Determining a Better Predictor of Bank's Solvency in Nigeria: Risk-Based Capital or Risk-Independent Capital?

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Abstract: This study empirically attempts to resolve the trade-off of the potential of risk-based capital and risk-independent capital in predicting bank solvency when measured by bank's z-score. To achieve the study's objective, bank-level data of Nigerian deposit money banks listed on the Nigerian Stock Exchange related to seven different measures of capital adequacy and other bank-specific factors are obtained from their annual reports and account between 2012 and 2016. The results reveal the superiority of risk-independent capital in a majority of random-effects models of panel regression analysis. Specifically and in comparison, equity-to-assets ratio is found to be superior to other indicators of capital adequacy using each model's adjusted R-square. When equity-to assets ratio is paired with each of other capital ratios, the results support the superiority of the model with equity-to- ssets and non-performing assets coverage ratios (which are both risk-independent capital measures) having higher adjusted R-square. Some significant results are also found for other bank-specific factors. These findings have policy implications on the regulation of banks in Nigeria most especially regarding co-opting non-regulatory measures of capital into regulatory regime. The investors and depositors are also provided with alternative means of analysing bank's financial condition to ensure their interests are not lost unaware because of the linkage of the z-score to bank's default risk.

Keywords: Bank's Z-Score; Capital Adequacy; Charter Value Theory; Deposit Money Banks; Equity-to-Assets Ratio.

JEL Classification: G21; M41; M48

1. Introduction

There is no disagreement in the literature regarding the vital role being played by banks in virtually all economies (Bougatef & Mgadmi, 2016; Sarpong, Winful, & Owusu-Mensah, 2014**;** Sepehrdoust & Berjisian, 2013; Sayed & Sayed, 2013; Tan, 2016). This singular rationale accounts for the need to keep their soundness, solvency and going-concern (Bougatef & Mgadmi, 2016; Jha & Hui, 2012) in order to entrench their effective performance and reliability (Ginevičius & Podviezko, 2013) because of the intertwining of their stability with that of a financial system of

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a country (Miletic, 2009). The linkage of the strength of banks with the stability of a financial system brings about the international convergence in the regulation of banks in the form of Basel Committee on Banking Supervision (BCBS) otherwise known as Basel Accord (Santos, 2001). The centrepiece of global regulation of banks superintended by central banks and other supervisory authorities in various jurisdictions ever remains capital since the establishment of BCBS in 1974.

Capital, in Basel's standard, is applied in terms of its adequacy and the ability to act as a buffer in a difficult situation (Athanasoglou, Brissimis & Delis, 2008) as well as protect the depositors against the potential shocks of losses that may be incurred by banks (Salgotra & Wadhwa, 2015). As argued in the related literature, one of the reasons by which banking crisis can be triggered is the capital inadequacy (Adegbaju & Olokoyo, 2008). This suggests that the effect of capital has the capacity to permeate all activities connected with the continued existence, that is, profitability, soundness, solvency, stability and going-concern of a bank.

The significance of capital can also be noted in the injection more funds into the shareholders' funds of banks whose capital base are found to be inadequate as done in Nigeria by the apex bank in 2009 (Ikpefan, 2013). Despite all-important role being played by the capital in the determination of banks' financial condition, scholars seldom agree on its superior measure most especially in the prediction of bank failure and/or performance.[1] Although there are several measures or indicators of bank capital adequacy (Klomp & De Haan, 2012; Schütz, 2014), they can basically be identified in two categories, that is, risk-based capital-RBC and risk-independent capital-RIC (Hogan, 2015; Mayes & Stremmel, 2014; Schütz, 2014; Smith, Grill & Lang, 2017; VanHoose, 2007). These indicators can also be categorised as "regulatory" and "non-regulatory" (Chernykh & Cole, 2015). The RBC and regulatory capitals are subjects of prudential regulation under Basel standards while RIC excluding leverage ratio introduced under Basel III in 2010 are purely non-regulatory (Chernykh & Cole, 2015; Hogan, 2015; Schütz, 2014).

Regarding the reality of the expectation of the influence of each measure of bank capital on bank financial condition, a number of studies place preference on the superiority of RIC (Chernykh & Cole, 2015; Hogan, 2015; Mayes & Stremmel, 2014). Others empirically provide the superiority of RBC over RIC (Huang, 2005; Mathuva, 2009) while quite few studies reveal mixed findings (Schütz, 2014; Yang, 2015). It has also been provided that the requirements for the computation of Basel's capital ratios are enormous and full of mind-numbing complexities compared to non-regulatory capitals (Chernykh & Cole, 2015).

