to finance unprofitable state-owned enterprises, or provide loans based on political grounds rather than risk analysis (Andrews, 2005; Chijoriga, 2000). This undermines the principles of "shareholder value maximisation" and also overlooks the best practices for risk management, resulting in instability. Financing unprofitable enterprises may result in higher non-performing loans, and thus reduce bank stability. For instance, Chijoriga (2000) notes that most government banks in Tanzania suffered high NPLs due to increased lending to financial distressed parastatals and cooperative societies.

However, most of the above empirical studies on ownership effects focus on developed countries, provide contradictory evidence, and do not investigate the joint effect of bank ownership type and capital ratios on banking stability. Theoretically, as the cost of raising capital may differ across banks of different ownership type, the same capital ratio may have a different impact on bank stability, depending on a bank's ownership type. For instance, as foreign-owned banks operating

in developing countries have greater access to developed capital markets (Claessens et al., 2001), they are able to raise capital at low cost (Zheng et al., 2017; Admati et al., 2010) and so, be more stable compared to local banks who may be constrained by weak financial markets (Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002). However, state-owned banks may get funding support from their government, and be able to raise capital easily and at lower cost than foreign and some private-domestic banks, who may not get such government assistance (Gupta and Mahakud, 2020; Pessarossi and Weill, 2015).

Unfortunately, the few studies that test the joint effects (e.g., Gupta and Mahakud, 2020; Pessarossi and Weill; 2015; Laeven and Levine, 2009), are also contradictory. One strand of the literature is based on the 'net impact' of capital resulting from the difference between an increase of agency costs between shareholders and managers, and a decrease in moral hazard between debt holders and shareholders (Berger and Bonaccorsi di Patti, 2006). Given the same regulation, different bank ownership types (with different corporate governance structures) may have different agency costs and moral hazard problems (Pessarossi and Weill, 2015). Thus, the net impact of capital ratios on bank risk could differ, depending on the bank ownership type.

For instance, Pessarossi and Weill (2015) study the association between capital ratio and cost efficiency of 100 Chinese banks for the period 2004 to 2009, and how bank ownership type ('Big Five' large state-owned, joint-stock, foreign, and city commercial banks) and bank size influence the association. Employing GMM techniques, a positive impact of capital ratio on cost efficiency is found. Moreover, joint-stock banks and foreign banks are found to be more efficient than their counterparts. Further, the interaction terms between capital ratio and city commercial banks have a positive and significant effect on bank efficiency, but there is a negative and significant effect with the interaction between capital ratio and the foreign banks. The study concludes that the effect of capital ratio on cost efficiency depends on the ownership type, but not on the size of a bank. However, Pessarossi and Weill (2015) concentrate on cost efficiency. Despite that cost efficiency and financial stability could be related[25], this study investigates bank financial stability, using NPL and Z-score, which is the most direct determinant of a bank's financial stability (Ghosh, 2014).

[25] A bank's cost efficiency can be considered a better proxy for bank stability. The literature indicates that degradation in cost efficiency has negative implications for bank financial stability (Pessarossi and Weill, 2015)

Moreover, there is a possibility of a conflict of interest on the part of the banking supervisor. This is termed as a "Dual-Agency" role because, unlike for foreign and private-domestic owned banks, with state banks, the government's role is both as owner and regulator of its own banks. This may result in the regulators being lenient to the state-owned banks, which can thus less implement the regulations (Andrews, 2005). Further, due to the concept of "too-big to fail", big but inefficient banks could receive less supervision and reduced regulation. As a result, managers may undertake higher risky activities, resulting in agency costs and bank instability (Williams and Nguyen, 2005).

In addition, the concept of "too-big to fail" may attract government support in terms of bail outs and guarantees, which, in turn, may result in moral hazard problems (Demirguc-Kunt and Kane 2002). Therefore, as it is argued that bank bail outs and insurance deposits are more noticeable with the government-owned banks (Andrews, 2005), higher capital ratios may result in higher risk-taking behavior and thus reducing a bank's financial stability, mostly in government-owned banks. However, state-owned banks may get funding support from their government, and so be able to raise capital easily and at lower cost than foreign and some private-domestic banks, who may not get such government assistance (Gupta and Mahakud, 2020; Pessarossi and Weill, 2015).

Further, as noted above, foreign banks in developing markets may have low funding costs due to their access to developed capital markets (Claessens et al., 2001; Clarke et al., 2000), thus, they can withstand risks. For instance, in Indian commercial banks, Gupta and Muhakad (2020) find that private banks (both foreign and domestically owned) have lower funding costs than public sector banks. Thus, as higher non-government (private) ownership improved performance, they are likely to be more stable. Given the same higher capital ratios, banks operating in developing countries may respond differently in terms of their stability, depending on their ownership type.

Another strand of the literature, though mostly inclined to ownership structures, argues that increasing the bank capital ratio can subject a bank's assets to more risk, thus entailing bank owners having more of their wealth at risk. Further, as capital requirements can decrease the utility of bank ownership, different owners may tend to increase bank risks differently in response to the capital regulations (Laeven and Levine, 2009). It thus hinges on the argument that any bank capital ratios and risk-taking alteration could depend on the motivations and types of the bank owners.

For instance, Laeven and Levine (2009) conduct a study of listed banks from 48 countries over the period 1996 to 2001 to examine the relationship between ownership structure and bank risk, and whether the effects of national bank regulations (capital regulations, activity restrictions, and deposit insurance) on risk-taking, change with banks' ownership structures. Firstly, using ordinary least squares (OLS) regression with clustering at the country level, they find that bank risk-taking is positively related to the relative power of shareholders in the governance structure of a bank. It is argued that these findings support the theory that share-holding managers have stronger motives to take-more risks than non-equity and debt-holding managers. Secondly, using the instrumental variables approach to examine the joint effect, these authors report that the real sign of the effect differs with ownership structure. Therefore, it can be argued that the same banking regulation may have a different impact on bank stability, depending on a bank's ownership structure.

In line with Laeven and Levine (2009)'s findings that share-holding managers have stronger motives for risks taking, a study by El-Sood (2017) on US banking holding companies (BHCs) from 2002 to 2014 finds both block and managerial holdings to be negatively related to bank risk taking. Further, examining the joint effect of regulatory capital and ownership structure on bank risk-taking, both the interaction terms (block holding x capital, and managerial holding x capital) are found to be positively related with risk-taking. However, as noted above, Laeven and Levine (2009) focus on the conflicts between banks' owners and managers, and both Laeven and Levine (2009) and El-Sood (2017) examine the ownership structures. The current study focuses on ownership type (i.e., foreign, private-domestic, or government) to test whether bank liberalisation, with diversified ownership types, could improve the stability of banks in a developing country.

Thus, studies on the link between capital ratios and bank stability are contradictory, and do not consider the joint role of capital ratios and bank ownership type. Thus, given the scant literature on the link between bank ownership, capital ratios and banks stability, and considering the bank ownership diversity in Tanzania, this study builds on previous results to also examine the effect of ownership type on bank stability, and further tests whether the capital ratios-bank stability linkage is influenced by a bank's ownership type. Thus, this study also proposes the null hypotheses below.

$H4B_0$: Bank ownership types and stability are not significantly related

$H4C_0$: Bank ownership types do not significantly affect the bank capital ratios- stability linkage

4.3 Data and Methodology

4.3.1 Data sources

This study uses an unbalanced annual panel dataset of 57 Tanzanian banks over a period of fifteen years (2006 to 2020). The study uses multiple sources of data, including the Tanzania Banking Sector Performance Review Report published by Ernst and Young in 2010 (data for the period from 2006 to 2009) and the audited annual financial reports published by Tanzanian banks for the period 2010 to 2020. For international banks, the study captures only the information for operations in Tanzania. It should be noted that in Tanzania all public and private banks are required by law to publish their financial reports (URT, 2014). Financial reports were reviewed to get information which is used to compute variables such as: bank stability - a dependent variable (bank-level Z scores and non-performing loans, or NPLs), key independent variable (capital ratios), and other bank control variables. The Financial Regulations and Guidelines issued by the Bank of Tanzania (BoT) were also used to obtain information on regulatory minimum risk-weighted capital. Macro-economic indicators were obtained from the World Development Indicators (WDI) database provided by the World Bank.

4.3.2 Econometric model

Due to potential endogeneity between bank stability and bank capital ratios, and the likelihood that bank stability may be highly persistent, standard panel data estimation models may be biased. Endogeneity problems may occur when a predictor or explanatory variable is correlated with the error term or due to omitted variables, measurement errors, or simultaneity bias (Roodman, 2009). For example, highly capitalised banks are likely to be more stable, and a higher bank stability may result in low risks and thus, high capital ratios. In other words, there are feedback links between bank capital and stability. This may result in endogenous relationships between variables, resulting in inverse simultaneity or causality, leading to biased OLS estimates (Delis and Kouretas, 2011).

Moreover, there is potential persistence in bank stability, as stability levels in the current period can affect stability levels in the next period(s). This study thus uses the system-generalised method of moments (Sys-GMM) as discussed and specified in Chapter 3 of this thesis. The system GMM-estimator, developed by Arellano and Bover (1995) and Blundell and Bond (1998), can resolve endogeneity and persistence problems by instrumenting for the independent variable and

employing lagged dependent variables and thus capture the dynamic nature of the regressors (lagged dependent variable) (Liang et al., 2013; Adams and Mehran, 2012). It thus controls for endogeneity and tests for time lags (Goddard et al., 2011; Berger et. al., 2000). The sys-GMM is also an appropriate method as the current study's panel is composed of greater cross-section (N = 57 banks) than time series (T = 15 years).

Equation (generic form) 4.1 below, is used to determine the dynamic relationship between bank capital ratios and bank stability.

$$FS_{i,t} = \alpha_i + FS_{i,t-1} + \sum_{d=1}^{d} \beta_d D_{i,t}^{d} + \sum_{k=1}^{k} \gamma_k X_{i,t}^{k} + \sum_{m=1}^{m} \lambda_m M_t^k + \mu_{i,t} \ldots\ldots\ldots\ldots\ldots (4.1)$$

Where the subscript *i* and *t* represent banks and time period (in years); respectively, α_i is a constant coefficient, $FS_{i.t}$ represents bank level financial stability, $FS_{i,t-1}$ is a one period lagged values of *FS* that measures the degree of persistence in financial stability, *X* represents bank-specific control variables, *D* denotes dummy variables, *M* represents macroeconomic variables that can affect financial stability, and the error term is represented by $\mu_{it.}$.

4.3.3 Study variables and empirical specification

Dependent variables- Bank Stability

i. Z-score

One of the most widely used measures of bank/financial stability is the Z-score (Ghosh, 2014; Cihak and Hesse, 2010; Laeven and Levine, 2009). The Z-score estimates the bank's distance to default (Pathan, 2009). It measures a bank's level of income that would cause its capital to be eroded. It also shows the maximum profit level required before a bank goes into bankruptcy. While higher Z-scores conform to higher capital levels and indicates that the bank is stable, low values suggest a high probability of bank insolvency (Laeven and Levine, 2009). However, the Z-score ignores systematic risk as it assumes normally distributed expected returns, which in reality, may not be the case. It also ignores the timing of returns as it is a static measure of insolvency. De Nicolo and Kwast (2002) argue that the Z-score is incapable of detecting a negative series of returns. Further, as this measure relies on past accounting information, it is a retrospective measure of financial stability. Historic returns may underestimate risks in times of distress. However, compared to other measures, the Z-score is the most direct determinant of financial stability

(Ghosh, 2014). It provides an indication of the progression of risk over time. Thus, this study uses the Z-score as a proxy for financial stability. Given that the Z-score can be affected by the reliability on the accounting practices, this study uses audited accounting data (which follows international accepted standards). The bank level Z-score, is given by:

$$Z_n^B = \frac{r_{it} + k_{it}}{\sigma(r_{it})} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4.2)$$

Where: Z_n^B represents the Z-score of bank *i* at time *t,* r_{it} *(π_{it}/a_{it})* represents a bank's return on assets, at time *t*, computed as the ratio of net income (π_{it}) to total assets *(a_{it})*, k_{it} *= (e_{it}/a_{it})* is the bank's equity capital computed as the ratio of total equity *(e_{it})* to total assets (a_{it}), $\sigma(r_{it})$ *is* the standard deviation of the bank's return on assets. Several scholars have also computed the Z-score using the above approach (see, for example, Cihak and Hesse; 2010; Laeven and Levine, 2009).

The Z-score measure is appropriate as bank regulators are more concerned with the level of capital that will protect banks from the risk of failure (Cihak and Hesse, 2010; Laeven and Levine, 2009).

ii. Non-performing loans (npl)

In this study, the ratio of non-performing loans (NPLs) to total loans, is used as a second measure of stability as it indirectly expresses the risk-taking behaviour of a bank with higher ratios, indicating that a bank is taking more risk in its operations (see also, Shrieve and Dahl, 1992; Ashraf et al., 2016). In order to ensure that banks and the banking system maintain financial stability, it is expected that the capital ratio will have a negative relationship with the NPL ratio, as higher capital theoretically enables banks to absorb unforeseen shocks and minimise risk-taking behaviour (Ashraf et al., 2016; Gambacorta and Mistrulli, 2004; Klomp and De Haan, 2012). However, as higher capital ratios may make it more likely that banks will take more risk and hence result in greater NPLs (Altunbas et al., 2007), a negative relationship could also be observed.

Independent variables

i) Capital Ratio (car)

The capital ratio is measured as the ratio of core capital to risk-weighted assets plus off-balance sheet exposures, or the ratio of total capital to risk-weighted assets plus off-balance sheet

exposures. This study thus uses the ratio of total capital to risk-weighted assets plus off-balance sheet exposures. A positive relationship between capital ratios and bank stability is expected. It is argued that higher capital helps a bank endure financial and economic shocks in times of crises, decreases loss of default, minimises managers' incentives for risk-taking, and so improves bank stability (Ashraf et al., 2016; Gambacorta and Mistrulli, 2004; Klomp and De Haan, 2012; Berger and Bouwman, 2013; Sufian and Chong, 2008; Santos, 2001). However, higher capital may motivate managers to increase the riskiness of bank asset portfolios; weaken bank efficiency and so reduce stability (Altunbas et al., 2007; Iannotta et al., 2007; Berger and Patti, 2006; Rime, 2001).

Control Variables

Literature suggests a number of variables that can affect bank stability. This study employs lending, profitability, liquidity, bank size, ownership types, and macro-economic variables (financial crisis, inflation rate, and GDP growth). These variables are commonly employed and have been used by several authors as explained for each of the variables below.

i. *Liquidity (lad)*

Liquidity is the ability to meet commitments as they come due and to be able to provide funds without incurring undesirable costs (BCBS, 2008), and is measured as the ratio of liquid assets to deposit liabilities. The liquidity ratio is also used in other studies (see, for example, Ayaydin and Karakaya, 2014; Berger and Bouwman 2009). A positive effect of bank liquidity ratio on bank stability is expected, as banks with more liquid assets are less likely to suffer a shock during a crisis (Berger and Bouwman 2009). Banks with high liquidity ratios can avoid investment in risky assets, thus improving their financial stability.

ii. *Bank size (bank_size)*

Bank size is one of the variables usually used in bank stability studies (see, for example, Anginer et al., 2018; and Laeven and Levine, 2009). This study measures bank size as the natural logarithm of total assets (see also, Laeven and Levine, 2009). Theoretically, banks are affected differently by economic turbulence depending on their size. Unlike small banks which have limited resources, larger banks can withstand local economic turbulence as they are better diversified (Strahan, 2006). Also, they can manage financial resources and risks efficiently. However, larger banks may

undermine bank stability. For instance, due to the concept of "too-big-to fail", big banks may be less rigorously supervised and regulated. As a result, bank managers may be motivated to take more risk, making larger banks riskier and so, less stable (Stern and Feldman, 2004).

iii. Lending (lend)

Lending captures the extent to which banks focus on loan supply rather than other sources of revenue. It is computed by the ratio of total loans to total assets. As higher lending may be associated with earnings through interest, its effect on bank stability is expected to be positive. Higher ratios show that a bank has informational advantages and low intermediation costs (Dietrich and Wanzenreid, 2011). However, higher lending ratios may imply loose lending conditions, which may lead to higher NPLs (Naceur and Omran, 2011; Amidu and Hinson, 2006), resulting in bank instability.

iv. Profitability (roa)

Profitability is included to assess how efficient management is in using its assets to generate earnings (Boateng, 2019; Khatab et al., 2011). It is computed by dividing profit after tax by total assets (Pandey, 2004). Profitability is expected to be positively related to bank stability. Banks that are profitable have the ability to lower their risks, thus increasing financial stability. However, bank profitability and a bank's financial stability may be negatively related. It is argued that, a quest for profit may motivate risk-taking behaviour, resulting in higher exposures (Durand, 2019).

v. Financial crisis-dummy

This study includes this variable to control for the 2007- 2009 global financial crisis (GFC). The variable is measured as a dummy 1 during the GFC period (i.e., 2007-2009), and 0, otherwise, as also measured by others (e.g., Ayaydin and Karakaya, 2014; Ghosh, 2014; Berger and Bouwman, 2013). A negative effect of the crisis on bank stability is expected. During the crisis, banks are likely to have higher NPLs, resulting in financial instability (Akhigbe et al., 2012; Albertazzi and Gambacorta, 2009). However, banks with stable resources during the crisis could continue to lend, so increasing earning and stability. Thus, as most African countries survived challenges of the GFC (BoT, 2009), there could be no effect of the crisis on the stability of Tanzanian banks.

vi. Inflation rate (inf)

Inflation rate, measured by consumer price index, is also used as a macro-economic control variable. In times of increasing inflation rate, interest rates increase and thus inflation is positively correlated with higher net interest margins and stability. However, as funding costs also increase during inflation, the impact of inflation rate on earnings will depend on the net effect between funding costs and net interest. Thus, high inflation can cause banks to increase their lending rates to offset associated costs (Naceur and Omran, 2011). However, a negative coefficient is expected if bank costs increase quicker than revenues (Sufian and Chong, 2008). Because of these trade-offs, Jokipii and Monnin (2013) argue that the effect of inflation on banks' stability is not clear.

vii. Real GDP growth (gdp)

This variable is used to control for variances in bank stability due to macro-economic conditions in different periods. When the economy maintains a steady growth, banks, as the financial intermediaries, share the benefit. Opportunities for bank investments may be associated with business cycles (Laeven and Majoni, 2003). For instance, during expansionary times, loan demand may increase, enabling higher interest charges to be imposed by banks (Athanasoglou *et* al., 2008). Also, the solvency of borrowers could be higher, resulting in an enhanced asset quality of banks. Moreover, during economic booms, banks could pro-cyclically broaden capital and thus participate in precautionary actions in expectation of upcoming economic slumps. Thus, as economic growth is associated with increasing incomes and decreased financial distress, GDP growth is expected to be positively related to bank stability. However, in times of difficulties such as financial crises, GDP growth and bank stability may be negatively associated (Uhde and Heimeshoff, 2009).

Based on the literature review, the study uses baseline Equation (specific form) 4.3, as given below:

$$FS_{i,t}=\alpha_{i_1}+\gamma_1 FS_{i,tl}+\gamma_2 car_{i,t}+\gamma_3 lad_{i,t}+\gamma_4 bank\_size_{i,t}+\gamma_5 lend_{i,t}+\gamma_6 roa_{i,t}+\lambda_1 crisis_t+\lambda_2 inf_t+\lambda_3 gdp_t+\mu_{i,t..} \quad (4.3)$$

Bank Ownership Type- Dummy

Bank ownership type is included to investigate its relationship with bank capital ratios. It is also interacted with bank capital ratios to examine the effect of the interaction terms (between capital ratio and each of the bank ownership type) on bank stability. As explained above, this uses three types of bank ownership, namely, foreign, private-domestic, and government ownership.

Foreign ownership *(for)* is defined by a dummy variable, 1 for a foreign-owned bank, and 0 otherwise. In line with the Global Advantage Hypothesis discussed above, this study expects foreign-owned banks to increase their stability relative to other types of bank ownership (see, for example, (Laidroo, 2016; Havrylchyk and Jurzyk, 2011). In developing countries, foreign banks (mostly being based in developed countries) are more stable than local banks due to their access to developed capital markets, better management skills and high-level technologies compared to their local counterparts (Claessens et al., 2001; Berger, 2000; Clarke et al., 2000).