[1] See, for example, (Demirgüç-Kunt, Detragiache & Merrouche, 2013; Estrella, Park & Peristiani, 2000; Mathuva, 2009; Mayes & Stremmel, 2014).

This study is set out to examine the impact of each measure of bank capital on the solvency of deposit money banks (DMBs) in Nigeria. Although Central Bank of Nigeria (CBN) is statutorily empowered to manage ailing banks, the recent injection of funds in the form of convertible Tier 2 debt as a bail out to those banks whose capital base is grossly inadequate gives a wrong signal of Nigerian DMBs' financial condition. Worse still, one of the DMBs classified as systematically important bank (SIB) is now under the management of CBN subsequent to its acquisition of an ailing bank under the management and control of CBN and Asset Management Corporation of Nigeria. Although a number of these capital ratios have been used to predict bank financial condition in the Nigerian context previously[1], bank distress was the focus against the bank solvency being examined in this study. More so, only a few of these measures of capital were examined. Thus, this study is the first to examine the influence of bank capital adequacy, using a long list of its indicators (RBC and RIC), on bank solvency/stability in Nigeria. The findings of this study have the capacity to improve the financial consciousness of Nigerian investors and depositors as well as bring about some regulatory and policy overhaul in the prudential supervision of DMBs in Nigeria.

Apart from Section 1 which provides a general background of what this study entails, the remaining part is structured as follows. Section 2 which is entitled "Literature Review" spells out the theoretical support for the study, reviews some basic concepts through which prior expectations are developed and reviews related previous empirical findings. Section 3 focuses on the collection and analysis of data while Section 4 presents and discusses the results of data analysis. Section 5 concludes the study and provides some policy implications based on the findings of the study.

2. Literature Review

This section reviews past studies relevant to the purpose of this study. Basically, bases are provided for the relevance of "charter value theory" to this study. It also reviews relevant concepts and provides prior expectations for the variables of the study as well as in-depth analysis of past empirical findings.

2.1. Theoretical Evidence

One of the theories that have been used to explain bank financial condition most especially in the areas of risk-taking, going-concern and solvency is the "charter value theory" (Demsetz, Staidenberg & Strahan, 1996; Ghosh, 2009; Keeley, 1990; Marcus, 1984; Marshall & Prescott, 2001; Martynova, Ratnovski & Vlahu, 2014). Although the relevance of charter value to bank financial condition was earlier demonstrated by Marcus (1984), the idea is often attributed to Keeley (1990) in a study testing the proposition that increased competitions cause bank charter values to decline, after which banks are made to increase default risk through increases in

[1] See, for example, (Okezie, 2011).

asset risk and reductions in capital (Freixas & Ma, 2015). Charter value, otherwise known as "franchise value", plays a strategic role of mitigating the problem of moral hazard peculiar to banking industry through increased bank's incentive to operate safely (Demsetz et al., 1996). It is not a matter of contention among scholars that charter value is the present value of the future profits that an organization is expected to earn as a going concern (Demsetz et al., 1996; Ghosh, 2009; Keeley, 1990; Marshall & Prescott, 2001). From the bank's stability viewpoint, it is the expected future value of the bank that is lost when the bank is unable to discharge its financial obligation (Marshall & Prescott, 2001).

Although studies on bank financial condition often provide interlink of charter value with market discipline, depositor's discipline, competition, deposit insurance and risk-taking (Demsetz et al., 1996; Ghosh, 2009a, 2009b; Marcus, 1984; Martynova, et al., 2014; Matutes & Vives, 2000), a number of others have established that a loss of charter value is synonymous to the loss of bank capital positions (Freixas & Ma, 2015; Hellmann, Murdoch & Stiglitz, 1999; Marshall & Prescott, 2001). This confirms an argument that "a bank's franchise value is the capitalised value of the bank's future profits" (Hellmann et al., 1999, p. 3) and a mathematical expression that "the increased equity reduces the probability of default and the associated loss of charter (Marcus, 1984, p. 559). More evidence can be deduced from the findings of Keeley (1990) who concluded that "banks with more market power, as reflected in larger market-to-book asset ratios, hold more capital relative to assets (on a market-value basis) and they have a lower default risk" (p. 1198). The argument of Estrella et al. (2000) is that the bank failure is consequent upon the dissipation of charter value which is the value the owners can capture by selling their stakes represented by equity and other forms of capital when the bank is a going-concern. This shows that banks having higher charter value are expected to have lower leverage risk and lower default risk. By this, it is not an understatement to state that capital adequacy is basically non-monotonic in charter value (Marshall & Prescott, 2001). Thus, bank solvency or default risk will not remain unchanged as the capital positions of a bank change. Although charter value theory does not recognise dichotomy of the measures of bank capital, it, however, lays emphasis on the ability of capital adequacy to reduce insolvency risk or improve bank solvency (Demsetz et al., 1996). This study is premised on this positive non-monotonic relationship between capital adequacy and bank solvency as evident in the literature (Demsetz et al., 1996; Keeley, 1990; Marshall & Prescott, 2001).

2.2. Banking Solvency

Banking solvency, stability and soundness are central to the banking regulation and supervision in any economy. In the light of this, scholars have devised several methods of measuring these key attributes of a well-managed bank (Demirgüç-Kunt & Detragiache, 2011). Although different measures are adopted in the past studies

(Demirgüç-Kunt & Detragiache, 2011), bank z-score remains a unified proxy adopted in the recent time (Adusei, 2015; Bourkhis & Nabi, 2013; Bustaman, Ekaputra, Husodo & Prijadi, 2017; Carretta, Farina, Fiordelisi, Schwizer, & Lopes, 2015; Demirgüç-Kunt & Detragiache, 2011; Diaconu & Oanea, 2014; Elhadi & Madi, 2016; Hogan, 2015; Rahman, Zheng & Ashraf, 2015) because of its cross-country relevance and indifference to subjective judgement of rating agencies' analysts (Demirgüç-Kunt & Detragiache, 2011). It is evident that there are a number of variants of z-score: Altman model; ZETA®; and a simplified form of z-score (Diaconu & Oanea, 2014), the latter, adopted in this study, has been in use consistently for more than three decades to measure bank solvency, stability and risk (Boyd & Graham, 1986; Mercieca, Schaeck & Wolfe, 2007; Stiroh, 2004).

Z-score, a measure of bank default risk, is considered as the return on assets ratio (ROA) plus the equity asset ratio (ETA) scaled by the standard deviation of return on assets ratio (Boyd & Graham, 1986; Demirgüç-Kunt & Detragiache, 2011; Rahman et al., 2015). Alternatively, using bank's return normality, z-score connotes the number of standard deviations below the mean by which earnings would have to fall in order to deplete shareholders' funds (Bourkhis & Nabi, 2013). "Z-score is an indicator of bank solvency that is inversely related to the bank's probability of default" (Hogan, 2015, p. 34). It does not only indicate the distance of a bank from insolvency, its higher value symbolises that a bank is more stable (Ghosh, 2014; Stiroh, 2004). Z-score has two components: ROA scaled by standard deviation of ROA and ETA scaled by standard deviation of ROA (Barry, Lepetit & Tarazi, 2011; Köhler, 2015) indicating risk-adjusted ROA and risk-adjusted ETA respectively (Adusei, 2015). In agreement with previous studies, z-score is adopted as dependent variable.[1]

2.3. Bank Capital Adequacy

Capital adequacy is one of the components of CAMELS framework. CAMELS, a collection of bank-level accounting and financial data based on individual bank's financial statements (Mayes & Stremmel, 2014; Schütz, 2014), represents capital adequacy, asset quality, management competence and expertise, earnings ability, liquidity and sensitivity to market risk (Jose, 1999). Having confirmed that the bank capital adequacy, based on the evidence from related literature, is measured in several ways (Chernykh & Cole, 2015; Schütz, 2014), this study addresses the trade-offs between its basic variants: risk-based capital (RBC); and risk-independent capital (RIC). The RBC, which is purely of Basel standards, has two variants (Chernykh & Cole, 2015; Hogan, 2015) while RIC has a number of measures (Schütz, 2014), all non-regulatory except leverage ratio. The components of each basic form of capital adequacy are described below.

[1] See, for example, (Adusei, 2015; Köhler, 2015).