The study measures private-domestic ownership *(pvt)* by a dummy variable, 1 for a private-domestically owned bank, and 0 otherwise, and expects a positive relationship with bank stability. Banks in developing countries often adopt aggressive lending strategies, maintain lower liquidity, and keep more assets, resulting in low NPLs and higher returns (Mian, 2003). Also, a well capitalised private bank (both foreign and private-domestic owned) may even be more stringent to maintain its status as a prime bank, and that attract premium clients only, leading to low NPL, hence higher stability.

Government bank ownership (*gvt*) is expressed as a dummy variable, 1 for a government owned, and 0 otherwise. Government owned banks are expected to have lower stability. Government owned banks might be used for political purposes (Andrews, 2005; Chijoriga, 2000). They may be prompted to provide loans to financially distressed parastatals, which could result in higher NPLs (Andrews, 2005; Chijoriga, 2000). Also, as government guarantees, bail outs and insurance deposits, are more noticeable with the state banks (Andrews, 2005), it may lead to inefficient supervision and motivate banks to take more risks, resulting in agency costs and instability (Williams and Nguyen, 2005). Moreover, these banks may be inefficient due to low technology,

low risk management skills, and lack of capital caused by weak financial markets and low economic growth (Griffith-Jones and Tyson, 2013; Claessens et al., 2001).

The interaction between foreign ownership and capital ratios is expected to have a positive effect on bank stability. It was noted above that, as the cost of raising equity capital may differ across banks of different ownership type, the same capital ratio may have a different effect on a bank financial stability, depending on a bank's type of ownership. Thus, as foreign-owned banks operating in developing countries (mostly from developed economies) have greater access to developed capital markets (Claessens et al., 2001), they are able to raise capital at low cost (Zheng et al., 2017; Admati et al., 2010) and so, be more stable compared to local banks (both private and government owned) who may be constrained by weak financial markets (Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002).

On the other hand, while the interaction between private-domestic and capital ratios is expected to have a positive influence on bank stability, the interaction between government ownership and capital ratios is expected to have a negative effect on bank stability. It was discussed above that, there is a "Dual-Agency" role in that, unlike foreign and private domestic-owned banks, the government's role is both as regulator and owner of the state-owned banks. This may result in a conflict of interest and make regulators to favour state banks with regards to bank regulations (such as capital requirements) (Andrews, 2005). Moreover, well capitalised state bank may in the long run, face high NPL, as the government may want to use it as a cash cow to finance its activities.

To examine the effect of ownership type and bank stability, and whether such effect varies with the type of bank ownership, Equation 4.3 above is extended to Equations 4.4, 4.5, and 4.6 below, matching with the foreign, private-domestic, and the government ownership types, respectively.

$$FS_{i,t}=\alpha_{i_1}+\gamma_1 FS_{i,t1}+\gamma_2 car_{i,t}+\gamma_3 lad_{i,t}+\gamma_4 bank\_size_{i,t}+\gamma_5 lend_{i,t}+\gamma_6 roa_{i,t}+\beta_1 for_{i,t}+\beta_2(for_{i,t}*car_{i,t}) +\lambda_1 crisis_t+\lambda_2 inf_t+\lambda_3 gdp_t+\mu_{i,t} \quad (4.4)$$

$$FS_{i,t}=\alpha_{i_1}+\gamma_1 FS_{i,t1}+\gamma_2 car_{i,t}+\gamma_3 lad_{i,t}+\gamma_4 bank\_size_{i,t}+\gamma_5 lend_{i,t}+\gamma_6 roa_{i,t}+\beta_1 pvt_{i,t}+\beta_2(pvt_{i,t}*car_{i,t}) +\lambda_1 crisis_t+\lambda_2 inf_t+\lambda_3 gdp_t+\mu_{i,t} \quad (4.5)$$

$$FS_{i,t}=\alpha_{i_1}+\gamma_1 FS_{i,t1}+\gamma_2 car_{i,t}+\gamma_3 lad_{i,t}+\gamma_4 bank\_size_{i,t}+\gamma_5 lend_{i,t}+\gamma_6 roa_{i,t}+\beta_1 gvt_{i,t}+\beta_2(gvt_{i,t}*car_{i,t}) +\lambda_1 crisis_t+\lambda_2 inf_t+\lambda_3 gdp_t+\mu_{i,t} \quad (4.6)$$

4.4 Empirical Results and Analysis

The main results of this study are presented in this section. First, descriptive statistics and the correlations of variables, as defined earlier, are considered. Second, the main estimations to investigate the effect of the bank capital ratio on bank stability are provided. Third, other estimations are added to examine the relationship between bank ownership type and bank stability, and whether the relationship between capital ratios and a bank's stability depends on the ownership type of the bank.

4.4.1 Summary Statistics

Descriptive statistics are presented in Table 4-1 below, indicating that bank stability displays very high variability over the study period. The mean value for the Z-score is 11.27% with a standard deviation of 11.49, while the minimum score is -18.17%, the maximum is 93.77%. In terms of NPL, the mean score is 6.69%, ranging from 0.0% to 60.36%, with a standard deviation of 8.98%. This suggests that bank stability has varied greatly across Tanzanian banks over the study time. Generally, in terms of Z-score, foreign-owned banks display higher bank stability (13.41%), followed by government banks (9.79%), and then private domestic banks, which displays an average value of 8.62% (Appendix Table 4A-1). However, as indicated in Table 4A-1, foreign banks in Tanzania display higher NPL levels compared to their local private and government-owned counterparts. As noted from the literature, although foreign banks in developing markets are more stable (Claessens et al., 2001; Clarke et al., 2000), they may exhibit higher risk-taking behavior (see, for instance, De Nicolò and Loukoianova, 2007; Berger, 2000).

The results show the average capital ratio for all banks in the study to be 25.48%. This figure is higher than the regulatory requirement ratio of 12%, indicating that, during the study period, the sector was, on average, adequately capitalised. However, capital ratios also show a greater variability, as evidenced by the standard deviation of 30.48%. Thus, the sample includes both under-capitalised and over-capitalised banks, as indicated by the minimum and maximum ratios of -89.39% and 254.25%, respectively. Whilst foreign banks have the highest mean value for this ratio (30.01%), private domestic and government banks display lower values of 20.56% and 20.91 %, respectively (Table 4A-1). This is in line with the argument that local banks in emerging markets may have less capital (compared to foreign banks), due to weak local capital markets (Claessens et al., 2001).

The mean value for the liquidity ratio is 58.38%. On average, foreign banks seem to be more liquid compared to the other two categories. It could be that government and private domestic banks have low liquidity due to higher involvement in lending activities, as compared to foreign banks operating in the country. In terms of bank size, on average, foreign-owned banks are larger (19.08) than private-domestic (18.06) and government-owned banks (18.23), as measured by the log of total assets.

The average loan-to-asset ratio for all banks is 50.41%, ranging from 0% to 87.20%. Private domestic banks display the highest loan-asset ratios (54.15%). While government banks come second (53.89%), foreign banks seem to lag behind in this regard (46.98%). This result indicates that locally owned banks provide more loans than foreign banks. For instance, based on political grounds (Andrews, 2005; Chijoriga, 2000), some state banks in developing countries could be involved in lending to parastatals organisations (for large development and agricultural activities), which require huge loans. On the other hand, private-domestic banks have a wide base of lending as they play a significant role in the provision of loans to small and medium enterprises (SMEs).

The average value for profitability among all banks in the Tanzanian sample is -0.86%, ranging from -46.44% to 11.78%, indicating a great variability in the profitability of Tanzanian banks. On average, foreign owned banks operating in Tanzania are generally the most profitable, followed by private domestic, whilst government banks tend to be the least profitable. In developing countries, foreign banks could operate profitably due to better risk management skills, high-level technologies, and access to developed markets (Claessens et al., 2001), which leads to low funding cost, thus enabling them to increase profitability.

Tanzania's average GDP growth rate over the period is 6.4%, ranging from 4.7% in 2006 to 8.5% in 2007, although dipping to 5.6% in 2008, the latter probably related to the 2007-2008 Global Financial Crisis (GFC). The rate picked up again in 2010 and was at 7% in 2019. However, it dropped to 4.8% in 2020, probably due to the effect of the Covid-19 global pandemic. The mean value for inflation rate over the period was 7.58%. During the GFC the rate increased from 7.0% in 2007 to 12.14 % in 2009, eventually peaking at 16% in 2012, and then declining to 3.29% in 2020.

Table 4-1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Med	Percentile			
							5th	25th	75th	95th
Z-score	610	11.269	11.491	-18.172	93.767	9.128	-0.1329	4.125	6.439	27.818
NPL	611	6.698	8.978	0	60.362	4.164	0	0	8.513	26.049
Capital ratio	611	25.482	30.48	-89.388	254.252	18.937	7.397	14.007	27.443	66.748
Liquidity	611	58.377	57.277	4.275	595.484	49.491	22.477	39.414	64	95
Bank size	611	18.612	1.911	12.388	22.683	18.875	15.215	17.484	19.986	21.254
Lending	611	50.412	14.909	0	87.204	51.851	23.349	42.981	60.000	72.176
Profitability	611	-.861	6.075	-46.437	11.779	0.971	-13.071	-1.295	2.1	3.408
Crisis	15	.173	.379	0	1	0	0	0	0	1
Inflation	15	7.584	3.672	3.29	16.001	6.2	3.29	5.175	10.278	16.001
GDP growth	15	6.414	1.008	4.7	8.5	6.7	4.7	5.6	6.9	8.5
Foreign	315	.516	.5	0	1	1	0	0	1	1
Private	204	.334	.472	0	1	0	0	0	1	1
Government	92	.151	.358	0	1	0	0	0	1	1

Table 4-2 below presents the correlation matrix to allow for preliminary examination of the association between the variables. This assessment is an important step as it shows an indication of the practicality of the models. If independent variables are highly correlated, the estimates of the regression could be biased due to multi-collinearity. As seen from the table, while the measure of bank stability (Z-score) is positively and significant correlated with the capital ratio, liquidity, bank size, profitability, and foreign ownership, it is significant and negatively correlated with NPL, lending, private ownership. On the other hand, while the other measure of stability, the non-performing loan ratio (NPL), is positively and significantly correlated with bank size and GDP growth, it is negatively and significantly correlated with capital ratios, liquidity, profitability, crisis, and inflation. The study's variable of interest, the capital ratio, is positively and significantly correlated with liquidity and the foreign ownership type, but negatively with bank size, lending and the private-domestic ownership type.

Moreover, liquidity is positively and significantly correlated with crisis and foreign ownership, but negatively with lending and private ownership. Bank size is positively and significantly correlated with profitability and foreign ownership, but negatively with crisis, inflation, and private-domestic, and government ownership. While lending is positively and significant correlated with profitability, private-domestic, and the government ownership, it is negatively and significantly correlated with crisis and the foreign ownership. Bank profitability and the crisis dummy are positively and significantly correlated. Crisis and inflation are also positively and

significantly related. Inflation is negatively and significantly related with GDP and the foreign ownership. The results further show that the three bank ownership types (foreign, private-domestic, and government) are all negatively and significantly correlated with each other.

Generally, all coefficients are less than 0.8. Multicollinearity becomes a serious problem if the correlation coefficient is above 0.8 (Kennedy, 2003), and therefore there does not appear to be any multi-collinearity problem amongst the variables.

Table 4-2: Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Z-score	1.000												
(2) NPL	-0.148*	1.000											
(3) Capital ratio	0.353*	-0.156*	1.000										
(4) Liquidity	0.222*	-0.093*	0.708*	1.000									
(5) Bank_size	0.285*	0.092*	-0.115*	-0.072	1.000								
(6) Lending	-0.151*	0.040	-0.482*	-0.576*	0.050	1.000							
(7) Profitability	0.368*	-0.103*	0.027	-0.077	0.430*	0.120*	1.000						
(8) Crisis	0.043	-0.118*	0.074	0.094*	-0.153*	-0.139*	0.117*	1.000					
(9) Inflation	-0.064	-0.211*	0.044	-0.015	-0.211*	-0.057	0.023	0.293*	1.000				
(10) GDP growth	-0.029	0.115*	-0.015	-0.053	0.026	0.023	-0.003	0.008	-0.212*	1.000			
(11) Foreign	0.193*	0.065	0.153*	0.170*	0.254*	-0.238*	0.034	-0.032	-0.086*	0.004	1.000		
(12) Private	-0.163*	-0.076	-0.114*	-0.155*	-0.204*	0.178*	-0.002	0.015	0.071	0.001	-0.730*	1.000	
(13) Government	-0.054	0.008	-0.063	-0.034	-0.085*	0.098*	-0.046	0.025	0.027	-0.007	-0.434*	-0.298*	1.000

*** *p<0.01, ** p<0.05, * p<0.1*

4.4.2 Empirical Results

This section provides for the estimation results as presented in Table 4-3 below. The dependent variables are bank-level financial stability, proxied by the *Z-score* and non-performing loans *(NPL)*. The risk-based capital-asset ratio *(car)* is the key independent variable used. Several estimations are performed, as shown in the table. First, in Models 1 and 5 (Columns 1 and 5), consideration is given to the relationship between capital ratios and bank stability, without moderating for bank ownership types. Second, in Models 2, 3, 4, 6, 7, and 8 (Columns 2, 3, 4, 6, 7, and 8, respectively), the three bank ownership types are introduced as dummy variables for foreign owned banks, private-domestic owned banks, and government owned banks, respectively.

The overall validity of the instruments is tested by using the Sargan or Hansen J-test of the overidentifying restrictions, which tests for the null hypothesis that the group of instruments are exogenous. The Sargan or Hansen J-test fails to reject the null hypothesis of exogeneity. The results also show that there is no significant correlation between the residuals and the instruments, indicating that the model is not over-identified in all estimations. Hence, the validity of the instruments is confirmed. Moreover, Arellano-Bond autocorrelation tests are performed. While AR(1) tests the first order autocorrelation in first differences, AR(2) tests for no second order autocorrelations. As anticipated, the AR(1) test rejects the null hypothesis of no first order autocorrelation in first differences. Also, as expected from the AR(2) p-value tests, the tests fail to reject the null hypothesis of no second order autocorrelation in levels.

Further, the study tests for the degree of persistence in the dependent variables. Thus, the Z-score and non-performing loan (NPL) numbers are lagged one period to measure for the degree of persistence in bank stability. From Table 4-3, $Z_{i,t-1}$ and $NPL_{i,t-1}$ are positive and statistically significant for all models. For instance, in Models 3 and 7, holding other variables constant, a one percentage point in period one, $Z_{i,t-1}$ and $NPL_{i,t-1}$, is related to a 57.05 and 82.12 percentage point of bank stability in period two (current), Z-score and NPL, respectively, indicating that the stability for Tanzanian banks is highly persistent. This vindicates the application of dynamic panel data techniques. Overall, the above results show that there are no specification problems, and so confirm that the system generalised method of moments (Sys-GMM) estimator is unbiased and consistent.

Table 4-3: Regression results-capital ratios and bank stability

Dependent variables	**Z-score**				**NPL**			
Independent Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Lag-stability	0.3005*	0.5359***	0.5705***	0.5347***	0.6363***	.6476***	0.8212***	0.6854***
	(0.153)	(0.1275)	(0.1323)	(0.1441)	(0.135)	(0.1544)	(0.1062)	(0.1283)
Capital ratio	0.1117*	0.0289	0.0408	-0.0422	-0.0883*	-0.0207	0.053	-0.1111***
	(0.0616)	(0.0426)	(0.0451)	(0.0671)	(0.0492)	(0.062)	(0.0368)	(0.037)
Liquidity	-0.0805	-0.0121	-0.0134	0.0358	0.0079	-0.0001	-0.0249	0.06*
	(0.0599)	(0.0288)	(.00247)	(0.0591)	(0.0398)	(0.0388)	(0.0553)	(0.0351)
Bank size	2.4027***	1.4291**	1.41**	2.1056***	0.1358	-0.0543	-0.6121	0.3269
	(0.633)	(0.6156)	(0.5383)	(0.5854)	(0.564)	(0.5674)	(0.6549)	(0.6152)
Lending	-0.0844	-0.0483	-0.0443	0.0273	-0.0617	-0.0459	-0.0032	-0.0018
	(0.1098)	(0.0453)	(0.0408)	(0.0619)	(0.0696)	(0.0834)	(0.0849)	(0.0559)
Profitability	0.0929	.1855**	0.185**	-0.0162	-0.122	-0.1016	0.0977	-0.1708
	(0.1019)	(0.086)	(0.0775)	(0.1141)	(0.1641)	(0.1478)	(0.1301)	(0.1274)
Crisis	-2.4185	0.5568	-0.5179	-11.6357***	9.7891***	10.8566***	15.4986***	22.5853**
	(1.8023)	(3.4005)	(4.3827)	(3.1359)	(2.4237)	(3.75)	(4.2383)	(8.7459)
Inflation	-0.0158	-0.2694	-0.1491	0.7412**	-1.7219***	-2.1452***	-3.7149**	-0.7366
	(0.6301)	(0.6121)	(0.7131)	(0.3307)	(0.4004)	(0.4956)	(1.468)	(0.9592)
GDP	0.2923	0.4651	0.5544	1.527	-3.2283*	-4.9868	-9.2771**	2.0703
	(1.5538)	(1.1165)	(1.0504)	(2.7682)	(1.7785)	(3.0811)	(3.8873)	(5.4767)
Foreign		-0.5392				1.5252		
		(1.5665)				(2.0345)		
Foreign x car		0.0198				-0.0442		
		(0.0453)				(0.078)		
Private			1.3574				2.1799*	
			(1.4837)				(1.257)	
Private x car			-0.059				-0.1535***	
			(0.0876)				(0.0545)	
Government				-1.7963				-4.0236
				(1.3109)				(2.5303)
Government x car				0.0874*				.1665**
				(0.0437)				(0.073)
Constant	-34.6465*	-21.3508	-23.4682*	-52.9824***	34.4436**	49.0583**	98.865***	-12.8371
	(17.6173)	(14.7818)	(13.5116)	(18.4714)	(16.7314)	(23.6444)	(34.861)	(42.9482)
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
F-test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR (1) (p-value)	0.011	0.001	0.001	0.004	0.010	0.012	0.012	0.008
AR (2) (p-value)	0.832	0.756	0.942	0.790	0.389	0.374	0.424	0.550
Hansen-overid (p-value)	0.092	0.156	0.156	0.809	0.163	0.072	0.744	0.184
Observations	554	554	554	554	554	554	554	554
No. of instruments	39	52	52	43	55	52	52	43
No of banks	57	57	57	57	57	57	57	57

*Robust standard errors are in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Models 1 to 8 in Table 4-3 above address the relationship between capital ratio and bank stability, measured by Z-score and NPL, in Columns 1-4 and 5-8, respectively. As hypothesised (H4A), the

capital ratio and Z-score are found to be positively related for all the models, except Model 4, it is also statistically significant for Model 1. For instance, in Column 1, holding other variables constant, a 1-percentage point increase in capital ratio is related to 11.17 percentage point increase in bank stability, proxied by the Z-score. This is similar to previous studies which show that well capitalised banks could have less earnings volatility, which may reduce the risk of bank insolvency, thus enhancing stability (see, for example, Berger and Bouwman, 2013; Klomp and De Haan, 2012; Beltratti and Stulz, 2009; and Sufian and Chong, 2008).

In Models 5, 6, and 8, capital ratios and NPL are negatively related, being statistically significant for Models 5 and 8, showing that an increase in capital ratios enhances bank stability. These results conform to the Regulatory Hypothesis, which suggests that regulators should require banks to hold higher risk-based capital ratios, as it enables banks to withstand shocks by minimising risk-taking behaviour, thus enhancing their stability (Altnubas et al., 2007 and Agusman et al., 2008).

The study also examines the effect of bank ownership type on the stability of Tanzanian banks. Foreign ownership and Z-scores have a negative but non-significant relationship. However, the negative coefficient may indicate that foreign banks operating in developing countries may not be familiar with the local markets in which they are operating, thus becoming unable to mitigate risks appropriately (Berger and Bouwman, 2013). On the other hand, private domestic and government ownership show a positive and negative link with the NPL, respectively, being significant for private domestic ownership, suggesting that private-domestic banks increases NPLs than other banks in Tanzania. This could be because in the sample, private domestic owned banks comprise community and regional banks with no reliable sources of capital, which may rely more on unwise lending practices, thus increasing NPLs, and probably resulting in bank failure. For instance, due to under-capitalisation problems, three government banks merged between 2017 and 2018 and seven banks failed, of whom one was a foreign and six were private-domestic banks (BoT, 2018).