2.3.1. Risk-Based Capital (RBC)

Risk-based capital (RBC), adopted to improve the identification of the risk inherent in a bank's operations (Hogan, 2015), is a focal point in the world of banking regulation (Hogan, 2015). RBC relates capital as defined in Basel's standards to the risk-weighted assets-RWA (Białas & Solek, 2010). Capital, in the Basel standards, comprises Tier 1 and Tier 2 capitals (Białas & Solek, 2010; Datey &Tiwari, 2014). Tier 1 capital is the bank core capital while Tier 2 capital consists of complimentary funds, that is, liabilities other than core capital like subordinated debts (Białas & Solek, 2010; CBN, 2015). The total sum of all bank asset categories multiplied by their designated risk weightings (Hogan, 2015) or the sum of credit RWA, market RWA and operational RWA (CBN, 2015) describe what RWA is all about. In the Basel standards, two RBC ratios are required as measures of capital adequacy: Tier 1 capital to RWA called core capital ratio (T1CR); and addition of Tier 1 to Tier 2 capital as a proportion of RWA (TCAR) also known as total regulatory or total risk-based capital ratio (Białas & Solek, 2010; Chernykh & Cole, 2015; Bank for International Settlements- BIS, 2010). Both TCAR and T1CR are adopted as RBC ratios because they have been found to explain bank financial condition in previous studies (Hogan, 2015; Mathuva, 2009; Mayes & Stremmel, 2014; Schütz, 2014).

2.3.2. Risk-Independent Capital (RIC)

Risk-independent capital (RIC) also known as risk-neutral capital (RNC) or non-risk- weighted capital is a measure of capital adequacy which does not incorporate the rigour of risk assessment and weightings required by regulatory body under Basel standards (Mayes & Stremmel, 2014). Some of the RIC ratios that have been adopted in the prediction of bank financial condition recently include: standard capital ratio of equity over total assets-ETA (Hogan, 2015); gross revenue ratio-GRR and leverage ratio-LVR (Estrella et al., 2000; Mayes & Stremmel, 2014); non-performing assets coverage ratio-NPAR (Chernykh & Cole, 2015); and tangible common equity ratio-TER (Schütz, 2014).

GRR is described as the ratio of core capital to gross revenue (Mayes & Stremmel, 2014) where core capital connotes Tier 1 capital while gross revenue represents the addition of interest income and non-interest income before the deduction of expenses (Schütz, 2014). Although LVR is measured using several approaches (D'Hulster, 2009; Yang, 2015), balance sheet approach which complies with the requirements of Basel Accords is adopted. LVR is measured as the ratio of Tier 1 capital to total assets less intangible assets (D'Hulster, 2009). TER is defined as the ratio of tangible common equity to total tangible assets (Schütz, 2014). Tangible common equity, described as a bank's total equity minus intangible assets, goodwill, and preferred stock equity, allows a bank to absorb losses and yet keep running its daily business operations (Demirgüç-Kunt et al., 2013; Schütz, 2014) while tangible assets represent bank's total assets minus goodwill and intangibles (Schütz, 2014). The last

RIC used in this study is the non-performing assets coverage ratio-NPAR. NPAR, defined as the "total equity capital plus loan loss reserves less non-performing assets, all divided by total assets" (Chernykh & Cole, 2015, p. 132) is a dependable tool in the prediction of bank's financial condition because it has elements of two components of CAMELS framework-capital adequacy and asset quality (Chernykh & Cole, 2015).

Based on the deductions from previous studies (see, for example, Chernykh & Cole, 2015; Hogan, 2015; Mathuva, 2009; Mayes & Stremmel, 2014; Schütz, 2014), a positive influence of each measure of capital adequacy on Nigerian DMBs' solvency/stability is expected.

2.4. Other Components of CAMELS Framework as Control Variables

The choice of control variables regarding the influence of the measures of capital adequacy on the bank's financial condition is guided by the components of CAMELS frameworks being referred to as the bank-specific factors (Cole & White, 2012; Mayes & Stremmel, 2014; Yang, 2015). Thus excluding measures of capital adequacy, AMELS (asset quality, management efficiency, earnings capacity, liquidity and sensitivity to market risk) indicators are adopted as basic control variables. Since there are several indicators for each component of AMELS (Klomp & De Haan, 2012) and past studies differed in their adoption of measures of each component (Mayes & Stremmel, 2014; Schütz, 2014; Yang, 2015), two indicators each are adopted for each component.