Further, the study assesses whether the relationship between capital ratios and bank stability depends on bank ownership type. To achieve this, each of the dummy variable-ownership type is interacted with the capital ratio to capture the moderating effect (if any) ownership type has on the

capital-stability relationship. The study finds a positive but non-significant relationship between the interaction terms (foreign ownership type and the capital ratio) and the Z-score in Model 2. However, Model 4 has positive and statistically significant, indicating that increasing capital ratios for government banks may foster their financial stability. Interestingly, while the link between capital ratios and bank stability (Zscore) is positive, negative, and positive for foreign, private-domestic, and state banks, respectively (Models 2, 3, and 4), the coefficients for interaction terms (for the same models) have opposite signs, indicating that in developing countries, the net impact of capital ratio on bank stability is moderated by the bank ownership type, consistency with H4C.

In terms of NPL, the results show a negative association between the interaction terms and NPL for foreign and private domestic banks (Models 6 and 7) being significant for the later. These results indicate that as capital ratio increases for private-domestic banks, their NPL reduces. The reason could be that, when capital ratios increase, private-domestic banks are forced to be more stringent in their lending practices, thus reducing the proportion of NPLs. Thus, these findings would suggest that while private-domestic banks in Tanzania increases higher NPLs, but if well capitalised they may reduce NPLs and so, improve their stability. However, the variable has a positive and significant relationship with government banks (Model 8), indicating that increasing capital ratios for government owned banks could increase their non-performing loans-NPLs. This could, as noted above, be due to moral hazards, government bail-outs, and the "Dual Agency" Hypotheses discussed above. It is also argued that most state banks in Tanzania suffer high NPLs due to increased lending to financially distressed parastatals and cooperative societies (Chijoriga, 2000). Thus, well capitalised state bank may in the long run, face high NPL, as the government may want to use it as a cash cow to finance its activities.

Similarly, as noted above for the Zscore models, the coefficients on the relationship between capital ratios and bank stability (NPL) have opposite signs from those for the interaction terms, for the same models (Columns 5, 6, and 7). This pattern of results provide empirical evidence to support the above theoretical view that the link between capital ratios and bank stability may be affected by the ownership type of a bank. As Laeven and Levine (2009) and Tandelilin et al. (2007) argue, the association between capital regulation and bank risks depends on ownership structure.

Focusing on bank specific as well as macro-economic variables presented in Models 1 to 8, liquidity and bank stability are negatively but non-significantly related for all the Z-score models, except Model 4. However, this variable has a positive and significant relationship with NPL in Model 8, indicating that an increase in liquidity, holding other factors constant, has a negative impact of stability of Tanzanian banks, as measured by the bank's proportion of non-performing loans to total loans. Bank size is positively and significantly associated with all the Z-score models, suggesting that an increase in bank size results in higher financial stability for Tanzanian banks. As expected, this findings may indicate that larger banks can withstand shocks as they can diversify (Berger et al., 2009; Strahan, 2006). They can also use economies of scale and control their portfolio asset risks efficiently. While ROA is positively related to all Z-scores (except Model 4), being statistically significant for Models 2 and 3, it is negatively and non-significantly related to all the NPL models (except Model 7), indicating that profitable banks can efficiently manage their assets (Khatab et al., 2011), lower their risks, and thus, enhance bank stability.

Considering the 2008 financial crisis, while the variable-crisis dummy is negatively related to all the Z-score models (except Model 4), and being significant for Models 2 and 3, it has a positive and statistically significant relationship to NPL for all the models (Models 5 - 8). As expected, the negative and positive signs with Z-score and NPLs, respectively, conform to the arguments that the financial crisis may have increased NPLs and thus decreased the stability of banks. Theoretically, an economic crisis can deteriorate the quality of the loan portfolio, resulting in credit risks and decreased bank stability (Akhigbe et al., 2012; Bolt et al., 2012; Albertazzi and Gambacorta, 2009). The rate of inflation has a positive and significant relationship with Z-score (Model 4). However, is negatively associated with all the NPLs models, being significant for Models 5, 6, and 7, indicating that an increase in inflation rate can lower NPLs and so improve bank stability. It is argued that during periods of high inflation, banks may reduce credits supply to risky customers and so, decrease NPLs (Nguyen et al., 2012). While GDP growth is negatively but non-significantly related to Zscore models, it is negatively related to all the NPLs models (except Model 8), being significant for Models 5 and 6. The results can be explained in that, theoretically, higher GDP is linked to increasing incomes and decreased financial distress, thus resulting in higher solvency of borrowers and reduced credit risks (Vasquez and Federico, 2012).

4.5 Chapter summary

Bank stability refers to the well-functioning of the banking system. As the main function of the financial intermediaries (banks) is to allocate resources across the various sectors of the economy in a way that ensures financial and monetary stability, bank instability can result in resource misallocation, and hamper savings and investments. Consequently, bank instability can have a contagion effect on other sectors of the economy (Davis, 2001; Bean, 2004), resulting in economic and financial crises. Theoretically, higher bank capital ratios are intended to enhance bank stability by protecting banks from the risk of failure. However, there is conflicting evidence on the effect of capital ratios on bank stability. Therefore, this study examines the relationship between capital ratios and the stability of Tanzanian banks, and the extent to which bank ownership type influences the bank capital ratio-stability linkage. A panel dataset of all 57 banks operating in Tanzania for the period of fifteen years (2006 to 2020) is used.

Descriptive results suggest that, although over the study period, the overall banking sector seems to be stable, individual banks have a wide range of variations in terms of stability as measured by the Z-score and NPL, respectively. Likewise, while the mean value for capital ratio exceeds the minimum regulatory requirement, the variation between under-capitalised and over-capitalised banks is high, with some banks being far below the minimum ratio.

Overall, the main results show that a high capital ratio is associated with a positive and negative impact on banks stability, proxied by the Z-score and NPL, respectively. The results indicate that as higher bank capital ratios reduces NPls, it enhances the stability of Tanzanian banks. Thus, it conforms to the Regulatory Hypothesis, which suggests a positive link between bank capital and stability.

In terms of bank ownership types, the results show that private-domestic banks increase their NPL relative to other bank ownership types. However, the interaction results between capital ratio and bank ownership type show that increasing capital ratios enhances the stability of Tanzanian banks, particularly the locally owned (government and private-domestic) banks. Further, increasing capital ratios for state banks may also increase NPLs. This could be due to moral hazard problems

resulting from government guarantees, or due to the "dual –agency" hypothesis. Also, as noted above, well capitalised state bank may in the long run, face high NPL, as the government may want to use it as a cash cow to finance its activities.

Generally, as the coefficients for interaction terms (ownership x capital ratios) seem to have opposite signs from the direct link between bank ownership and bank stability, the results provide empirical evidence to support the theoretical argument that the link between capital ratios and bank stability may vary, depending on the ownership type of a bank (Laeven and Levine, 2009; Tandelilin et al., 2007).

The empirical evidence reminds bank owners of the need to establish proper control mechanisms to limit managers from excessive risks-taking. Thus, bank managers should increase their bank capital commensurably with the risk they take, to ensure that banks have adequate risk-based capital ratios. Moreover, banking sector stakeholders are provided with information on the bank ownership type-stability nexus. Thus, in terms of bank ownership types, the study provides bank owners with insight on the consequences of increasing capital, and alerts banks operating in Tanzania, and other developing countries, on how better to manage their capital and asset risks, given their ownership types. The study further provide policy recommendations for banking regulators. As the findings conform to the Regulatory Hypothesis, banking regulatory authorities should continue to strengthen bank capital regulatory requirements. As developing countries like Tanzania have less developed financial markets, banks in these countries may experience higher funding costs, thus lagging behind foreign banks (from developed economies) in terms of capitalisation, as evidenced in this study. Thus, banking regulatory authorities and policy makers should strive to ensure that local banks can raise capital with easy and at low cost. Further, as the relationship between capital ratios and bank stability may be influenced by the ownership types of a bank, the bank capital ratios-ownership nexus need to be properly aligned so as to reduce risk-taking and improve their stability. Banking regulators and policy makers are thus enlightened on how best to regulate and supervise banks with ownership differences. To that end, central banks in developing countries (e.g., the bank of Tanzania or BoT) may devise regulatory capital requirement frameworks that would also accommodate banks with different ownership types.

Chapter 5: Conclusion and policy implications

5.1 Introduction

This study investigates the extent to which regulatory pressure (resulting from capital requirement) affect the way in which banks balance the simultaneous relationship between changes in bank capital ratios, lending and investment in government securities. The study also examines the extent to which bank capital ratios affect bank profitability, and the dynamic relationship between bank capital and bank stability. In examining these, the study seeks to understand the unique dynamics around the Tanzanian banking structure such as the impact of divert in bank ownership. Specifically, the study addresses three objectives: i) to investigate how regulatory pressure and bank ownership types are related to changes in bank capital ratios, lending, and investment in government securities; and examine the simultaneity relationship between changes in capital ratios, lending, and investment in government securities, ii) to examine the link between capital ratios and bank profitability of different owned banks; and assess whether board monitoring (board size and independence) moderate this link, and, iii) to assess the relationship between capital ratios and bank stability, and test whether bank ownership type affects the capital ratios-stability linkage.

Banking crises during the last three decades have increased the need for enhanced bank regulations to protect banks against the risk of failure stemming from risks within their loan portfolios. This has thus made banking one of the most regulated sectors and capital requirements being at the heart of such regulations. The Basel-I, Basel-II, and Basel III Accords were thus introduced in 1988, 2004, and 2010, respectively. Capital standards are primarily intended to increase banks' capital ratios to protect them against failure. Developing countries also continue to implement bank capital regulations because, as banks dominate the financial sectors in these countries, bank failure may have a contagion effect, resulting in an overall financial crisis and distress to their economies. Banks, particularly in developing countries where financial markets are weak, play a significant role of financial intermediation by converting deposits into loans, and channeling those funds from surplus to deficit units, thus minimise financial instability and enhance economic growth.

Although the Basel Accords aim at increasing bank capital ratios so as to enhance bank stability by protecting banks from the risk of failure (BCBS, 2004), studies (mostly in developed countries)

are mixed on how capital requirements affect bank capital ratios, and whether in practice higher capital ratios increase bank stability and reduce their risk of failure. Available studies on this topic in developing countries also are contradictory. Thus, although bank capital requirements are theoretically expected to result in higher average bank capital ratios, and so enhance bank profitability and stability, higher risk-weighted capital requirements may raise moral hazards, thus increase risk-taking and lower bank stability. Consequently, banking sectors' instability, may result in an overall financial crisis and potentially very negative effects on the entire economy.

In addition, the implementation of the Basel Accords has increased concerns on the consequences of higher capital requirements on the banks' core role as loan suppliers to the real economy. This is because, as raising capital is costly, especially in developing countries where financial markets are underdeveloped, higher regulatory pressure may compel banks to increase their lending rates, leading to a contraction in loan supply which, in turn, may cause economic decline. Consequently, banks may substitute loans with government securities, which are considered to be of lower risk. However, available studies on the effect of regulatory pressure on changes in bank capital ratios, lending, and investment in government securities are mixed, and do not test the simultaneous link between changes in capital ratios, lending, and investment in government securities.

Further, results on the effect of bank ownership type on bank capital ratios, lending, investment in government securities, profitability, and stability are mixed, and do not test whether and how the link between capital ratios on bank stability may vary with bank ownership type. This study provides empirical evidence from Tanzania, a developing country, due to its historical (economic and political) background, and a diversified banking system, as discussed in Chapter 1above.

The sections below present the findings, implications, contribution, limitations, and suggests the areas for further research.

5.2 Summary of main findings

Chapter 2 uses an unbalanced panel dataset of all 57 banks operating in Tanzania over the period 2006 to 2020 to investigate how and whether regulatory pressure (resulting from bank capital

requirement is related with changes in bank capital ratios, lending, and investment in government securities of banks with different ownership, in the context of Tanzania. Moreover, using simultaneous models, the study examines the simultaneous relationship between changes in bank capital ratios, lending, and investment in government securities. Specifically, the study answers the following three research questions: *First*, what is the effect of regulatory pressure on changes in bank capital ratios, lending, and investment in government securities? *Second*, what is the interrelationship between changes in bank capital ratios, lending, and investment in government securities for banks under regulatory pressure? *Third*, what is the effect of ownership type on changes in bank capital ratios, lending and bank investment in government securities? Thus, given the role of bank lending and investment government securities in economic growth, this study contributes to the literature on how banks under regulatory pressure adjust their capital ratios, lending and investment in government securities, and the extent to which these adjustments vary with the ownership type of a bank.

Descriptive results indicate that, on average, the Tanzanian banking sector seems to maintain capital buffers above the BoT regulatory minimum capital requirement. However, there is great variability amongst the banks, with some banks being over-capitalised and other undercapitalised and falling below the regulatory threshold. The results further suggest that, on average, Tanzanian banks increase their changes in high risk assets (generally loans) more than their changes in low risk assets (mostly government securities).

Employing the three stage least squares (3SLS) and conditional mixed-processes (CMP) estimates, the study finds a negative and significant relationship between regulatory pressure and changes in capital ratios, similar to prior findings (e.g., Ding and Sickles, 2019; Minni, 2016; Ahmad et al., 2009). This finding show that higher regulatory pressure (which increases for banks with capital ratios below the minimum regulatory requirement or those with low excess capital) can decrease changes in bank capital ratios. This result may also explain the reason why, after the 2012 increase in the minimum core capital to TZS 15 billion From TZS 5 billion, the BoT closed five banks at the same time and put three banks on the watch list due to under-capitalisation and failure (BoT, 2018).

In addition, regulatory pressure seem to reduce adjustments in bank lending as evidenced in the results. This is also in line with the theoretical argument that banks under regulatory pressure decrease their changes in portfolio risk (Rime, 2001). The findings on the simultaneous models show a simultaneous link between changes in capital ratios and both changes in lending and investment in government securities, where positive changes in capital ratios is significantly negative and positive related to changes in lending and investment in government securities, respectively. As expected, while an increase in lending reduces adjustments in bank capital ratios, an increase in investment in government securities increases changes in bank capital ratios, providing for a switching regime from higher risk-weighted assets, and thus, reflecting a rebalancing of banks' portfolio towards lower risk and safer assets (Bouis, 2019).

Further, the results suggest that changes in lending have a negative and statistically significant relationship with foreign owned banks relative to other banks. This suggests that foreign banks operating in Tanzania reduce their adjustments in lending, relative to other banks, which is similar to the findings of Cull and Peria (2013), who reveal that foreign banks are associated with a decrease in credit supply in the CEE region. This could be that, unlike local banks, as foreign-owned banks in Tanzania may not be familiar with the local markets in which they are operating, thus becoming unable to mitigate risks appropriately (Berger and Bouwman, 2013) and so decrease their lending. However, while foreign banks seem to increase changes in investment in government securities relative to their counterparts, private-domestic banks lower their changes in investment in government securities, indicating that, under regulatory pressure, private-domestic banks in Tanzania can reduce their changes in investment in government securities more than other types of banks. This could be because, in developing countries, these banks may have low capital due to less-developed capital markets, low levels of technology, and low risk management skills, thus limiting their investment potential (Berger et al., 2008; Barth et al., 2004; La Porta et al., 2002).

Chapter 3 examines the association between bank capital ratios and profitability using an unbalanced bank-level data for 57 Tanzanian banks for the period from 2006 to 2020. Employing the OLS, FE or RE, and the Sys-GMM techniques, the study contributes to the literature on the linkage between bank capital ratios and profitability, and tests the role of board monitoring (board size and independence) on the linkage. Specifically, the study answers three research questions:

First, what are the impact of capital ratios on bank profitability? *Second*, what is the effect of board size and independence on bank profitability? To what extent does board size and independence moderate such effects? *Third*, how does bank ownership type affect bank profitability? Descriptive statistics suggest that over the study period, bank profitability varied greatly across Tanzanian banks, and that, on average, the banking sector was not profitable. In addition, although on average the banking sector is adequately capitalised, the results show a high variability in the capital ratios.

The results show that the relationship between capital ratio and bank profitability (ROA and NIM) is positive and statistically significant (consistent with Hypothesis 3A) for both the static and dynamic models. These findings indicate that higher capital ratio causes an increase in the profitability of Tanzanian banks, which are similar to previous findings (e.g., Olszak et al., 2017; Zheng et al., 2017; Naceur and Omran, 2011; García-Herrero et al., 2009) and conforms to the Expected Bankruptcy Costs Hypothesis, as discussed above.

In addition, while board size has a non-significant positive relationship with ROA for all models, has a negative and non-significant relationship with NIM, similar to the findings study of De Vita and Luo (2018). In terms of board independence, the results are consistent with Hypothesis 3C, which proposes a positive relationship between board independence and bank profitability measured in terms of ROA. Thus, an increase on the proportion of non-executive directors on the board results in higher ROA for Tanzanian banks. However, the results show a negative and significant relationship between board independence and NIM, which could suggest that outside directors may be out of touch and so lose control of a bank's activities due to information asymmetry between inside and outside directors (Brennan and Solomon, 2008; Cho and Kim, 2007), thus harming profitability.

Moreover, the relationship between the interaction term (capital x board size) and ROA is negative and significant, consistency with Hypothesis 3D. However, while the link between the interaction term (capital x board independence) and ROA is negative and significant, it is positive and significant for NIM, thus supporting Hypothesis 3E. The findings suggest that a smaller and more independent board can minimise the agency costs (Jensen and Meckling, 1976), leading to reduced

cost of capital (Pathan and Skully, 2010) and increased profitability. The results conform to the Agency Theory which argues that, non-executive directors (who can increase monitoring) can effectively reduce management's risk-taking motives, thus enhancing profitability.

In terms of bank ownership types, while foreign banks seem to reduce their NIM, relative to other types of banks, private domestic banks increase their profitability (in terms of NIM) relative to other types of banks. This suggests that foreign banks may have higher operating costs, while local (private) banks could be charging higher interest rates (Demirgüç-Kunt and Huizinga, 2000).

Chapter 4 investigates the relationship between capital ratios and the stability of banks in the context of Tanzania, assesses the relationship between bank ownership type and bank stability, and further examines whether the relationship between bank capital ratios on bank stability is influenced by a bank's ownership type. To achieve this, a panel dataset of all 57 banks operating in Tanzania for the period of fifteen years, from 2006 to 2020, is used.

Descriptive results show that, although the overall banking sector seems to be stable, individual banks have a wide range of variations in terms of financial stability. Likewise, while the mean capital ratio exceeds the minimum regulatory capital requirement, the variation between under-capitalised and over-capitalised banks is high, with some banks being far below the minimum ratio.

Overall, the main results show that an increase in bank capital ratio results in a significant positive and negative relationship with Zscore and NPL, respectively, therefore improving banks' stability. This result is similar to previous findings (see, for example, Berger and Bouwman, 2013; Klomp and De Haan, 2012; Beltratti and Stulz, 2009; Sufian and Chong, 2008). This result also supports the Regulatory Hypothesis which suggests that regulators should require banks to hold higher risk-based capital ratios. According to the theory, higher capital enables banks to withstand shocks by minimising losses of default, thus increasing bank stability.

Considering bank ownership types, the results show that private-domestic owned banks increase their NPL relative to other bank ownership types. However, based on the interaction results between capital ratio and bank ownership type, the results reveal that increasing capital ratios for

Tanzanian banks enhance their stability, particularly the locally owned banks. However, increasing capital ratios for government owned banks result in increased NPL for these banks. This may suggest the presence of moral hazard problems resulting from government guarantees, or due to the "dual –agency" hypothesis. Lastly, as the coefficients of the interaction terms change to an opposite signs from the direct link between ownership type and bank stability, the results provide empirical evidence to support the theoretical view discussed above that the capital ratios-stability nexus can be affected by the ownership type of a bank.

5.3 Policy implications and recommendations

This study has some policy implications. First, as the results show that higher regulatory pressure (which increases with a bank's decrease in excess capital or with capital ratios falling below the minimum regulatory requirement, and vice-versa) induces banks to reduce their adjustments in capital ratios and lending, it suggests the need of very-well capitalized banks to maintain a large buffer stock of capital. This could improve the banking sector's capital adequacy and lending activities. In addition, as the findings suggest a simultaneous relationship between changes in bank capital ratios and lending, and capital ratios and investment in government securities, banking regulations should be harmonised to accommodate such relationships. Regulators should thus set capital standards that do not compromise the lending and investment in government securities activities, as they are both vital to economic growth. It was noted above that, as banks dominate the financial system, particularly in developing countries like Tanzania where financial markets are weak, they play a significant role in financial intermediation by converting deposits into loans, and channeling those funds from surplus to deficit units, thus lowering economic disequilibrium and boosting economic growth. Therefore, if bank lending is compromised, it can restrain economic activities. Further, as weak financial markets in developing countries may limit governments' funding options, banks' investment in government securities supports economic growth by financing government expenditures. If banks' investments in government securities is compromised, it may also weaken government spending, as banks buy a stake of these securities.

Finally, while foreign-owned banks in Tanzania reduce their adjustments in lending relative to local banks, local banks in the country (state- and private-domestic-owned) seem to decrease their

adjustments in investment in government securities relative to foreign-owned banks. Thus regulators may need to set regulations that can encourage loan supply for foreign owned banks, and also motivate local banks to increase their investment in government securities.

The empirical evidence reported in Chapter 3 result in some implications and recommendations as follows. Firstly, as the findings show that higher risk-adjusted capital ratios increase bank profitability, bank owners and management need to be acquainted with the link between capital ratios and bank profitability. The results offer evidence of the importance of managing bank risks in line with the levels of capital ratios. Thus, bank owners should be motivated to increase bank capital, but limiting managers from taking excessive risks. In addition, the significant negative and positive effect of board size and independence on banks' profitability, respectively, clearly indicates that smaller and more independent boards could lead to higher bank profitability.

In addition, as the relationship between capital ratio and bank profitability could be influenced by a bank's board size and independence, it signifies an effective role of board size and independence in monitoring managers' decisions with regard to increased bank capital ratios. Thus, banks and regulations should focus not only on stringent capital requirements, but also on smaller boards with more non-executive directors which could efficiently monitor risks to enhance bank profits. Moreover, the results show that, at least with regards to Tanzania, a bank's profitability is also affected by its ownership type. Thus, policy makers in developing countries should endeavour to strengthen the capital regulations while also encouraging all banking institutions, especially local banks, to implement such regulations for enhanced bank capitalisation, so that, increased bank capitalisation could lead to improved bank profitability.

The empirical evidence in Chapter 4 similarly provide some implications and policy recommendations. In the first place, as the results show that a higher capital ratio results in greater bank stability, it provides bank shareholders and managers with information and a reminder to ensure that their banks' risk-based capital ratios are an important mechanism for enhanced stability. In addition, as increasing capital ratios for locally owned banks seems to improve their stability

more than for foreign banks, it provides insight on the consequences of increasing capital, and alerts banks in developing countries on how better to manage their capital and asset risks.

Secondly, the findings provide policy recommendations for banking regulators and governments. As higher capital ratios reduce bank risks (non-performing loans) and increase stability (Zscore), banking regulators should continue to strengthen the capital regulations and require banks to raise capital commensurately with the risk undertaken, so as improve the banking sector's stability. Given that a bank's ownership type has an important effect on how capital ratios impacts stability, the ownership types should be observed when planning for an effective financial sector. Meanwhile, in order to supervise bank capital for enhanced bank stability, policy makers and central banks in developing countries (e.g., The Bank of Tanzania) should potentially come up with ways to motivate foreign banks entries, while also encouraging the performance of local banks. Generally, policy makers, especially in developing countries, should strive to ensure that the capital regulations accommodate all banks with different ownership types, given that these banks have different avenues and capability to raise capital. This study thus sheds more light on the effective means of supervising and regulating banks with different capital levels, board sizes and board independence, and differences in ownership types.

5.4 Contribution to knowledge

This study addresses the literature gaps on the link between capital ratios and bank behaviour. Specifically, it makes a contribution to the body of knowledge on how banks (with different ownership types) under regulatory pressure to meet capital requirements adjust their capital ratios, and how their capital ratios affect not only bank profitability and stability, but also how it relates to their actions related to asset mix adjustments, such as lending and investment in government securities. First, most studies on this topic concentrate on developed countries with well-developed capital markets, where most banks can easily adjust their capital (due to low funding costs) (Rime, 2001), they may have less regulatory pressure. However, as most developing countries have weak capital markets (Griffith-Jones and Tyson, 2013), bank capital ratios and risk adjustments (to meet higher regulatory capital requirements) in these countries may result in higher funding cost (see for example, Ibrahim et al., 2012) thus, be more affected by regulatory pressure as they have to

adjust their capital ratios to meet capital requirements to avoid regulatory penalties (Rime, 2001). Thus, as higher bank capital ratios adjustments can increase funding costs (Francis and Osborne, 2012; Ibrahim et al., 2012; Bolton and Freixas, 2006), it may increase lending rates, leading to constrained loan growth (Francis and Osborne, 2012; Jimenez et al., 2012) and hinder economic growth. An empirical contribution of this study in the context of a developing country (Tanzania) reveal that, regulatory pressure (which is higher for banks with capital ratios below the minimum requirement or those with low excess capital) reduce adjustments in capital ratios and lending.

Secondly, as most studies place little attention on the feedback link between the variables, they do not explicitly assess whether banks respond to higher capital requirements by adjusting the numerator (capital) or the denominator (assets) of their capital ratio. This study contributes to the literature by showing that, under regulatory pressure to meet capital requirements, banks' changes in capital ratios have a simultaneous relationship with both changes in lending and investment in government securities. Specifically, higher changes in capital ratios reduces and increases adjustments in lending and investment in government securities, respectively. On the other hand, while changes in lending lowers adjustments in capital ratios, changes in investment in government securities provides for a switching regime from higher risky assets by increasing changes in banks capital ratio. Theoretically, this could reflect a rebalancing of banks' portfolio towards lower risk and safer assets (Bouis, 2019). Further, local banks are found to increase their lending adjustments, relative to foreign banks. While foreign banks reduce their changes in higher risk asset (loans), they increase that in low risk assets (government securities), relative to their counterparts.

Third, prior studies on the link between capital ratios and bank profitability and stability have contradictory results, and do not test how board monitoring (board size and board independence), and ownership type may influence these linkages. Empirically, this study contributes to the literature by showing that, while banks with more non-executive directors can increase (reduce) ROA (NIM), increasing capital for these banks reduces (increases) ROA (NIM). Further, while locally owned banks in Tanzania (particularly private-domestic) increase NPL relative to other banks, if well capitalised, these banks can improve their stability. However, higher capitalised state banks can increase NPL.

5.5 Limitations of the study

The current study had some limitations. First, the current study was limited to the context of Tanzania due to the country's historical (financial and economic) background. It is discussed in chapter one of this thesis that, unlike many other sub-Saharan countries, Tanzania implemented a strongly socialist economic model after independence in 1961. Following The Arusha Declaration (an ideology of socialism) of 1967, Tanzania became a centrally planned economy, and so it resorted to the creation of State Corporations, commonly called parastatals organisations or state-owned enterprises (SOEs) (Nyerere, 1968). As a result, all private banking activities were prohibited in the country. Thus, the study does not cover other countries and so, it does not compare whether the results could differ from other countries (which have no socialism background) in the region, such as the South African Development Community (SADC) or the East African Community (EAC). This was due to bank-level data limitations in those countries. Tanzanian law requires all banks operating in the country, regardless of whether they are listed or not, to publicly publish their financial reports. Thus, the researcher had more access to bank-level data in Tanzania. It was noted above that, although some other countries may also require banks to publish their data, it is often not easy to get bank-level data either from the banks' websites (especially historical data), or from their central banks, who usually report only at the banking sector-level.

Second, due to resource (e.g., time and funding) and financial market constraints, the study was also limited to few bank profitability and stability indicators (e.g., ROA, NIM, Z-score, and NPLs), and in the context of Tanzania. For instance, due to less developed financial markets in the country, the study was limited to few bank stability indicators (e.g., Z-score, and NPLs), Thus, the most well-known market based stability measures, such as the structural approach (SA), probabilities of distress (PoDs) derived from out-of-the money (OOM) option prices (Segoviano and Goodhart, 2009) cannot be estimated in Tanzania. Moreover, the study did not examine another vital element of Basel III Accord (liquidity), as explained under Section 5.6 below.

Third, some banks under the study were not in operation for the entire period of the study. While some banks were licensed after 2006, others exited the sector before 2020 due to various reasons, such as failures. Therefore, given also that the study was only conducted in one country-Tanzania,

the study was limited to a relatively small sample size. However, for the Sys-GMM estimation models, an option *small* is used, which requests small-sample corrections to the covariance matrix estimate, resulting in an F-test instead of a Wald $\chi 2$ test for overall fit in t-test instead of z-test statistics for the coefficients (Roodman, 2009).

5.6 Suggestions for further research

This study proposes future research as follows. First, as the current research was limited to few profitability and stability indicators, and only in the context of Tanzania, thus in future, with ample resources, a similar study may include other variables (e.g., bank efficiency, return on equity, and volatility of ROA) and be extended to other regions such as the South African Development Community (SADC) or the East African Community (EAC).

Second, as noted above that due to resource constraints, the current study concentrates only on how regulatory bank capital requirements could improve bank capital ratios, thus not considering the role of the Basel III Accord on the bank liquidity, especially in developing countries, which are mostly overlooked.

Liquidity is the ability to meet commitments as they come due and to be able to provide funds without incurring undesirable costs (BCBS, 2008). One of the issues in the 2008 financial crisis was a dearth of both liquid funding and assets (Acharya and Mora, 2015).

The importance of bank liquidity has recently attracted much concern to regulators and supervisors. As banks may encounter difficulties, especially during crisis episodes, to preserve sufficient reserves, they are required to hold a minimum amount of liquid assets so as to meet their customers' demands. Thus, Basel III Accord, among other issues, has proposed liquidity requirements to protect banks (Liikanen et al., 2012). It sets minimum liquidity regulatory requirements such as the liquidity coverage ratio (LCR) and the net stable funding ratio (NSFR). While the LCR requires banks to hold sufficient assets of high-quality liquid to subsist short-term stress, the NSFR requires banks to have adequate funding to withstand stress tests over a long-term period (BCBS, 2010).

Theoretically, liquidity is needed to protect banks from bank runs, a risk that creditors will withdraw all their money at the same time due to, among other reasons, depositors' loss of confidence in a bank. This can make a bank unable to pay its debts due to illiquidity, leading to failure. Thus, although banks hold capital to manage their risks, theories also suggest that bank capital affect banks' ability to create liquidity. Banks under regulatory pressure may retain liquidity for protective motives rather than increase their lending (Cantero-Saiz et al., 2014).

Basel III on LCR and NSFR requirements was implemented in 2015 and 2018, respectively (BCBS, 2020); therefore there is not enough variation in data pints. However in future, as more data is availed, it could also be beneficial to investigate, for example, the following research questions, either in the context of Tanzania, or to extend this to a bigger group of developing countries or regions:

i) What is the effect of Basel III accord on bank liquidity?
ii) Is there a simultaneous relationship between bank liquidity and capital ratios?
iii) To what extent does bank liquidity vary with a bank's ownership type?

Thus, there is a need for a study to test and recommend whether an execution of Basel III Accord on liquidity standards has helped banks in developing countries to improve their liquidity. This is because regulators should design regulatory policies that can alleviate bank run consequences and the vast costs resulting from such contagion effects to various economic sectors (IMF 2014).

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Appendices

Appendix 1: Chapter 1

Table 1A-1: List of banks used for the study

S/No.	Bank name	Abbreviation	Ownership
1.	Access Bank (Tanzania) Limited	Access	Foreign
2.	African Banking Corporation (Tanzania) Limited	Bank ABC	Foreign
3.	Akiba Commercial Bank Plc.	Akiba	Foreign
4.	Amana Bank Limited	Amana	Private Domestic
5.	Azania Bank Limited	Azania	Private Domestic
6.	Bank M (Tanzania) Plc	Bank M	Private Domestic
7.	Bank of Africa (Tanzania) Limited	BOA	Foreign
8.	Bank of Baroda (Tanzania) Limited	BOB	Foreign
9.	Bank of India (Tanzania) Limited	BOI	Foreign
10.	Barclays Bank (Tanzania) Limited	Barclays	Foreign
11.	Canara Bank (Tanzania) Limited	Canara	Foreign
12.	China Commercial Bank Limited	China	Foreign
13.	China Dasheng Bank Limited	China Dasheng	Foreign
14.	Citibank (Tanzania) Limited	Citibank	Foreign
15.	Commercial Bank of Africa (Tanzania) Limited	CBA	Foreign
16.	Covenant Bank for Women Ltd	Covenant	Private Domestic
17.	CRDB Bank Plc.	CRDB	Private Domestic
18.	DCB Commercial Bank Plc.	DCB	Government
19.	Diamond Trust Bank (Tanzania) Limited	DTB	Foreign
20.	Ecobank (Tanzania) Limited	EcoBank	Foreign
21.	Efatha Bank Ltd	Efatha	Private Domestic
22.	Equity Bank (Tanzania) Limited	Equity	Foreign
23.	Exim Bank (Tanzania) Limited	Exim	Private Domestic
24.	First National Bank (Tanzania) Limited	FNB	Foreign
25.	Guarantee Trust Bank Limited	Guaranty Trust	Foreign
26.	Habib African Bank Limited	Habib	Foreign
27.	I & M Bank (Tanzania) Limited	I&M	Foreign
28.	International Commercial Bank (Tanzania) Limited	ICB	Foreign
29.	Kagera Farmers' Cooperative Bank Limited	Kagera	Private Domestic
30.	KCB Bank (Tanzania) Limited	KCB	Foreign
31.	Kilimanjaro Cooperative Bank Limited	Kili Corp	Private Domestic
32.	Letshego/Advans Bank (T) Limited	Letshego	Foreign
33.	Maendeleo Bank Plc	Maendeleo	Private Domestic
34.	Mbinga Community Bank Limited	Mbinga	Private Domestic
35.	Meru Community Bank Limited	Meru	Private Domestic

36.	Mkombozi Commercial Bank Plc.	Mkombozi	Private Domestic
37.	Mufindi Community Bank Limited	Mufindi	Private Domestic
38.	Mwalimu Commercial Bank Plc.	MCB	Foreign
39.	Mwanga Rural Community Bank Ltd	Mwanga	Private Domestic
40.	NBC Limited	NBC	Foreign
41.	NCBA Bank Limited	NCBA	Private Domestic
42.	NIC Bank (Tanzania) Limited	NIC	Foreign
43.	Njombe Community Bank Limited	Njombe	Private Domestic
44.	NMB Bank Plc.	NMB	Private Domestic
45.	Peoples' Bank of Zanzibar Limited	PBZ	Government
46.	Stanbic Bank (Tanzania) Limited	Stanbic	Foreign
47.	Standard Chartered Bank (Tanzania) Limited	Standard	Foreign
48.	TADB Bank Limited	TADB	Government
49.	Tandahimba Community Bank Limited	TCB	Government
50.	Tanzania Women's Bank Plc.	TWB	Government
51.	TIB Corporate Bank Limited	TIB Corp	Government
52.	TIB Development Bank Limited	TIB Dev	Government
53.	TPB Bank Limited	TPB	Government
54.	Twiga Bancorp Limited	Twiga	Government
55.	UBL Bank (Tanzania) Limited	UBL	Foreign
56.	Uchumi Commercial Bank Limited	Uchumi	Private Domestic,
57.	United Bank for Africa (Tanzania) Limited	UBA	Foreign

Source: BoT (2016, 2020); IMF (2016)

Table 1A-2: Adoption and Implementation of the Basel Standards in Tanzania

Basel component	Adoption	Implementation
Basel I	Adopted with the Banking and Financial Institutions (BFI) Act, 1991 BFI Act (Amendment), 1993 (capital adequacy ratio were brought into line with Basel standards)	
Risk-based supervision	Adopted with the Banking and Financial Institutions (BFI) Act, 2006	The Banking and Financial Institutions (Capital Adequacy) Regulations, 2008
Basel II	Credit risk SA, operational risk, and market risk adopted with the Banking and Financial Institutions (Capital Adequacy) Regulations, 2014 Pillar II—Risk Management Guidelines for Banks and Financial Institutions, 2010	Operational risk was implemented in 2017 after a three-year moratorium pronounced in the Banking and Financial Institutions (Capital adequacy) amendment) Regulations, 2015
Basel III	Capital conservation buffer of 2.5% adopted with the Banking and Financial Institutions (Capital Adequacy) regulations, 2014	Implemented in August 2017 announced in the Monetary Policy Statement, June, 2017

Source: adopted from Gray (2020)

Table 1A-3: Enforcement to non-compliance of regulatory capital requirements in Tanzania

For non-compliance to capital regulations, Section 26 of the Banking and Financial Institutions (Capital Adequacy) Regulations, 2008 (published on the Government Gazette No. 373), provides for Sanctions and Penalties, as below.

26.-(1) Without prejudice to other penalties and actions prescribed by the Act, failure to comply with any provision of these Regulations shall attract one or more of the following sanctions-

(a) prohibition from declaring or paying dividends;
(b) suspension from opening new branches;
(c) suspension of access to the credit facilities of the Bank;
(d) suspension from lending and investment operations;
(e) suspension of the activity to issue letter of credit/guarantee;
(f) suspension of capital expenditure;
(g) revocation of banking license;
(h) suspension from office of the defaulting director, officer or employee; and
(i) disqualification from holding any position or office in any bank or financial institutions in Tanzania.

(2) Any director, officer or employee of a bank who intentionally sanctions or votes for the approval of any credit accommodation, branch expansion or capital expenditure while the bank or financial institution remains under suspension as provided under paragraphs (b) to (f) of sub-regulation (1) shall be suspended from office.

(3) The suspension from office prescribed under paragraph (h) of sub-regulation (1) shall be without prejudice to any other punitive measures the Bank may take against the defaulting director, officer or employee.

Source: URT (2008)

Table 1A-4 Revocation of banking licenses (of some banks) by the BoT in 2018

NOTICE TO THE PUBLIC

REVOCATION OF BANKING BUSINESS LICENSES AND COMPULSORY LIQUIDATION OF COVENANT BANK FOR WOMEN (TANZANIA) LIMITED, EFATHA BANK LIMITED, NJOMBE COMMUNITY BANK LIMITED, KAGERA FARMERS COOPERATIVE BANK LIMITED AND MERU COMMUNITY BANK LIMITED

Pursuant to the provisions of Section 56(1)(g), 56(2) (a), (b) and (d), 58(2)(i), 11(3)(c) and (j), 61(1) and 41(a) of the *Banking and Financial Institutions Act, 2006*, the Bank of Tanzania has decided to take possession of; discontinue operations; revoke banking business licenses; and place under compulsory liquidation the following banks:

1. Covenant Bank For Women (Tanzania) Limited;
2. Efatha Bank Limited;
3. Njombe Community Bank Limited;
4. Kagera Farmers' Cooperative Bank Limited; and
5. Meru Community Bank Limited.

Further, in line with its mandate under Section 41(a) of the Banking and Financial Institutions Act, 2006; the Bank of Tanzania has appointed the Deposit Insurance Board (DIB) as the Liquidator of the aforesaid banks effective from 4th January 2018.