To control for asset quality, the ratios of non-performing loans to gross loans (NPL/GL) and loan loss provision (impairment charges for loan losses in the income statement) to net interest revenue (LLP/NIR) are adopted because they are found to be more helpful and often used (Bourkhis & Nabi, 2013; Mayes & Stremmel, 2014). Although measuring management competence is somehow difficult (Mayes & Stremmel, 2014), past studies have found cost-to-income ratio-CIR (Bourkhis & Nabi, 2013; Klomp & De Haan, 2012; Mathuva, 2009; Schütz, 2014) and asset turnover ratio, that is, ratio of revenue to total asset- RTA (Abdelrahim, 2013) empirically useful. Hence, CIR and RTA are adopted as measures of management efficiency. The return on assets (ROA) and return on equity (ROE) which are often used as measures of profitability/earnings quality (Olson & Zoubi, 2011) are adopted in agreement with previous related studies (Mayes & Stremmel, 2014; Schütz, 2014; Yang, 2015). Also, the ratios of liquid assets to total assets (LTA) and liquid assets to deposit (LTD) are adopted to control for liquidity as evident in the previous studies (Mayes & Stremmel, 2014; Schütz, 2014). Sensitivity to market risk has several indicators because it is linked to the fluctuations in interest rate, foreign exchange rates and equity prices (Aspal & Nazneen, 2014; Federal Deposit Insurance Corporation- FDIC, 2015). Consequently, to control for sensitivity to market risk, two of its measures- ratio total interest expenses to total deposit (MKR1) and interest gap ratio (MKR2) which are empirically proven (Aspal & Nazneen, 2014; Klomp & De Haan, 2012; Schütz, 2014) are adopted.

Apart from measures of asset quality, sensitivity to market risk and CIR which higher values are expected to negatively influence bank's solvency, other indicators of AMELS as used in this study are expected to have positive impact on Nigerian DMBs' z-score and its components.

2.5. Other Control Variables

In line with previous studies, four additional control variables: bank size (SIZE); age (AGE); systematically important status (SIM); and the penalties for contravening related banks' legal and institutional frameworks (PEN) related to bank financial condition are adopted. Following Athanasoglou et al. (2008), Mayes and Stremmel, (2014) and Smith et al. (2017) bank size is measured by natural logarithm of total assets while age since the commencement of operation of a bank measures bank age as adopted by Bahadori, Talebnia and Imani (2015). The systematically important status (SIM) of a bank is emphasised by the requirements of additional capital surcharge and net stable funding ratio among others for systematically important banks by Basel III (BIS, 2010; Datey & Tiwari, 2014). Furthermore, the statutory and institutional requirements for banks to comply with several frameworks and codes with sanctions for non-compliance lay emphasis on the supposedly influence of penalties paid by banks for contravening banking rule and regulations (Ezeoha, 2011). Except for penalties for contravening related banks' legal and institutional frameworks (PEN) which is expected to have negative relationship with bank's solvency, the anticipated coefficient sign of others: SIZE; AGE; and SIM is positive.

2.6. Previous Empirical Studies

It is evident that z-score as a measure of bank financial condition is used in different forms, that is, as an indicator of risk, stability, soundness, solvency and probability of default risk (Adusei, 2015; Bustaman et al., 2017; Demirgüç-Kunt & Detragiache, 2011; Ghosh, 2014; Hogan, 2015; Mercieca et al., 2007; Valahzaghard & Jabbari, 2013). Also, capital ratios are used to predict different forms of bank financial condition (Demirgüç-Kunt et al., 2013; Hogan, 2015; Huang, 2005; Mathuva, 2009; Yang, 2015) and a few empirical studies have the same combination of dependent and independent variables as adopted in this study. Based on this rationale, previous studies using individually or collectively variables adopted in this study are reviewed.

Starting with studies reporting the superiority of risk-based capital (RBC) ratios over risk-independent capital (RIC) ratios in predicting bank financial condition, Huang (2005), using implied asset risk as a measure of risk, found the significant predictive power of Basel I capital ratio (RBC) and total equity to asset (ETA) ratio. In comparison, it was found that RBC ratios provided greater information than traditional ETA ratio in predicting risk based on bank-level data of Taiwan commercial and other banks between 1998 and 2002. Though, bank financial condition was measured with return on asset (ROA) and return on equity (ROE), Mathuva (2009) was able to find the superiority of RBC ratios by providing empirical support for the positive relationship between Tier 1 capital ratio (an RBC) and the profitability of commercial banks in Kenya when ETA significantly and negatively influenced their financial performance.

For studies with superiority of RIC over RBC, Demirgüç-Kunt et al. (2013) provided series of empirical evidence with emphasis on superiority of leverage ratio in explaining stock returns- a measure of bank financial condition using a multi-country panel of banks. Specifically, Demirgüç-Kunt et al. (2013) established a stronger relationship between capital and stock returns when capital was measured by leverage ratio rather than Tier 1 capital ratio. Another study that examined the determinants of distance-to-default using 94 US and European Union-EU internationally active commercial banks and broker dealers, Blundell-Wignall and Roulet (2013), equally found empirical support for the explanatory potential of leverage ratio compared to Tier 1 capital ratio using both univariate and multivariate regression analyses. When separate multivariate regressions were run for all sampled banks, global systemically important financial institutions (G-SIFI), and other large banks, the leverage ratio also outmatched the core capital ratio. When core capital ratio significantly explained the distance-to-default, it was against the prior expectation. Blundell-Wignall and Roulet (2013) also provided the relevance of predictive ability of SIZE among others. Also, Mayes and Stremmel (2014), using quarterly and publicly available data of 16,188 Federal Deposit Insurance Corporation-insured banks of United States of America between 1992 and 2012, found the significant predictive power of leverage ratio, total regulatory capital ratio and gross revenue ratio of bank distress and failure but with a clause of higher predictive accuracy of leverage ratio in a logit model. The study also provided for the relevance of AMELS indicators in predicting bank distress as well. Further evidence on the leverage ratio most especially based on Basel III was provided by Dermine (2015) who developed model that confirmed the superiority of Basel III leverage ratio- a RIC over Basel II/III risk-based capital ratios in predicting the probability of bank runs.

Another important study in this direction is the study of Hogan (2015) who found that equity to capital ratio was a better predictor of bank financial condition than the total regulatory capital ratio for US bank holding companies between 1999 and 2010. This was after it has been established that both are statistically significant predictors of stock returns and z-scores using 3-stage least squares regressions and OLS regressions with firm-fixed effects. In an attempt to determine best capital ratio to trigger prompt corrective action, Chernykh and Cole (2015) examined a number of RBC and RIC ratios of US commercial banks between 2007 and 2012. It was found that all the regulatory capital ratios: leverage; core capital; total risk-based; and tangible equity are all good predictors of bank distress but when compared with another ratio called "non-performing assets coverage ratio (NPAR), NPAR outperformed other commonly used ratios as enunciated using their pseudo R-squares and receiver-operating-characteristics (ROC) curves in univariate logistic regressions. Chernykh and Cole (2015) further evidence revealed that NPAR outperformed the core and total risk-based capital ratios in discriminating failed and survived banks among the well-capitalised banks. By these results, it evident that NPAR does not only perform better than RBC ratios, its superiority over other RIC ratios- leverage and tangible equity cannot be ignored.

There are also a number of studies that provided mixed results of the superiority of the two basic capital ratios. In a study examining the predictability of bank failure through capital ratios, Estrella et al. (2000) provided separate superiority for RBC ratio of core capital and RIC ratio of leverage and gross revenue using the time horizon of the prediction in logit models. As provided by Estrella et al. (2000) leverage ratio outperformed others in separate models while gross revenue ratio performed better than others in a model including all the three variables at one-year horizon but at two-year horizon the superiority of core capital ratio was evident using pseudo R-square and concordance ratio. In Nigeria, Okezie (2011) cannot empirically distinguish among three capital ratios of leverage, gross revenue and core capital as all are found to be equally efficient in the prediction of bank distress based on bank distress data between 1991 and 2004. For Schütz (2014), using a sample of the largest 100 EU banks and 100 US banks, there is evidence of significant predictive power of both RBC and RIC ratios one year and two years prior to the occurrence of bank distress in both banking jurisdictions. Another US's evidence was provided by Yang (2015) that leverage ratio was superior in the prediction of failure of large banks while small banks distress was equally explained by Tier 1 capital, leverage and supplementary leverage ratios.

A number of other studies most especially those with z-scores as their dependent variable and a few of explanatory variables as adopted in this study are also considered for empirical reviews. To start with, in a study examining the link between diversification and risk-adjusted performance for small community banks in US, Stiroh (2004) empirically showed that capital ratio of equity-to-asset and SIZE have significant positive impact on z-scores and risk-adjusted ROA of these banks. A study for small European banks by Mercieca et al. (2007) which followed Stiroh's (2004) approach had similar findings regarding equity-to-assets and SIZE. For Ghosh (2014), while ROA positively explained z-score, SIZE has significant negative influence on it based on bank-level dataset of Gulf Cooperation Countries between 1996 and 2011. Further evidence provided by Demirgüç-Kunt and Detragiache (2011) revealed that there is no positive relationship between Basel Core Principles Compliance index and bank soundness measured by bank z-score using bank-level data of more than 3000 banks in 86 countries. For Iranian banking, Valahzaghard and Jabbari (2013) empirically demonstrated that ETA- a measure capital adequacy has significant positive impact on z-score while AMELS indicators negatively influence it except profitability indicator. It has also been empirically shown by Adusei (2015) that SIZE and ROE have significant positive influence on bank stability measured by z-score and its two components with fixed-effects model of panel regression using bank-level data of 112 rural banks in Ghana between 2009 and 2013. Another empirical finding by Elhadi and Madi (2016), while comparing determinants of stability (measured by z-score) of United Kingdom-UK building societies and public limited liability banks, showed that cost-to-income ratio and SIZE have significant negative influence on financial stability of both institutions before and during Global Financial Crisis. While testing the effect of interest margin, market power and diversification strategy on bank stability, Bustaman et al. (2017) provided evidence of significant negative and positive influence of SIZE and cost-to-income ratio on bank z-score respectively while no significant relationship was established between measures of liquidity and asset quality and the z-score used to measure bank stability.