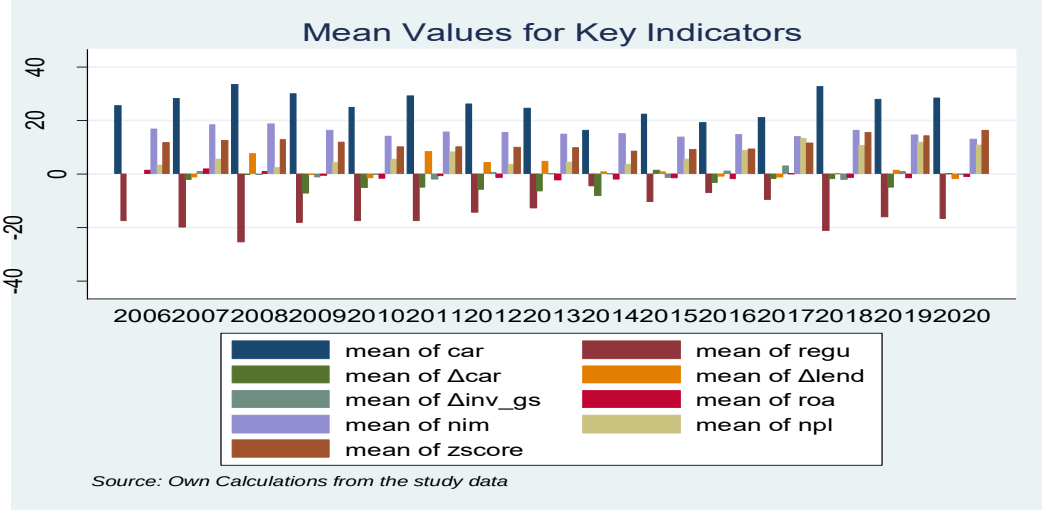
This measure has been taken upon determination by the Bank of Tanzania, that the aforesaid banks are critically undercapitalized, hence, violating the requirements of the *Banking and Financial Institutions Act, 2006* and its regulations. Continuation of their operations in their current capital position is detrimental to the interest of depositors and poses a risk to the stability of the financial system.

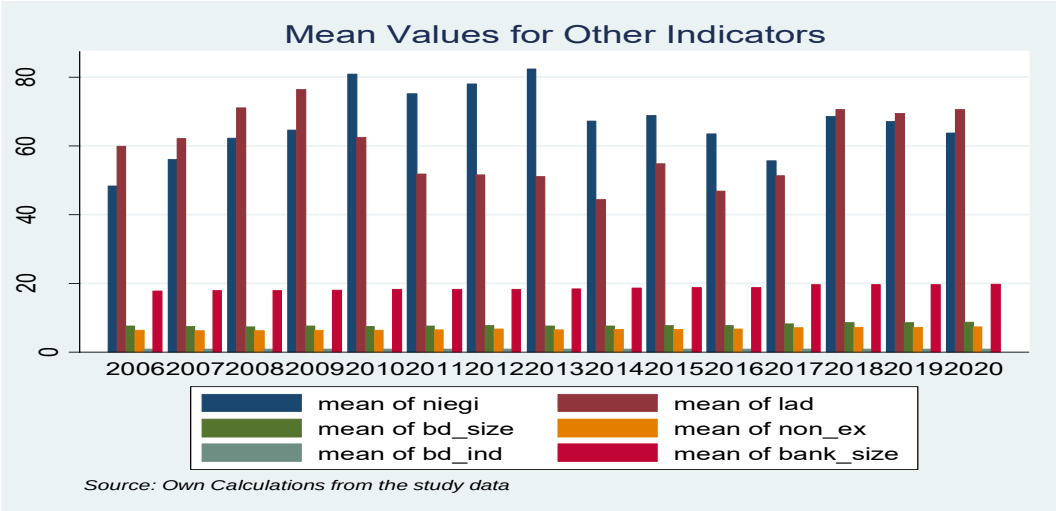
The Bank of Tanzania would like to assure the public that it will continue to protect interests of depositors and maintain the stability of the banking sector.

BANK OF TANZANIA

4th January 2018

Source: BoT (2018)





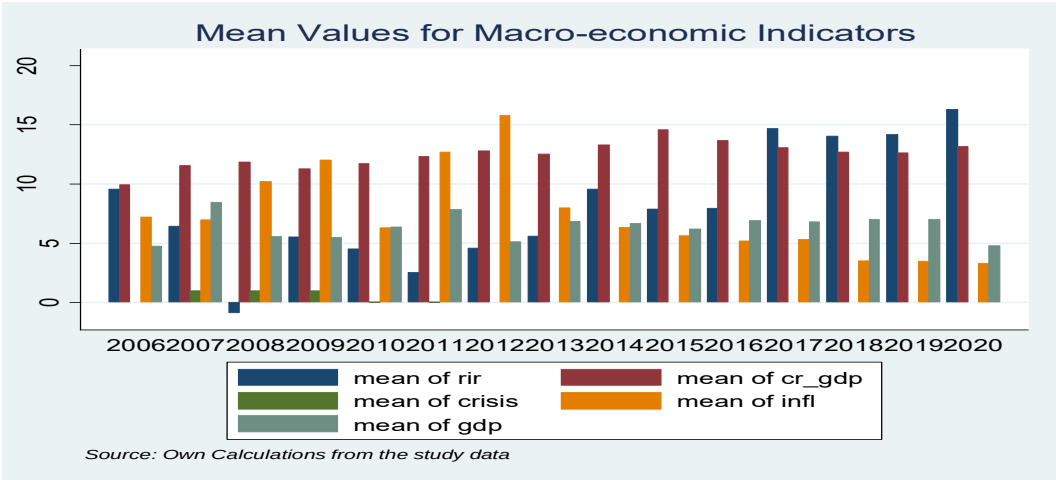


Figure 1A-1: Tanzania banking sector performance trend (2006-2020)

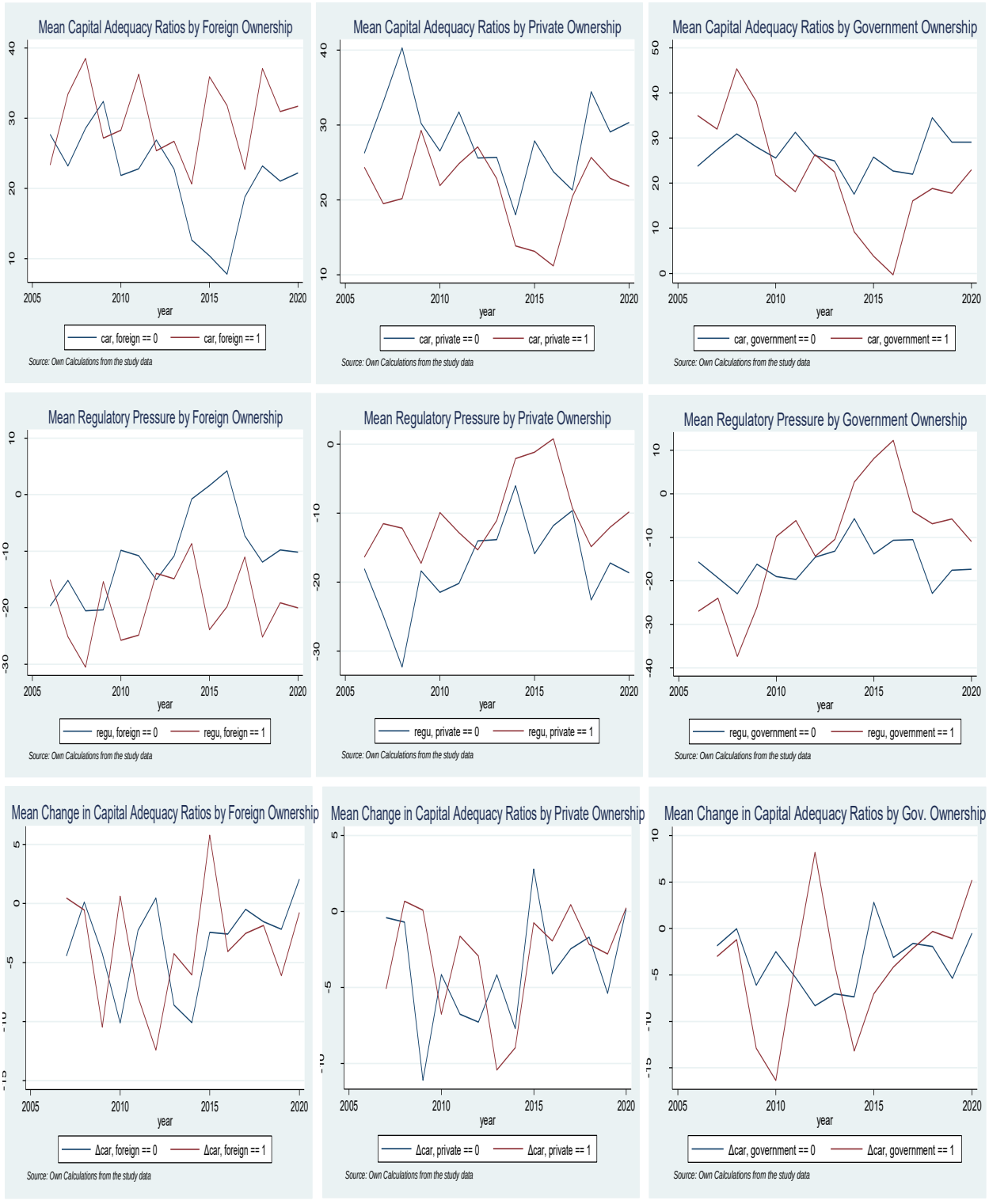


Fig. 1A-2: Tanzania banking sector performance trend-key indicators by ownership types (2006-2020)


Mean Change in Lending by Foreign Ownership
Δlend, foreign == 0
Δlend, foreign == 1
Source: Own Calculations from the study data
Mean Change in Lending by Private Ownership
Δlend, private == 0
Δlend, private == 1
Source: Own Calculations from the study data
Mean Change in Lending by Government Ownership
Δlend, government == 0
Δlend, government == 1
Source: Own Calculations from the study data
Mean Change in Investment in Gov. Sec. by Foreign Ownership
Δinv_gs, foreign == 0
Δinv_gs, foreign == 1
Source: Own Calculations from the study data
Mean Change in Investment in Gov. Sec. by Private Ownership
Δinv_gs, private == 0
Δinv_gs, private == 1
Source: Own Calculations from the study data
Mean Change in Investment in Gov. Sec. by Gov. Ownership
Δinv_gs, government == 0
Δinv_gs, government == 1
Source: Own Calculations from the study data
Mean Return on Assets by Foreign Ownership
roa, foreign == 0
roa, foreign == 1
Source: Own Calculations from the study data
Mean Return on Assets by Private Ownership
roa, private == 0
roa, private == 1
Source: Own Calculations from the study data
Mean Return on Assets by Government Ownership
roa, government == 0
roa, government == 1
Source: Own Calculations from the study data
year

Fig. 1A-2 (cont.…)


Mean Net Interest Margin by Foreign Ownership
nim, foreign == 0
nim, foreign == 1
Source: Own Calculations from the study data
Mean Net Interest Margin by Private Ownership
nim, private == 0
nim, private == 1
Source: Own Calculations from the study data
Mean Net Interest Margin by Government Ownership
nim, government == 0
nim, government == 1
Source: Own Calculations from the study data
Mean Z-Score by Foreign Ownership
zscore, foreign == 0
zscore, foreign == 1
Source: Own Calculations from the study data
Mean Z-Score by Private Ownership
zscore, private == 0
zscore, private == 1
Source: Own Calculations from the study data
Mean Z-Score by Government Ownership
zscore, government == 0
zscore, government == 1
Source: Own Calculations from the study data
Mean Non-Performing Loans by Foreign Ownership
npl, foreign == 0
npl, foreign == 1
Source: Own Calculations from the study data
Mean Non-Performing Loans by Private Ownership
npl, private == 0
npl, private == 1
Source: Own Calculations from the study data
Mean Non-Performing Loans by Government Ownership
npl, government == 0
npl, government == 1
Source: Own Calculations from the study data
year

Fig. 1A-2 (cont.…)

Appendix 2: Chapter 2

Table 2A-1: Summary statistics: by ownership types

Summary statistics: N mean sd min max by (owner_type)

owner_types: foreign

	N	mean	sd	min	max
regu	315	-19.341	37.513	-243.885	12.356
Î”car	288	-3.607	18.587	-121.879	83.973
Î”lend	288	1.281	10.329	-29.8	50.031
Î”inv gs	288	.211	8.451	-29.846	27.92
lag car	288	29.503	33.954	-.356	254.252
lag lend	288	47.14	14.755	0	78
Lag inv gs	288	15.602	9.907	0	51.872
roa	315	-.658	4.712	-32.544	5.282
nim	315	14.515	9.313	0	61.161
lad	315	67.804	68.402	13	595.484
npl	315	7.267	9.666	0	60.362
bank size	315	19.082	1.153	15.671	21.311
rir	315	8.476	4.78	-1.202	16.28
cr gdp	315	12.605	1.047	9.79	14.614
crisis	315	.162	.369	0	1
infl	315	7.279	3.673	3.29	16.001
gdp	315	6.417	1.005	4.7	8.5

owner_types: private

regu	204	-9.422	21.1	-125.552	90.923
Î”car	183	-3.494	14.991	-97.46	42.685
Î”lend	183	2.001	9.679	-19.532	51.651
Î”inv gs	183	-.091	5.221	-32.725	20.503
lag car	183	21.424	20.484	-72.371	137.552
lag lend	183	53.626	13.689	0	87.204
lag inv gs	183	7.055	9.788	0	56.679
roa	204	-.874	6.755	-46.437	11.779
nim	204	15.963	8.81	-8.937	55
lad	204	45.883	27.45	4.275	336
npl	204	5.741	6.646	0	41.614
bank size	204	18.061	2.555	13.284	22.683
rir	204	7.315	4.203	-1.202	16.28
cr gdp	204	12.592	1.125	9.79	14.614
crisis	204	.181	.386	0	1
infl	204	7.95	3.658	3.29	16.001
gdp	204	6.415	1.015	4.7	8.5

owner_types: government

regu	92	-9.604	28.093	-110.248	101.388
Î”car	83	-4.573	17.081	-94.248	31.692
Î”lend	83	1.759	13.914	-44.267	63
Î”inv gs	83	-.685	7.473	-30.38	25.624
lag car	83	22.9	25.742	-69.201	118.248
lag lend	83	53.808	16.513	6	80.913
lag inv gs	83	11.822	14.272	0	63.7
roa	92	-1.526	8.271	-39.192	6.55
nim	92	16.76	8.731	0	46
lad	92	53.803	59.05	5.732	563
npl	92	6.871	10.778	0	53.278
bank size	92	18.226	1.931	12.388	20.723
rir	92	7.531	4.481	-1.202	16.28
cr gdp	92	12.547	1.123	9.79	14.614
crisis	92	.196	.399	0	1
infl	92	7.819	3.648	3.29	16.001
gdp	92	6.397	1.011	4.7	8.5

Table 2A-2: The Durbin–Wu–Hausman test for endogeneity

```
      Source |       SS           df       MS      Number of obs   =       554
-------------+----------------------------------   F(12, 541)      =    528.65
       Model |  151159.996        12  12596.6663   Prob > F        =    0.0000
    Residual |  12890.8313       541  23.8277843   R-squared       =    0.9214
-------------+----------------------------------   Adj R-squared   =    0.9197
       Total |  164050.827       553  296.656106   Root MSE        =    4.8814

------------------------------------------------------------------------------
        Δcar |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       Δlend |  -.3678657    .040524    -9.08   0.000    -.4474695    -.288262
     Δinv_gs |   .0266885   .0658511     0.41   0.685    -.1026666    .1560437
        regu |  -.6614896   .0136524   -48.45   0.000    -.6883079   -.6346713
         roa |   .3355834   .0425059     7.89   0.000     .2520867    .4190802
         npl |  -.0030798    .024342    -0.13   0.899    -.0508963    .0447367
   bank_size |    -.14074   .1339592    -1.05   0.294    -.4038839    .1224038
      crisis |   -2.11875   .5964973    -3.55   0.000    -3.290484    -.947015
        infl |   .1404997     .06456     2.18   0.030     .0136807    .2673186
         gdp |  -.3054906   .2312322    -1.32   0.187    -.7597135    .1487324
             |
         car |
          L1. |  -.7395783   .0125687   -58.84   0.000    -.7642677   -.7148888
             |
   Δlend_res |   .3998577   .0473222     8.45   0.000     .3068999    .4928155
 Δinv_gs_res |  -.1638732    .072937    -2.25   0.025    -.3071476   -.0205987
       _cons |   12.86067   3.224539     3.99   0.000     6.526522    19.19482
------------------------------------------------------------------------------

. test Δlend_res

 ( 1)  Δlend_res = 0

       F(  1,   541) =   71.40
            Prob > F =    0.0000

. test Δinv_gs_res

 ( 1)  Δinv_gs_res = 0

       F(  1,   541) =    5.05
            Prob > F =    0.0251
```

Table 2A-3: Rank Order condition

Endogenous coefficients matrix

	Δcar	Δlend	Δinv_gs
Δcar	-1		
Δlend	.5	-1	
Δinv_gs	.5	.5	-1

Exogenous coefficients matrix

	regu	roa	npl	bank_size	crisis	infl	gdp	L. car	nim	lad	rir	L. lend	L. cr_gdp	L. inv_gs
Δcar	.5	.5	.5	.5	.5	.5	.5	.5	0	0	0	0	0	0
Δlend	.5	.5	.5	.5	.5	.5	.5	0	.5	.5	.5	.5	0	0
Δinv_gs	.5	.5	.5	.5	.5	.5	.5	0	0	.5	0	0	.5	.5

Eq 1 is identified
Eq 2 is identified
Eq 3 is identified

System is identified

Table 2A-4: Hansen-Sargan test for overidentifying restrictions

```
Number of equations: 3
Total number of exogenous variables in system : 28
Number of estimated coefficients : 77
Net of 6 linear constraints / dependencies
Hansen-Sargan overidentification statistic :    11.314
Under H0, distributed as Chi-sq(7), pval = 0.1255
```

Table 2A-5: Test for overall system heteroscedasticity

```
================================================
* System Heteroscedasticity Tests (3sls)
================================================
*** Single Equation Heteroscedasticity Tests:
  Ho: Homoscedasticity - Ha: Heteroscedasticity

 Eq. Δcar  : Engle LM ARCH Test: E2 = E2_1  =  1.5567 P-Value > Chi2(1) 0.2122
 Eq. Δcar  : Hall-Pagan LM Test: E2 = Yh    = 79.7187 P-Value > Chi2(1) 0.0000
 Eq. Δcar  : Hall-Pagan LM Test: E2 = Yh2   =309.6314 P-Value > Chi2(1) 0.0000
 Eq. Δcar  : Hall-Pagan LM Test: E2 = LYh2  = 17.9188 P-Value > Chi2(1) 0.0000
--------------------------------------------------------------------------------
 Eq. Δlend : Engle LM ARCH Test: E2 = E2_1  = 69.2003 P-Value > Chi2(1) 0.0000
 Eq. Δlend : Hall-Pagan LM Test: E2 = Yh    =  0.0602 P-Value > Chi2(1) 0.8062
 Eq. Δlend : Hall-Pagan LM Test: E2 = Yh2   = 95.7213 P-Value > Chi2(1) 0.0000
 Eq. Δlend : Hall-Pagan LM Test: E2 = LYh2  = 35.6810 P-Value > Chi2(1) 0.0000
--------------------------------------------------------------------------------
 Eq. Δinv_gs: Engle LM ARCH Test: E2 = E2_1 = 63.0060 P-Value > Chi2(1) 0.0000
 Eq. Δinv_gs: Hall-Pagan LM Test: E2 = Yh   =  2.3547 P-Value > Chi2(1) 0.1249
 Eq. Δinv_gs: Hall-Pagan LM Test: E2 = Yh2  = 29.1104 P-Value > Chi2(1) 0.0000
 Eq. Δinv_gs: Hall-Pagan LM Test: E2 = LYh2 = 17.1349 P-Value > Chi2(1) 0.0000
--------------------------------------------------------------------------------
*** Overall System Heteroscedasticity Tests:
 Ho: No Overall System Heteroscedasticity

- Breusch-Pagan LM Test         = 218.0294       P-Value > Chi2(3)   0.0000
- Likelihood Ratio LR Test      = 204.0481       P-Value > Chi2(3)   0.0000
- Wald Test                     = 465.1889       P-Value > Chi2(3)   0.0000
--------------------------------------------------------------------------------.
```