3. Research Methods

Bank solvency/stability is often measured by z-score and made a function of a number of bank-specific variables in the previous studies (Adusei, 2015; Bustaman et al., 2017; Elhadi & Madi, 2016; Hogan, 2015). In order to achieve the objective of this study, approaches similar to ones adopted in the previous studies are used. Z-score, a measure of bank solvency and the dependent variable of this study is defined mathematically as:

$$Z - SCORE_{it} = \frac{ETA_{it} + ROA_{it}}{\sigma ROA_{i\rho}} \text{ --- } (1)$$

Where: ί stands for each bank; t = each year of the sample period; ρ = the whole sample period

Having defined bank financial condition as a function of a number of bank-specific factors, Hogan's (2015) model is adopted with some elements of the models of Adusei (2015), Bustaman et al. (2017), Schütz (2014), and Yang (2015). Hence, the following model is derived from the variables of the study using the z-score as the dependent variable:

$$Z - SCORE_{it} = \alpha + \beta_1 CAR_{it} + \beta_2 (AMELS)_{it} + \beta_3 (OCV)_{it} + \varepsilon_{it} \text{ ------------- } (2)$$

In the equation 2, CAR stands for capital adequacy ratio- a general indicator of all 7 capital ratios identified in this study, since all the capital ratios are substitutes, each is used at a point in time in a model. AMELS is a vector of components of CAMELS framework other than capital and each is measured with 2 indicators. OCV is matrix of "other control variables" that is, SIZE, AGE, SIM and PEN adopted for this study.

Since CAR consists of 7 components that are close substitutes and each component of AMELS is measured with 2 indicators that are not used together in a model, equation 2 consists of 14 models in all. These variables which are 22 in all, dependent and explanatory, are described in Table 1.

The data related to the variables of the study are obtained from the annual reports and account of all DMBs listed on the Nigerian Stock Exchange (NSE) between 2012 and 2016, a period known for change in DMBs' financial reporting system with the adoption of International Financial Reporting Standards (IFRSs). With 15 DMBs out of 21 having their financial information in the public domain within the sample period, 75 bank-year observations are apparent but an unbalanced panel data of 72 bank-year observations is eventually used for analysis due to missing financial information of a number of these DMBs.

Data obtained from the financial statements of these DMBs are analysed descriptively and inferentially. Descriptive statistics include mean, standard deviation, maximum and minimum values while inferential statistics used are correlation and regression analyses. Correlation analysis seeks to know the level of relationship between the study's variables in order to determine whether they are collinear. The regression analysis seeks to determine the extent of the predictability of DMBs' solvency by each of capital ratios and other explanatory variables adopted. Since data are collected at time-series and cross-sectional levels, a choice is made between the random-effects and fixed effects models of panel data regression based on the results of hausman tests (HauM). The results of hausman tests and subsequent tests of Breusch-Pagan Lagrange Multiplier (LMtest) upon the choice of random-effects model following the hausman tests show that random-effects model is appropriate for all the models (see Tables 5a & 5b) except the model with ETA and second set of AMELS indicators (see Table 6a). Further tests performed and reported include Wald statistics (W-stat), F-statistics (F-stat), heteroscedasticity (Heter.) and variance inflation factor (VIF). VIF is performed to complement the results of correlation analysis in detecting the multi-collinearity among the explanatory variables but the overall VIF (mVIF) is reported. Based on the result of overall VIF (mVIF) for each model which is less than 10, multi-collinearity is not present (Gujarati & Porter, 2009) among the explanatory variables. For the presence of heteroscedasticity (Heter.), robust standard errors are added to the model. All the results of additional tests are reported in the Tables 5a, 5b, 6a and 6b alongside with the regression estimates.