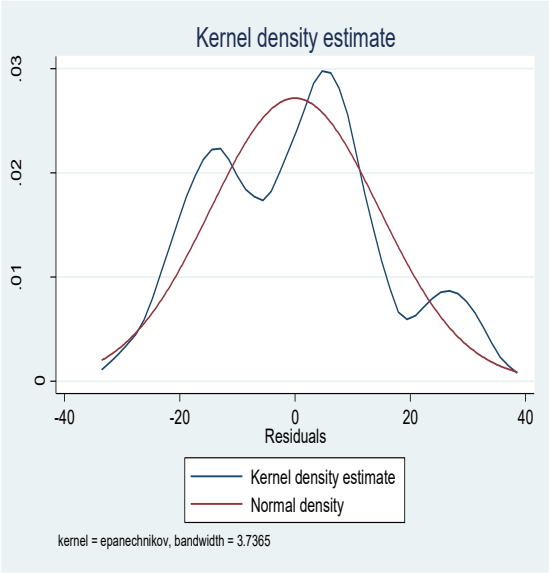


Figure 2A-1: Normality check: kernel density estimate

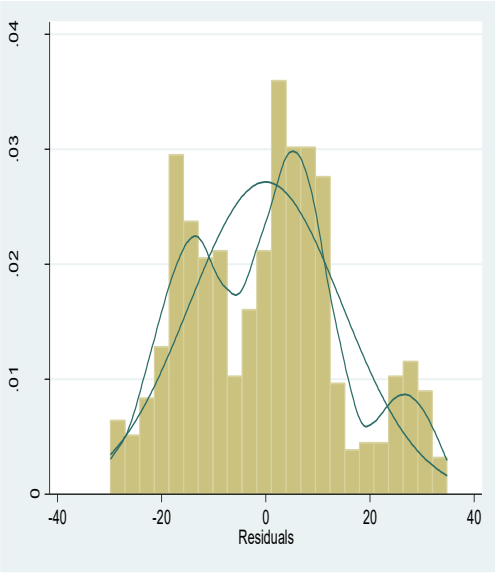


Figure 2A-2: Normality check: normal residuals

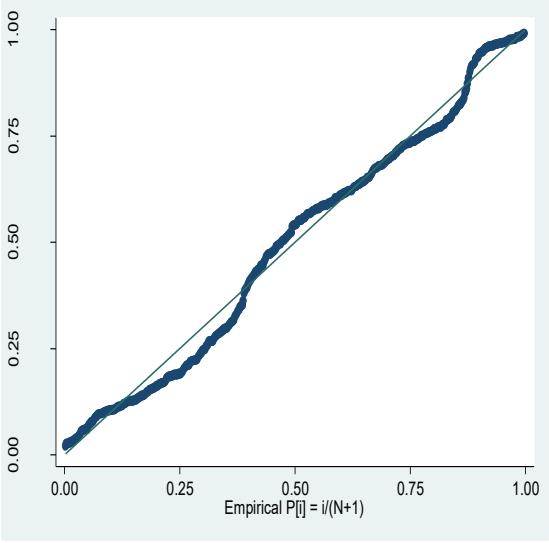


Figure 2A-3: Normality check: standardize normal probability plot (pnorm)

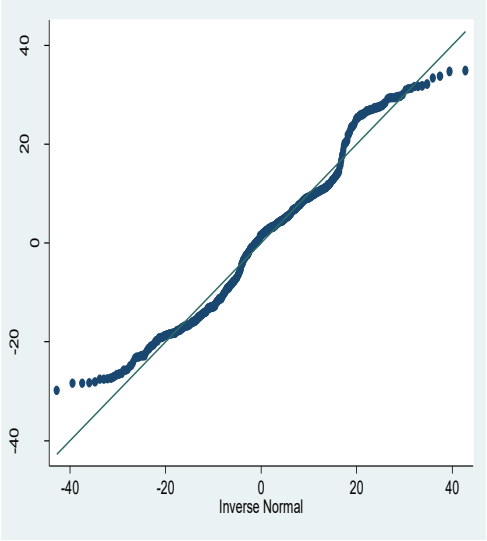
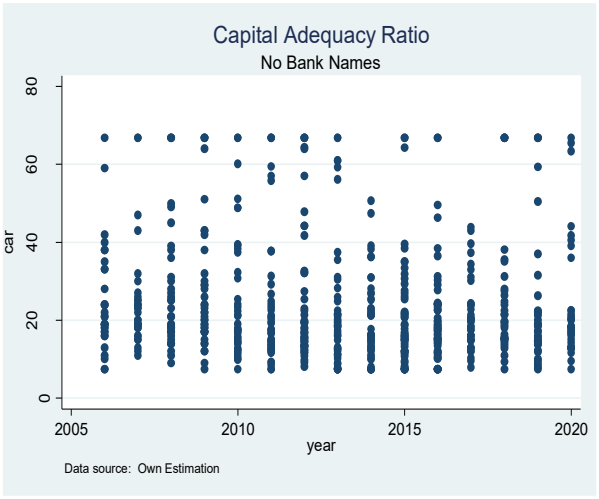
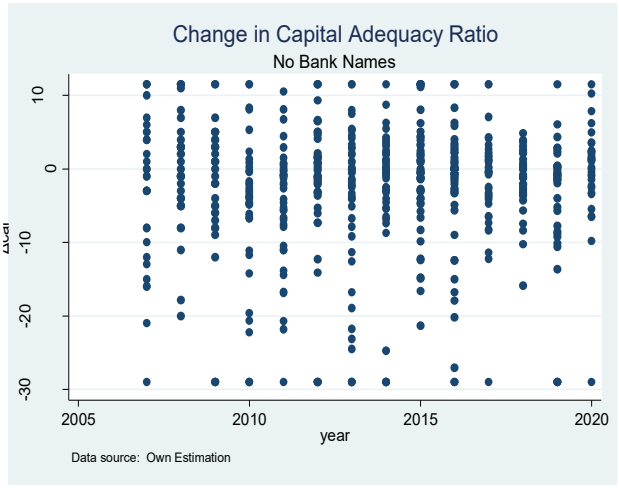
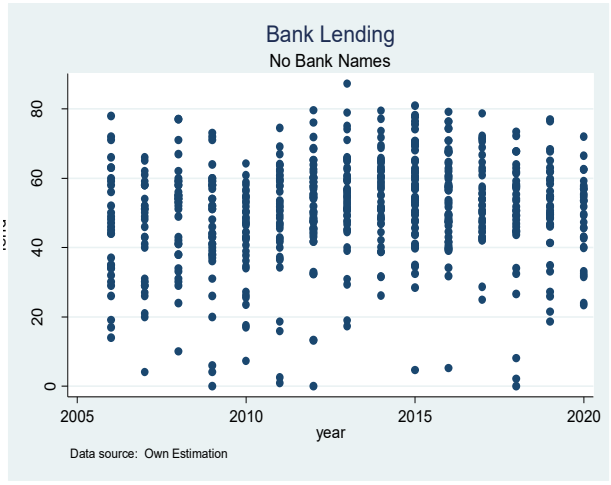
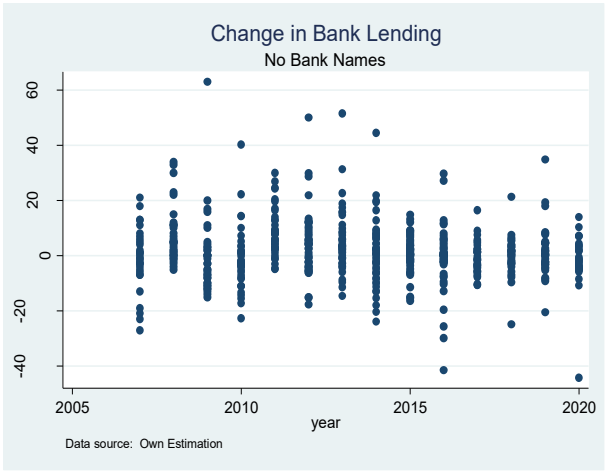


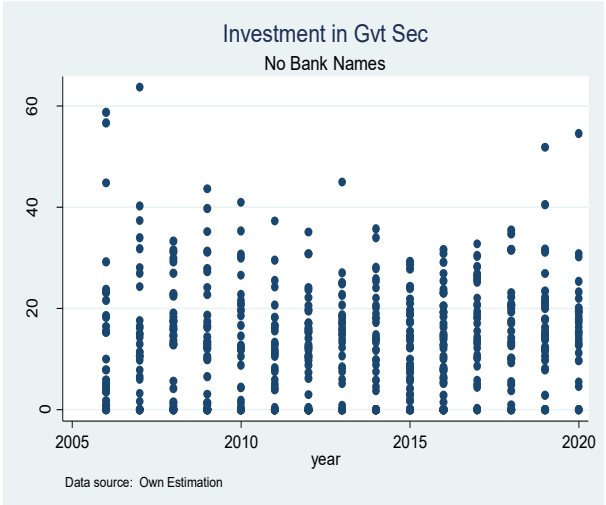
Figure 2A-4: Normality check: quintile-normal plots (qnorm)











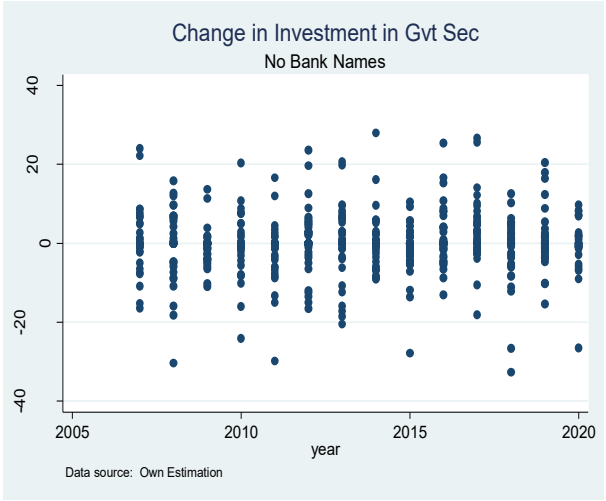
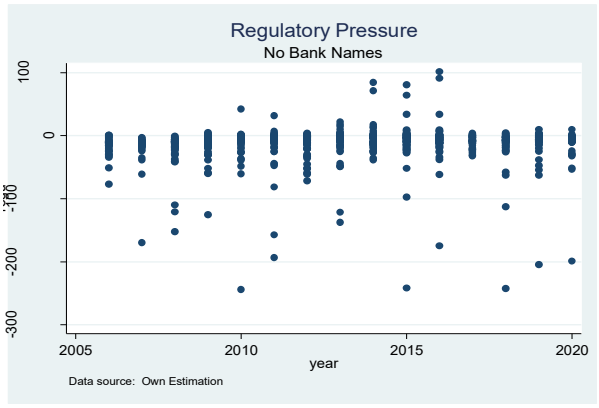
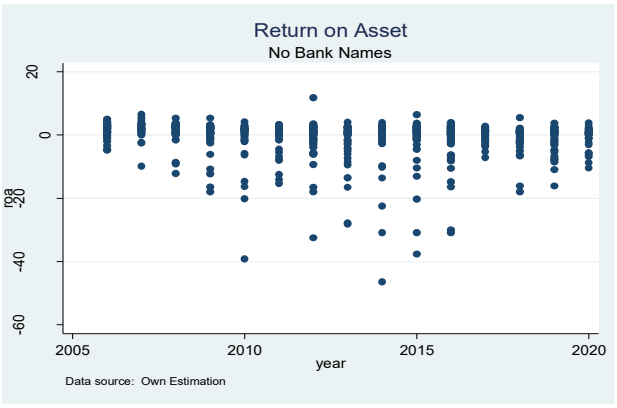
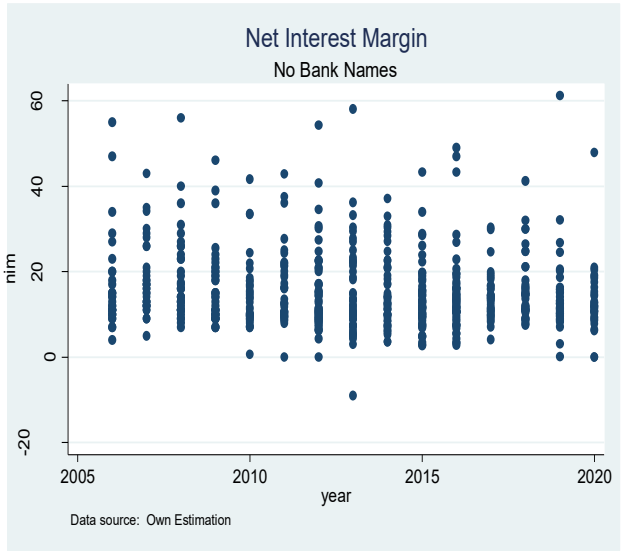
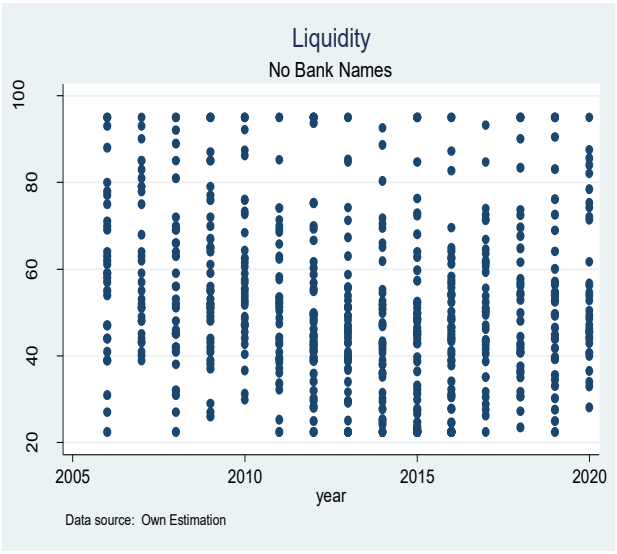


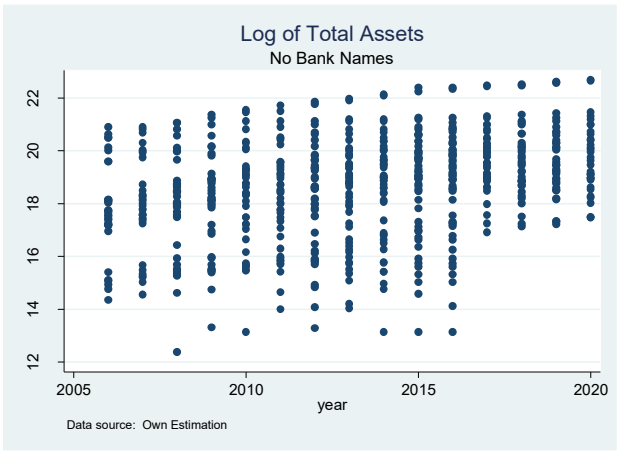
Figure 2A-5: Scatter graphs for outlier detection











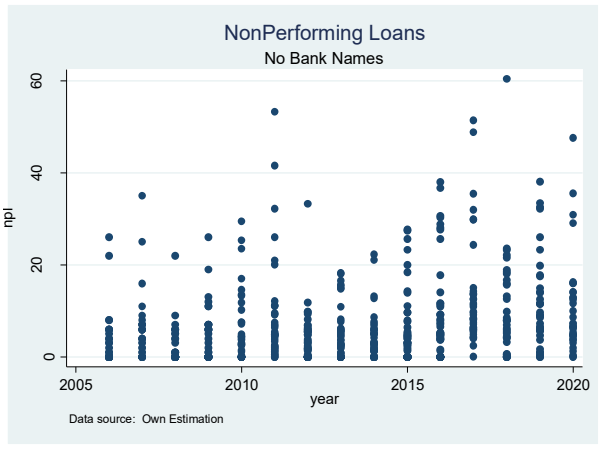


Figure 2A-5: (continues…)

Table 2A-6: Simultaneous models estimates- capital, lending, and investment (3SLS and CMP)-Winsorised variables

Variables	3SLS			CMP		
	Δcar	Δlend	Δinv_gs	Δcar	Δlend	Δinv_gs
	(1)	(2)	(3)	(4)	(5)	(6)
regu, Winsorized fraction .05	-0.5670***	-0.2319***	-0.0055	-0.5673***	-0.2319***	-0.0055
	(0.0237)	(0.0202)	(0.0215)	(0.0458)	(0.0251)	(0.0241)
Δcar, Winsorized fraction .05		-0.0817***	0.0852**		-0.0817*	0.0849*
		(0.0317)	(0.0337)		(0.0423)	(0.0430)
Δlend, Winsorized fraction .05	-0.0688*		-0.0438	-0.0692		-0.0439
	(0.0361)		(0.0406)	(0.0479)		(0.0428)
Δinv_gs, Winsorized fraction .05	-0.0399	0.0176		-0.0435	0.0174	
	(0.0811)	(0.0835)		(0.0867)	(0.0878)	
car, Winsorized fraction .05 = L,	-0.7141***			-0.7143***		
	(0.0224)			(0.0416)		
lend, Winsorized fraction .05 = L,		-0.6245***			-0.6245***	
		(0.0244)			(0.0310)	
inv_gs, Winsorized fraction .05 = L,			-0.2959***			-0.2959***
			(0.0261)			(0.0283)
roa, Winsorized fraction .05	0.4494***	0.0789	0.0366	0.4496***	0.0789	0.0368
	(0.0588)	(0.0637)	(0.0671)	(0.1118)	(0.0829)	(0.0704)
nim, Winsorized fraction .05		-0.0875***			-0.0875**	
		(0.0308)			(0.0393)	
lad, Winsorized fraction .05		-0.4604***	0.0905***		-0.4604***	0.0906***
		(0.0204)	(0.0174)		(0.0260)	(0.0190)
npl, Winsorized fraction .05	0.0237	-0.0817***	0.0283	0.0238	-0.0817**	0.0283
	(0.0294)	(0.0298)	(0.0318)	(0.0378)	(0.0362)	(0.0319)
bank_size, Winsorized fraction .05	0.0677	0.4658***	0.4484***	0.0669	0.4658***	0.4484***
	(0.1354)	(0.1548)	(0.1685)	(0.1290)	(0.1535)	(0.1554)
cr_gdp		-0.2944			-0.2944**	
		(0.5199)			(0.1437)	
rir			-1.0179			-1.0179
			(1.2272)			(0.9768)
crisis	-1.6764	-3.4584	-2.8349	-1.6902*	-3.4593***	-2.8350**
	(2.3907)	(2.8523)	(2.5709)	(0.9829)	(0.6875)	(1.3786)
infl	0.3560	-0.4721	-0.4625	0.3544***	-0.4722***	-0.4623
	(0.3104)	(0.4248)	(0.3325)	(0.1277)	(0.1316)	(0.2855)
gdp	0.1014	-1.2556	2.0005*	0.1078	-1.2552***	2.0009**
	(0.9919)	(1.1890)	(1.0565)	(0.3200)	(0.3618)	(0.9219)
Constant	6.8719	58.8900***	-4.3655	6.8631**	58.8884***	-4.3705
	(5.9445)	(13.9790)	(17.5611)	(3.3619)	(6.0748)	(13.4166)
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	554	554	554	554	554	554
R-squared	0.7571	0.6947	0.2738	N/A	N/A	N/A

*Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1*

Appendix 3: Chapter 3

Table 3A-1: Hausman test result for fe vs re- Capital and ROA

	---- Coefficients ----			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
car	.0742835	.052618	.0216655	.003728
lend	.0694993	.1007305	-.0312312	.0038354
npl	.0053559	-.0011632	.0065191	.
bank_size	5.316615	2.475272	2.841343	.4010413
infl	-.0343857	-.039923	.0055373	.
gdp	.2656441	.1600404	.1056036	.
_iyear_2006	10.68267	6.279778	4.40289	.541275
_iyear_2007	9.402998	5.939606	3.463393	.
_iyear_2008	8.150078	4.875934	3.274143	.
_iyear_2009	6.451437	3.725085	2.726351	.
_iyear_2010	4.187204	2.270441	1.916763	.
_iyear_2011	4.057639	2.620448	1.43719	.
_iyear_2012	3.618252	2.18086	1.437392	.
_iyear_2013	1.052565	.0426064	1.009959	.
_iyear_2014	.8631872	.2172549	.6459323	.
_iyear_2015	.3495238	.0745505	.2749732	.
_iyear_2016	.170459	-.0356684	.2061274	.
_iyear_2017	-.188321	.0683636	-.2566847	.
_iyear_2018	-.7934423	-.6951042	-.0983381	.
_iyear_2019	-1.020634	-.8504495	-.1701844	.

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(20) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 59.65
Prob>chi2 = 0.0000
(V_b-V_B is not positive definite)

Table 3A-2: Test for autocorrelation:

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      54) =     17.646
           Prob > F =      0.0001
```

Table 3A-3: Test for heteroskedasticity:

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of roa

         chi2(1)      =   569.69
         Prob > chi2  =   0.0000
```

. **Table 3A-4: Test for multicollinearity:**

```
     Variable |       VIF       1/VIF
--------------+----------------------
          car |      1.38    0.726274
         lend |      1.31    0.760972
         infl |      1.13    0.881934
    bank_size |      1.08    0.921660
          npl |      1.08    0.925319
          gdp |      1.05    0.949315
         bank |      1.04    0.959999
--------------+----------------------
     Mean VIF |      1.16
```

Table 3A-5: Hausman test for fe vs re- Capital and NIM

```
.                                  ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |       fe           re         Difference          S.E.
-------------+----------------------------------------------------------------
         car |     .055133     .0570434       -.0019103        .0081089
        lend |    -.139439    -.1074857       -.0319532        .0109986
         npl |   -.0196582    -.0133387       -.0063194         .007813
   bank_size |   -.0532621    -1.125125        1.071863        .7061354
        infl |     .077745     .0929935       -.0152485        .0156179
         gdp |   -.1035151    -.1393786        .0358636        .0398848
 _iyear_2006 |    3.931952     1.929146        2.002806        1.224486
 _iyear_2007 |    5.154213     3.537347        1.616866        .9758126
 _iyear_2008 |    5.134099     3.411071        1.723028        .9550289
 _iyear_2009 |     2.18963     .7379011        1.451729        .7970206
 _iyear_2010 |    .6827457    -.3172493         .999995        .6038016
 _iyear_2011 |    2.007875     .9672565        1.040619        .4752162
 _iyear_2012 |    1.948489     .7773724        1.171116        .4827252
 _iyear_2013 |     2.50153      1.58996        .9115705        .3982842
 _iyear_2014 |     3.31612     2.645198        .6709223        .3094225
 _iyear_2015 |    2.186181     1.484426        .7017555        .2709308
 _iyear_2016 |    3.352127     2.701376        .6507506        .2541599
 _iyear_2017 |    2.996128     2.672099        .3240289        .2134006
 _iyear_2018 |    3.883282     3.650916        .2323663        .1438186
 _iyear_2019 |    2.607256     2.409749        .1975062        .1566276
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(15) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       25.68
                Prob>chi2 =      0.0416
                (V_b-V_B is not positive definite)
```

.

Table 3A-6: Test for autocorrelation:

.

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      54) =     17.396
           Prob > F =      0.0001
```

Table 3A-7: Test for heteroskedasticity:

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of nim

         chi2(1)      =   189.33
         Prob > chi2  =   0.0000
```

Table 3A-8: Test for multicollinearity:

Variable	VIF	1/VIF
car	1.38	0.726274
lend	1.31	0.760972
infl	1.13	0.881934
bank_size	1.08	0.921660
npl	1.08	0.925319
gdp	1.05	0.949315
bank	1.04	0.959999
Mean VIF	1.16	

.**Table 3A-9: Hausman test: fe or re: capital and ROA with board size and independence**

	---- Coefficients ----			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
car	.2150996	.2368618	-.0217622	.03951
lend	.0621784	.0931167	-.0309383	.004042
npl	.000081	-.006891	.006972	.
bank_size	5.193776	2.468081	2.725695	.398434
infl	-.0388212	-.0464422	.007621	.
gdp	.2279649	.1114415	.1165234	.
bd_size	.129814	.0338529	.0959611	.133151
bd_ind	2.974783	3.097804	-.1230206	1.60039
c.car#|				
c.bd_size	-.0113018	-.011408	.0001063	.0004976
c.car#|				
c.bd_ind	-.0668169	-.1161651	.0493482	.0490495
_iyear_2006	10.45872	6.135282	4.323438	.5652366
_iyear_2007	9.303963	5.96139	3.342573	.
_iyear_2008	7.838022	4.632774	3.205248	.
_iyear_2009	6.379774	3.708334	2.67144	.
_iyear_2010	4.170448	2.279301	1.891147	.
_iyear_2011	4.507612	3.110168	1.397443	.
_iyear_2012	3.674364	2.244978	1.429387	.
_iyear_2013	1.099204	.0659642	1.033239	.
_iyear_2014	.9995096	.3244594	.6750502	.
_iyear_2015	.6763589	.3283607	.3479981	.
_iyear_2016	.4404776	.1723945	.2680831	.
_iyear_2017	.0241024	.231641	-.2075386	.
_iyear_2018	-.6853371	-.6248653	-.0604719	.
_iyear_2019	-.9615886	-.7829451	-.1786435	.

```
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg
    Test:  Ho:  difference in coefficients not systematic

                 chi2(23) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       53.49
                Prob>chi2 =      0.0003
                (V_b-V_B is not positive definite)
```

Table 3A-10: Test for autocorrelation:

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      54) =     16.886
           Prob > F =      0.0001
```

.

Table 3A-11: Test for heteroskedasticity:

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of roa

         chi2(1)      =   473.37
         Prob > chi2  =   0.0000
```

Table 3A-12: Test for multicollinearity:

Variable	VIF	1/VIF
car	79.53	0.012573
lend	1.39	0.719942
npl	1.08	0.922563
bank_size	1.45	0.687902
infl	1.16	0.865028
gdp	1.06	0.942583
bd_size	2.19	0.455804
bd_ind	1.94	0.515845
c.car#|		
c.bd_size	17.76	0.056302
c.car#|		
c.bd_ind	39.09	0.025581
bank	1.05	0.956632
Mean VIF	13.43	

Table 3A-13: Hausman test: fe or re: capital and NIM with board size and independence

.

	---- Coefficients ----			
	(b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
car	-.2652937	-.0645645	-.2007292	.0755287
lend	-.1467575	-.1057608	-.0409967	.0110103
npl	-.0193823	-.0116438	-.0077385	.0075791
bank_size	.2803983	-1.141918	1.422316	.7058967
infl	.0801879	.0886123	-.0084244	.0160799
gdp	-.02046	-.1410625	.1206026	.084266
bd_size	.1392765	.0602909	.0789856	.2595844
bd_ind	-6.04353	-.627824	-5.415706	3.390393
c.car#|				
c.bd_size	-.0016062	.0047756	-.0063818	.0017099
c.car#|				
c.bd_ind	.3936192	.1035769	.2900423	.0904162
_iyear_2006	4.672988	1.990988	2.682	1.245254
_iyear_2007	5.257821	3.584849	1.672971	1.071457
_iyear_2008	5.511013	3.519077	1.991936	.9913738
_iyear_2009	2.645409	.7735423	1.871867	.8527021
_iyear_2010	1.015107	-.3001794	1.315287	.6665527
_iyear_2011	2.36898	.8710151	1.497965	.6499748
_iyear_2012	2.488555	.8225624	1.665992	.571169
_iyear_2013	2.868225	1.660229	1.207996	.4871369

```
 _iyear_2014 |     3.53921      2.67661        .8626006        .3951828
 _iyear_2015 |    2.391129     1.438146        .9529828        .3475056
 _iyear_2016 |      3.5435     2.693138        .8503615        .3678266
 _iyear_2017 |    3.143599     2.674754        .4688447          .32999
 _iyear_2018 |    4.267469     3.743976        .5234926         .268719
 _iyear_2019 |    2.544001     2.458487        .0855139        .2276835
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(19) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       34.69
                Prob>chi2 =      0.0152
                (V_b-V_B is not positive definite)
.
```

Table 3A-14: Test for autocorrelation:

```
Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,      54) =     15.172
           Prob > F =      0.0003
.
```

Table 3A-15: Test for heteroskedasticity:

```
.
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of nim

         chi2(1)      =   266.03
         Prob > chi2  =   0.0000
```

Table 3A-16:.Test for multicollinearity:

```
         Variable |       VIF       1/VIF
------------------+----------------------
              car |     79.53    0.012573
             lend |      1.39    0.719942
              npl |      1.08    0.922563
        bank_size |      1.45    0.687902
             infl |      1.16    0.865028
              gdp |      1.06    0.942583
          bd_size |      2.19    0.455804
           bd_ind |      1.94    0.515845
            c.car#|
        c.bd_size |     17.76    0.056302
            c.car#|
         c.bd_ind |     39.09    0.025581
             bank |      1.05    0.956632
------------------+----------------------
        Mean VIF |     13.43
```

Table 3A-17: Capital ratios and bank profitability (Static and Dynamic OLS)

Variables	ROA		NIM	
	Static OLS	Dynamic OLS	Static OLS	Dynamic OLS
	(1)	(2)	(3)	(4)
Lag-profitability		.5906***		.0604
		(.067)		(.0749)
Capital ratio	.3802***	.3672**	-.1027	-.3428
	(.118)	(.1614)	(.2037)	(.2149)
Lending	.0874***	.0337**	-.0295	-.0357
	(.0247)	(.0172)	(.035)	(.0314)
Non-perf. loans	-.0614**	-.0374	.0053	-.0041
	(.0247)	(.0259)	(.0363)	(.0343)
Bank size	1.6156***	.6332***	-1.4451***	-1.5334***
	(.2041)	(.1451)	(.2659)	(.2372)
Board size	.2467	.3446*	-.1099	-.7027**
	(.1942)	(.1988)	(.3197)	(.3184)
Board independence	5.655**	4.8528	5.1716	3.8036
	(2.7709)	(3.1488)	(5.6261)	(5.3843)
Capital ratio x board size	-.0192***	-.0181**	.013	.0371***
	(.0061)	(.0085)	(.0092)	(.0106)
Capital x board independence	-.2389***	-.2433*	.1054	.2166
	(.0917)	(.1247)	(.2024)	(.2017)
Inflation	-.0802	-.1515*	.1088	.0461
	(.1095)	(.0847)	(.5315)	(.4663)
GDP growth	.0289	.1259	-.3534	.0904
	(.2975)	(.37)	(1.2949)	(1.3095)
Constant	-43.6472***	-21.4482***	37.8876***	42.0904***
	(5.4104)	(5.4317)	(10.0137)	(9.438)
Observations	611	554	611	554
R-squared	.3754	.657	.2346	.3083

Robust standard errors are in parentheses
*** p<0.01, ** p<0.05, * p<0.1*

Table 3A-18: Wooldridge Test for Strict Exogeneity (Dependent Variable- ROA)

Regression results

roa	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
car	.228	.099	2.31	.021	.034	.422	**
lend	.087	.02	4.30	0	.047	.127	***
npl	.027	.027	1.01	.313	-.026	.08	
bank_size	3.014	.843	3.58	0	1.358	4.671	***
bd_size	.562	.342	1.64	.101	-.11	1.234	
bd_ind	7.867	6.136	1.28	.2	-4.191	19.925	
c.car#c.bd_size	-.004	.004	-1.14	.254	-.012	.003	
c.car#c.bd_ind	-.183	.109	-1.69	.092	-.397	.03	*
infl	-.091	.072	-1.27	.204	-.233	.05	
gdp	-.459	.279	-1.65	.1	-1.006	.088	
F.car	.309	.173	1.79	.074	-.03	.649	*
F.lend	.008	.023	0.37	.71	-.036	.053	
F.npl	-.065	.026	-2.52	.012	-.116	-.014	**
F.bank_size	-1.891	.943	-2.01	.045	-3.743	-.039	**
F.infl	.194	.069	2.81	.005	.058	.329	***

F.gdp	-.123	.235	-0.52	.6	-.584	.338	
F.bd_size	.12	.32	0.37	.708	-.509	.748	
F.bd_ind	-3.852	5.548	-0.69	.488	-14.753	7.049	
cF.car#c.bd_size	-.024	.007	-3.50	.001	-.037	-.01	***
cF.car#c.bd_ind	-.091	.185	-0.49	.623	-.455	.273	
Constant	-33.375	8.551	-3.90	0	-50.177	-16.573	***

Mean dependent var	-0.714	SD dependent var	5.993
R-squared	0.219	Number of obs	554.000
F-test	6.718	Prob > F	0.000
Akaike crit. (AIC)	3018.299	Bayesian crit. (BIC)	3108.959

*** p<.01, ** p<.05, * p<.1

(1) F.car = 0
(2) F.lend = 0
(3) F.npl = 0
(4) F.bank_size = 0
(5) F.bd_size = 0
(6) F.bd_ind = 0
(7) cF.car#c.bd_size = 0
(8) cF.car#c.bd_ind = 0
(9) F.infl = 0
(10) F.gdp = 0
F(10, 478) = 4.73
Prob > F = 0.0000

Table 3A-19: Wooldridge Test for Strict Exogeneity (Dependent Variable- NIM)

Regression results

roa	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
car	.228	.099	2.31	.021	.034	.422	**
lend	.087	.02	4.30	0	.047	.127	***
npl	.027	.027	1.01	.313	-.026	.08	
bank_size	3.014	.843	3.58	0	1.358	4.671	***
bd_size	.562	.342	1.64	.101	-.11	1.234	
bd_ind	7.867	6.136	1.28	.2	-4.191	19.925	
c.car#c.bd_size	-.004	.004	-1.14	.254	-.012	.003	
c.car#c.bd_ind	-.183	.109	-1.69	.092	-.397	.03	*
infl	-.091	.072	-1.27	.204	-.233	.05	
gdp	-.459	.279	-1.65	.1	-1.006	.088	
F.car	.309	.173	1.79	.074	-.03	.649	*
F.lend	.008	.023	0.37	.71	-.036	.053	
F.npl	-.065	.026	-2.52	.012	-.116	-.014	**
F.bank_size	-1.891	.943	-2.01	.045	-3.743	-.039	**
F.infl	.194	.069	2.81	.005	.058	.329	***
F.gdp	-.123	.235	-0.52	.6	-.584	.338	
F.bd_size	.12	.32	0.37	.708	-.509	.748	
F.bd_ind	-3.852	5.548	-0.69	.488	-14.753	7.049	
cF.car#c.bd_size	-.024	.007	-3.50	.001	-.037	-.01	***
cF.car#c.bd_ind	-.091	.185	-0.49	.623	-.455	.273	
Constant	-33.375	8.551	-3.90	0	-50.177	-16.573	***

Mean dependent var	-0.714	SD dependent var	5.993

R-squared	0.219	Number of obs	554.000
F-test	6.718	Prob > F	0.000
Akaike crit. (AIC)	3018.299	Bayesian crit. (BIC)	3108.959

*** p<.01, ** p<.05, * p<.1

(1) F.car = 0
(2) F.lend = 0
(3) F.npl = 0
(4) F.bank_size = 0
(5) F.bd_size = 0
(6) F.bd_ind = 0
(7) cF.car#c.bd_size = 0
(8) cF.car#c.bd_ind = 0
(9) F.infl = 0
(10) F.gdp = 0
F(10, 478) = 4.73
Prob > F = 0.0000

Table 3A-20: Bound test between dynamic OLS, FE, and GMM -capital ratio and bank profitability (ROA)

	(1) OLS	(2) FE	(3) GMM
Lag-profitability	.5906***	.2709***	.574***
	(.067)	(.0836)	(.1288)
car	.3672**	.5293**	.8108**
	(.1614)	(.2589)	(.3513)
lend	.0337**	.0397	-.022
	(.0172)	(.0259)	(.0371)
npl	-.0374	-.0068	-.0619
	(.0259)	(.0259)	(.0553)
bank_size	.6332***	3.5753***	.8414
	(.1451)	(.855)	(.6086)
bd_size	.3446*	.3606**	.5945
	(.1988)	(.1646)	(.5391)
bd_ind	4.8528	9.5632	24.7519**
	(3.1488)	(6.422)	(9.4662)
c.car#c.bd_size	-.0181**	-.0202***	-.0303*
	(.0085)	(.0063)	(.0181)
c.car#c.bd_ind	-.2433*	-.372	-.7291***
	(.1247)	(.2853)	(.2694)
infl	-.1515*	-.0947*	-1.4725
	(.0847)	(.0501)	(1.4907)
gdp	.1259	.0628	-9.3251
	(.37)	(.1376)	(10.0778)
_cons	-21.4482***	-83.8303***	32.8071
	(5.4317)	(18.0005)	(77.6308)
Observations	554	554	554
Pseudo R^2	.z	.z	.z

Robust standard errors are in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3A-21: Bound test between dynamic OLS, FE, and GMM -capital ratio and bank profitability (NIM)

	(4)	(5)	(6)
	1	1	1
Lag-profitability	.5491***	.2184***	.5156***
	(.0548)	(.0728)	(.1472)
car	-.0968	-.2163	-.8469*
	(.2004)	(.4437)	(.5014)
lend	-.0302	-.127***	-.0069
	(.0226)	(.035)	(.0723)
npl	.0013	-.0244	-.0341
	(.0275)	(.0301)	(.0637)
bank_size	-.5588***	-.6418	-.005
	(.1686)	(1.1248)	(.5934)
bd_size	-.4838**	-.1666	-.2607
	(.2259)	(.4381)	(.5228)
bd_ind	3.4753	-4.2396	-41.5822**
	(5.2077)	(8.7173)	(16.9067)
c.car#c.bd_size	.0197**	.0116	.0088
	(.0081)	(.016)	(.0204)
c.car#c.bd_ind	.0053	.2439	1.0823**
	(.2251)	(.3889)	(.5261)
infl	.3105	.1154*	-.6265
	(.274)	(.061)	(1.1383)
gdp	.6023	.4807***	1.4675
	(.6947)	(.1607)	(3.4057)
_cons	11.7523*	28.4011	35.666
	(7.0934)	(26.4106)	(28.9576)
Observations	554	554	554
Pseudo R^2	.z	.z	.z

Robust standard errors are in parentheses
*** p<0.01, ** p<0.05, * p<0.1*

Table 3A-22: Lags of bank profitability with ROA as the dependent variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	t-1	t-2	t-3	t-4	t-5	t-6	t-7	t-8	t-all
L.roa	.591***								.612***
	(.067)								(.118)
L2.roa		.284***							-.143
		(.063)							(.174)
L3.roa			.115*						-.117
			(.064)						(.082)
L4.roa				.097					.171*
				(.064)					(.09)
L5.roa					.073				-.268
					(.063)				(.171)
L6.roa						.028			-.032
						(.071)			(.125)
L7.roa							.123*		.191*
							(.073)		(.104)
L8.roa								.133**	.036
								(.067)	(.076)
car	.367**	.608***	.146	.015	-.166	-.31	-.337	-.363	-.167
	(.161)	(.143)	(.186)	(.195)	(.246)	(.271)	(.357)	(.356)	(.26)
lend	.034**	.044**	.056**	.048**	.059***	.05**	.047*	.052**	.014
	(.017)	(.021)	(.022)	(.022)	(.023)	(.024)	(.028)	(.025)	(.023)
npl	-.037	-.081***	-.103***	-.105***	-.088***	-.099***	-.082***	-.121***	-.082***
	(.026)	(.026)	(.026)	(.027)	(.026)	(.027)	(.029)	(.032)	(.023)
bank_size	.633***	.903***	1.047***	1.06***	1.17***	1.379***	1.404***	1.161***	.595**
	(.145)	(.175)	(.184)	(.194)	(.215)	(.236)	(.279)	(.282)	(.255)
bd_size	.345*	.701***	.965***	1.009***	.771***	.796***	.755***	.986***	.65**
	(.199)	(.23)	(.175)	(.163)	(.207)	(.271)	(.29)	(.298)	(.305)
bd_ind	4.853	5.419*	-6.767	-9.32*	-14.524**	-18.14**	-18.368*	-22.603**	-11.152
	(3.149)	(3.254)	(5.125)	(5.487)	(6.89)	(8.114)	(10.198)	(9.414)	(7.775)
c.car#c.bd_size	-.018**	-.038***	-.051***	-.05***	-.044***	-.048***	-.046***	-.059***	-.038**
	(.009)	(.009)	(.007)	(.007)	(.01)	(.012)	(.013)	(.014)	(.015)
c.car#c.bd_ind	-.243*	-.262**	.419*	.586**	.774**	.988***	.996**	1.146**	.625*
	(.125)	(.109)	(.227)	(.242)	(.312)	(.356)	(.458)	(.443)	(.342)
infl	-.151*	-.161	-.188*	-.195**	-.217**	-.135**	-.121	.099	.2
	(.085)	(.11)	(.11)	(.098)	(.087)	(.068)	(.101)	(.183)	(.158)
gdp	.126	.014	.038	.569	.866*	1.774***	1.755***	2.983**	3.736***
	(.37)	(.302)	(.342)	(.404)	(.454)	(.592)	(.611)	(1.301)	(1.072)
cons	-21.448***	-31.145***	-26.486***	-27.134***	-25.584***	-30.98***	-30.898***	-30.532***	-27.054***
	(5.432)	(5.372)	(4.71)	(5.177)	(5.407)	(6.909)	(7.387)	(8.922)	(9.026)
Observations	554	498	443	394	345	299	254	210	210
R-squared	.657	.583	.593	.61	.631	.665	.664	.707	.822

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 3A-23: Lags of bank profitability with NIM as the dependent variables

	(1) t-1	(2) t-2	(3) t-3	(4) t-4	(5) t-5	(6) t-6	(7) t-7	(8) t-8	(9) t-all
L.nim	.549***								.459**
	(.055)								(.2)
L2.nim		.441***							.138
		(.048)							(.15)
L3.nim			.379***						.156
			(.055)						(.146)
L4.nim				.33***					-.063
				(.055)					(.087)
L5.nim					.357***				.249**
					(.053)				(.122)
L6.nim						.28***			-.215
						(.054)			(.132)
L7.nim							.23***		.08
							(.058)		(.085)
L8.nim								.215***	-.037
								(.06)	(.05)
car	-.097	-.076	-.002	.071	.201	.287	.119	.08	.008
	(.2)	(.193)	(.35)	(.352)	(.36)	(.383)	(.575)	(.755)	(.35)
lend	-.03	-.044*	-.067**	-.071**	-.085***	-.07**	-.054	-.044	-.076*
	(.023)	(.025)	(.028)	(.029)	(.03)	(.035)	(.039)	(.045)	(.042)
npl	.001	.005	-.023	-.037	-.06*	-.098**	-.091**	-.089*	-.003
	(.028)	(.03)	(.032)	(.033)	(.033)	(.038)	(.042)	(.047)	(.036)
bank_size	-.559***	-.665***	-.742***	-.677***	-.631***	-.773***	-.79**	-.744**	.09
	(.169)	(.19)	(.218)	(.236)	(.243)	(.255)	(.308)	(.327)	(.21)
bd_size	-.484**	-.702**	-.651*	-.813**	-1.22***	-1.04**	-1.103*	-.731	-.796
	(.226)	(.274)	(.35)	(.338)	(.391)	(.461)	(.585)	(.829)	(.492)
bd_ind	3.475	8.26**	11.11	13.096*	19.56**	21.979**	18.502	15.677	11.404
	(5.208)	(3.726)	(7.744)	(7.499)	(8.533)	(9.239)	(12.35)	(14.42)	(7.006)
car#bd_size	.02**	.029***	.029*	.03**	.049***	.038*	.04	.022	.036*
	(.008)	(.011)	(.015)	(.014)	(.017)	(.02)	(.025)	(.037)	(.02)
car#bd_ind	.005	-.144	-.229	-.312	-.62	-.64	-.451	-.23	-.306
	(.225)	(.133)	(.391)	(.374)	(.406)	(.427)	(.597)	(.692)	(.331)
infl	.311	.078	-.335	-.389	-.354	-.23	-.554	.489*	.991***
	(.274)	(.338)	(.35)	(.286)	(.245)	(.377)	(.357)	(.266)	(.176)
gdp	.602	-.78	-1.634**	-1.356*	-1.642*	-.739	-.438	6.49***	6.931***
	(.695)	(.834)	(.698)	(.78)	(.867)	(2.429)	(2.204)	(1.77)	(1.007)
cons	11.752*	20.598**	28.601***	26.333***	25.248***	20.779	23.931	-14.89	-37.5***
	(7.093)	(8.068)	(9.004)	(8.899)	(8.646)	(14.68)	(15.57)	(14.65)	(7.667)
Observations	554	498	443	394	345	299	254	210	210
R-squared	.586	.472	.388	.365	.399	.316	.272	.249	.621

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 3A-24: Summary statistics: N mean sd min max by (bank ownership type)

owner_types: foreign

	N	mean	sd	min	max
roa	315	-.658	4.712	-32.544	5.282
nim	315	14.515	9.313	0	61.161
car	315	30.006	35.437	-.356	254.252
bd size	315	7.965	2.132	5	13
bd ind	315	.853	.112	.5	1
lend	315	46.973	14.664	0	78
npl	315	7.267	9.666	0	60.362
bank size	315	19.082	1.153	15.671	21.311
infl	315	7.279	3.673	3.29	16.001
gdp	315	6.417	1.005	4.7	8.5

owner_types: private_domestic

roa	204	-.874	6.755	-46.437	11.779
nim	204	15.963	8.81	-8.937	55
car	204	20.559	21.014	-78.923	137.552
bd size	204	7.569	2.117	5	13
bd ind	204	.848	.111	.6	1
lend	204	54.153	13.44	0	87.204
npl	204	5.741	6.646	0	41.614
bank size	204	18.061	2.555	13.284	22.683
infl	204	7.95	3.658	3.29	16.001
gdp	204	6.415	1.015	4.7	8.5

owner_types: government

roa	92	-1.526	8.271	-39.192	6.55
nim	92	16.76	8.731	0	46
car	92	20.908	27.621	-89.388	118.248
bd size	92	7.652	1.41	5	11
bd ind	92	.85	.101	.545	1
lend	92	53.889	16.138	6	80.913
npl	92	6.871	10.778	0	53.278
bank size	92	18.226	1.931	12.388	20.723
infl	92	7.819	3.648	3.29	16.001
gdp	92	6.397	1.011	4.7	8.5

Appendix 4: Chapter 4

Table 4A-1: Summary statistics: N mean sd min max by (bank ownership type)

owner_types: foreign

	N	mean	Sd	min	max
zscore	315	13.409	12.372	-1.558	93.767
npl	315	7.267	9.666	0	60.362
car	315	30.006	35.437	-.356	254.252
lad	315	67.804	68.402	13	595.484
Bank_size	315	19.082	1.153	15.671	21.311
lend	315	46.973	14.664	0	78
roa	315	-.658	4.712	-32.544	5.282
crisis	315	.162	.369	0	1
infl	315	7.279	3.673	3.29	16.001
gdp	315	6.417	1.005	4.7	8.5

owner_types: private

zscore	203	8.622	7.949	-13.214	27.255
npl	204	5.741	6.646	0	41.614
car	204	20.559	21.014	-78.923	137.552
lad	204	45.883	27.45	4.275	336
Bank_size	204	18.061	2.555	13.284	22.683
lend	204	54.153	13.44	0	87.204
roa	204	-.874	6.755	-46.437	11.779
crisis	204	.181	.386	0	1
infl	204	7.95	3.658	3.29	16.001
gdp	204	6.415	1.015	4.7	8.5

owner_types: government

zscore	92	9.786	13.473	-18.172	82.743
npl	92	6.871	10.778	0	53.278
car	92	20.908	27.621	-89.388	118.248
lad	92	53.803	59.05	5.732	563
Bank_size	92	18.226	1.931	12.388	20.723
lend	92	53.889	16.138	6	80.913
roa	92	-1.526	8.271	-39.192	6.55
crisis	92	.196	.399	0	1
infl	92	7.819	3.648	3.29	16.001
gdp	92	6.397	1.011	4.7	8.5

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 4A-2: Capital ratios and bank stability (Static and Dynamic OLS)

Variables	Zscore		NPL	
	Static OLS	Dynamic OLS	Static OLS	Dynamic OLS
Lag-stability		.8654***		.6092***
		(.05)		(.0746)
Capital ratio	.1395***	-.004	-.0477***	-.0231
	(.0232)	(.0181)	(.0171)	(.0209)
Liquidity	-.0068	.0034	-.0034	-.0006
	(.0122)	(.0069)	(.0061)	(.0091)
Bank size	1.1455***	.1573	.0644	-.0384
	(.215)	(.0991)	(.2005)	(.181)
Lending	-.0177	-.0087	-.0291	-.0169
	(.0381)	(.0225)	(.0296)	(.0263)
Profitability	.5164***	.2157***	-.1466*	-.0952
	(.0946)	(.0392)	(.0761)	(.0714)
Crisis	-.0001	-.4195	11.0986***	8.7585***
	(3.3929)	(.9265)	(3.1058)	(1.8726)
Inflation	.0451	.1008	-1.3776	-1.2891**
	(.4225)	(.0612)	(.8828)	(.5517)
GDP	.059	.4423	-1.7598	-2.3342
	(1.3296)	(.37)	(1.5823)	(1.5559)
Constant	-14.348	-1.5664	25.3952**	21.2764**
	(14.5306)	(4.0668)	(10.6984)	(10.1353)
Observations	610	554	611	554
R-squared	.3022	.8694	.1857	.4529

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*

Table 4A-3: Wooldridge Test for Strict Exogeneity (Dependent Variable- Zscore

Regression results

zscore	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
car	.0899	.0095	9.49	0	.0713	.1086	***
lad	.0129	.0049	2.66	.008	.0034	.0225	***
bank_size	-3.7921	.6203	-6.11	0	-5.0109	-2.5734	***
lend	.0426	.0162	2.64	.0086	.0109	.0744	***
roa	.1426	.0373	3.82	.0002	.0693	.216	***
crisis	-.0992	.4519	-0.22	.8264	-.9871	.7887	
infl	-.0327	.0555	-0.59	.5554	-.1417	.0762	
gdp	.2373	.1983	1.20	.232	-.1523	.627	
F.car	.0718	.0151	4.76	0	.0422	.1014	***
F.lad	-.0367	.0183	-2.01	.0451	-.0726	-.0008	**
F.bank_size	3.804	.6992	5.44	0	2.4301	5.1778	***
F.lend	.0165	.0249	0.66	.5084	-.0325	.0655	
F.roa	-.1476	.0397	-3.72	.0002	-.2256	-.0695	***
F.crisis	-.2044	.5152	-0.40	.6917	-1.2167	.8079	
F.infl	-.1309	.0503	-2.60	.0096	-.2298	-.032	***
F.gdp	.0413	.1867	0.22	.825	-.3256	.4082	
Constant	4.1285	8.6975	0.47	.6352	-12.9611	21.2181	

Mean dependent var	11.170	SD dependent var	10.662
R-squared	0.516	Number of obs	554.000
F-test	32.166	Prob > F	0.000
Akaike crit. (AIC)	2631.188	Bayesian crit. (BIC)	2704.580

**** p<.01, ** p<.05, * p<.1*

(1) F.car = 0
(2) F.lad = 0
(3) F.bank_size = 0
(4) F.lend = 0
(5) F.roa = 0
(6) F.crisis = 0
(7) F.infl = 0
(8) F.gdp = 0
F(8, 482) = 8.40
Prob > F = 0.0000

Table 4A-4: Wooldridge Test for Strict Exogeneity (Dependent Variable- NPL)

Regression results

npl	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
car	-.0412	.0256	-1.61	.1074	-.0915	.009	
lad	.0191	.0131	1.45	.1464	-.0067	.0448	
bank_size	6.4558	1.6733	3.86	.0001	3.1679	9.7437	***
lend	-.0624	.0436	-1.43	.1529	-.1481	.0233	
roa	.0924	.1007	0.92	.3593	-.1055	.2903	
crisis	-.5712	1.2191	-0.47	.6396	-2.9666	1.8243	
infl	-.1643	.1496	-1.10	.2728	-.4582	.1297	
gdp	1.0884	.535	2.03	.0425	.0372	2.1397	**
F.car	-.0506	.0407	-1.24	.2143	-.1305	.0293	
F.lad	.0396	.0493	0.80	.4217	-.0572	.1364	
F.bank_size	-5.816	1.8863	-3.08	.0022	-9.5224	-2.1096	***
F.lend	-.0341	.0673	-0.51	.6123	-.1664	.0981	
F.roa	.0354	.1071	0.33	.7415	-.1752	.2459	
F.crisis	-1.5831	1.3899	-1.14	.2553	-4.3141	1.1479	
F.infl	-.1168	.1357	-0.86	.3898	-.3836	.1499	
F.gdp	-.4805	.5037	-0.95	.3406	-1.4702	.5093	
Constant	-2.2231	23.4638	-0.09	.9246	-48.327	43.8809	

Mean dependent var	6.166	SD dependent var	8.475
R-squared	0.161	Number of obs	554.000
F-test	5.800	Prob > F	0.000
Akaike crit. (AIC)	3730.799	Bayesian crit. (BIC)	3804.190

*** p<.01, ** p<.05, * p<.1*

(1) F.car = 0
(2) F.lad = 0
(3) F.bank_size = 0
(4) F.lend = 0
(5) F.roa = 0
(6) F.crisis = 0
(7) F.infl = 0
(8) F.gdp = 0
F(8, 482) = 2.13
Prob > F = 0.0317

Table 4A-5: Capital ratio and bank stability (Zscore) Dynamic OLS, FE, and GMM

Variables	OLS	FE	GMM
	(1)	(2)	(3)
Lag-Zscore	.8654***	.0374	.3005*
	(.05)	(.2014)	(.153)
Capital ratios	-.004	.126***	.1117*
	(.0181)	(.0446)	(.0616)
Liquidity	.0034	.017	-.0805
	(.0069)	(.0272)	(.0599)
Bank_size	.1573	-1.0629	2.4027***
	(.0991)	(.7399)	(.633)
Lending	-.0087	.0604*	-.0844
	(.0225)	(.0309)	(.1098)
ROA	.2157***	.1466*	.0929
	(.0392)	(.0756)	(.1019)
Crisis	-.4195	.1872	-2.4185
	(.9265)	(.2399)	(1.8023)
Inflation	.1008	-.0346	-.0158
	(.0612)	(.0555)	(.6301)
GDP growth	.4423	.1052	.2923
	(.37)	(.1123)	(1.5538)
Constant	-1.5664	25.7909	-34.6465*
	(4.0668)	(17.5525)	(17.6173)
Year dummies	Yes	Yes	yes
Observations	554	554	554

Robust standard errors are in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

Table 4A-6: Lags of bank stability with Zscore as the dependent variable

	(1) t-1	(2) t-2	(3) t-3	(4) t-4	(5) t-5	(6) t-6	(7) t-7	(8) t-8	(9) t=all
L.zscore	.8654***								.7437***
	(.05)								(.0894)
L2.zscore		.8469***							.0482
		(.0398)							(.0935)
L3.zscore			.7519***						-.0058
			(.0408)						(.0897)
L4.zscore				.7318***					-.0298
				(.0454)					(.1098)
L5.zscore					.7341***				.0157
					(.0462)				(.0999)
L6.zscore						.7058***			.166
						(.059)			(.1048)
L7.zscore							.6739***		.0588
							(.0665)		(.0883)
L8.zscore								.6656***	-.0122
								(.0762)	(.0535)
car	-.004	.03*	.0439**	.0582***	.065***	.0708***	.0586**	.0403	-.007
	(.0181)	(.0178)	(.0173)	(.02)	(.0231)	(.0235)	(.0246)	(.031)	(.0153)
lad	.0034	-.0068	.0341	.0178	.0119	.0156	.0103	.0333	.034*
	(.0069)	(.0109)	(.025)	(.0238)	(.0253)	(.0262)	(.0298)	(.0363)	(.019)
bank_size	.1573	.2779**	.3957***	.5844***	.7337***	.9289***	1.1131***	1.1298***	-.0689
	(.0991)	(.1154)	(.136)	(.1451)	(.1549)	(.1946)	(.2151)	(.246)	(.131)
lend	-.0087	-.0127	.0291	.0164	.0174	.0367	.0303	.0766	.0436
	(.0225)	(.0196)	(.0314)	(.0297)	(.0333)	(.0351)	(.0395)	(.0525)	(.0278)
roa	.2157***	.2528***	.3067***	.2807***	.2314***	.2105**	.2204**	.24**	.1601***
	(.0392)	(.0444)	(.0608)	(.0713)	(.082)	(.0914)	(.0966)	(.1105)	(.0431)
crisis	-.4195	-.4014	-2.388**	-3.1567***	-6.5232***				
	(.9265)	(.7222)	(1.2076)	(1.1611)	(1.4356)				
infl	.1008	.1688**	.0611	-.0451	-.1529	.0264	-.4193***	-.3567**	.1009
	(.0612)	(.0659)	(.0902)	(.1254)	(.0989)	(.1698)	(.0936)	(.1793)	(.0937)
gdp	.4423	.5467***	-.4804	-.5319	-.8632*	-.2272	-1.399***	.7065	1.1083*
	(.37)	(.2103)	(.3707)	(.5478)	(.4896)	(.8215)	(.5029)	(1.0053)	(.6142)
_cons	-1.5664	-5.4807*	-7.133	-7.3467	-4.9849	-17.4759***	-13.2064**	-26.3016***	-10.262*
	(4.0668)	(3.0636)	(4.6086)	(5.1389)	(5.9488)	(6.02)	(6.1926)	(9.4205)	(5.5622)
Observations	554	498	443	394	345	299	254	210	210
R-squared	.8694	.8771	.8265	.8087	.8058	.7796	.7635	.7418	.944

Robust standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1

Table 4A-7: Lags of bank stability with NPL as the dependent variable

	(1) t-1	(2) t-2	(3) t-3	(4) t-4	(5) t-5	(6) t-6	(7) t-7	(8) t-8	(9) t=all
L.npl	.6092***								.776***
	(.0746)								(.1043)
L2.npl		.383***							-.018
		(.0854)							(.1252)
L3.npl			.174**						-.1212*
			(.0685)						(.0726)
L4.npl				.1784**					.0419
				(.0757)					(.0721)
L5.npl					.1238				-.066
					(.0786)				(.068)
L6.npl						.1109			.051
						(.0891)			(.0789)
L7.npl							.0337		.0007
							(.0906)		(.0699)
L8.npl								-.0993	-.1042**
								(.0894)	(.0521)
car	-.0231	-.0346	-.0275	-.0203	-.0028	.0266	.0146	.0652	.0263
	(.0209)	(.04)	(.0585)	(.062)	(.0662)	(.0702)	(.081)	(.0969)	(.0558)
lad	-.0006	.004	.0365	.0311	.0403	.0278	.0196	-.0082	-.0209
	(.0091)	(.0185)	(.0776)	(.0801)	(.0797)	(.0876)	(.0925)	(.0976)	(.0651)
bank_size	-.0384	-.0959	-.1898	-.2737	-.3891	-.2658	-.6242	-.6875	-.6717*
	(.181)	(.2357)	(.3123)	(.3534)	(.3897)	(.426)	(.4518)	(.5184)	(.3794)
lend	-.0169	-.0146	.0034	-.0103	-.0015	.0218	.0455	.0542	.0455
	(.0263)	(.0368)	(.09)	(.0939)	(.0944)	(.1035)	(.1104)	(.1189)	(.0775)
roa	-.0952	-.1664	-.2892**	-.3312**	-.37**	-.4112**	-.3539*	-.5452**	-.1316
	(.0714)	(.101)	(.1305)	(.1431)	(.1659)	(.177)	(.1831)	(.2388)	(.1709)
crisis	8.7585***	13.4155***	17.9918***	22.6229***	43.4267***				
	(1.8726)	(2.7333)	(4.8104)	(8.1966)	(12.9701)				
infl	-1.2891**	-1.8531***	-1.4013*	-1.1773	-.3951	-.3888	.6838	3.1907***	4.5599***
	(.5517)	(.6103)	(.7873)	(.7622)	(.8941)	(.9319)	(.8265)	(.3295)	(.6539)
gdp	-2.3342	-1.6093	.0845	3.273	8.3813*	8.4205	6.2152	22.1501***	29.3463***
	(1.5559)	(1.683)	(2.1009)	(3.7326)	(5.0294)	(5.251)	(5.1714)	(2.327)	(2.7133)
_cons	21.2764**	23.8054**	27.7055	2.2322	-46.273	-30.3591	-11.4344	-153.9701***	-211.2266***
	(10.1353)	(11.3075)	(24.0673)	(32.7057)	(45.6471)	(36.1743)	(29.9924)	(20.0373)	(24.8654)
Observations	554	498	443	394	345	299	254	210	210
R-squared	.4529	.2866	.2137	.2169	.2232	.2284	.2067	.2307	.6168

Robust standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*