Table 1. Definition of Study's Variables

S/N	Variable	Variable Type	Measurement	Expected Sign of Explanatory variables
1	Bank's Solvency (Z-SCORE)	Dependent	Return on assets ratio (ROA) plus the equity to asset ratio (ETA) scaled by the standard deviation of return on assets ratio	
2	Total Regulatory Capital Ratio (TCAR)	Independent	Sum of Tier 1 and Tier 2 capitals scaled by risk-weighted assets	+
3	Core Capital Ratio (T1CR)	Independent	Tier 1 capital scaled by risk-weighted assets	+
4	Equity to total Assets (ETA)	Independent	Ratio of Total Equity to Total Assets	+
5	Tangible common equity ratio (TER)	Independent	Ratio of tangible common equity to total tangible assets	+
6	Leverage Ratio (LVR)	Independent	The ratio of Tier 1 capital to total adjusted assets	+
7	Gross Revenue Ratio (GRR)	Independent	Tier 1 capital scaled by the sum of interest and non-interest income	+
8	Non-performing Assets Coverage Ratio (NPAR)	Independent	Total equity capital plus loan loss reserves less non-performing assets, all scaled by total assets	+
9	Non-Performing Loan Ratio (NPL/GL)	Control	Non-performing Loans to Gross Loans	-
10	Impairment for Loan Losses in Profit or Loss account (LLP/NIR)	Control	The ratio of impairment for loan losses in income statement to Net Interest Income	-
11	Cost to Income Ratio (CIR)	Control	Ratio of operating expenses to operating income	-
12	Asset Turnover (RTA)	Control	Ratio of Gross revenue to total asset	+
13	Return on Asset (ROA)	Control	Net income scaled by total assets	+
14	Return on Equity (ROE)	Control	Ratio of Net income to shareholders' fund	+
15	Liquidity (LTA)	Control	Total Liquid Assets scaled by Total Assets	+
16	Liquidity (LTD)	Control	Liquid Assets to Total Deposits	+
17	Market Risk (MKR1)	Control	Total interest expenses to total deposit	-
18	Interest Gap Ratio (MKR2)	Control	Difference between Rate-Sensitive Assets and Rate-Sensitive Liabilities scaled by earning assets	-
19	Banks' Size (SIZE)	Control	Natural Logarithm of Bank's Total Assets	+
20	Bank's Age (AGE)	Control	Natural Logarithm of Bank's Age since Commencement of Operation	+
21	DMB's Systemic Status (SIM)	Control	'1' is assigned if a DMB is classified as Systematically Important Bank (SIB), otherwise '0'	+
22	Contravention of Banking Regulation (PEN)	Control	Natural Logarithm of penalties paid for contravening banking regulation yearly by each bank	-

Source: Author's Compilation, 2017 based on deductions from related literature. Items 2-8 are measures of capital adequacy jointly called "capital adequacy ratio" (CAR), AMELS indicators are items 9-18 while" other control variables" (OCV) are items 19-22.

4. Results Presentation and Discussion

This section focuses on the analysis and presentation of data as well as discussion of findings. Specifically, the results of descriptive, correlation and regression analyses are presented.

4.1. Descriptive Analysis

The descriptive statistics of all the variables are presented in the Table 2. Accordingly, z-score has a maximum value of 57.35 and mean score of 28.3. These are satisfactory but a negative minimum z-score is a source of concern for DMBs' solvency/stability. It is also palpable that all the regulatory capital ratios including GRR and NPAR are adequate in terms of maximum and average values but negative minimum values provide the need for further investigation of Nigerian DMB's stability. The closeness of minimum values of ETA and TER to zero is also not typical of banks that are satisfactorily solvent and stable. Other variables of interest include NPL/GL and CIR which are as high as 96% and 284% respectively. With an average of 1.6% and 5.4% for ROA and ROE respectively within the sample period, it is evident that DMBs' profitability is at the low ebb. Other results are as depicted in Table 2.

Table 2. Study's Variables Description

Variable	Obs	Mean	Std. Dev.	Min	Max
Z-SCORE	72	28.3052	14.7975	-1.3353	57.3488
TCAR	72	0.1616	0.1142	-0.4698	0.3050
T1CR	72	0.1366	0.1090	-0.4698	0.3030
ETA	72	0.1389	0.0369	0.0050	0.2300
TER	72	0.1309	0.0339	0.0005	0.1961
LVR	72	0.0865	0.0877	-0.4779	0.1800
GRR	72	0.7392	0.5805	-2.5896	1.5600
NPAR	72	0.0795	0.1030	-0.5851	0.1726
LLPNIR	72	0.1917	0.1785	0.0000	0.7266
NPLGL	72	0.0761	0.1277	0.0171	0.9646
CIR	72	0.7734	0.3057	0.3685	2.8400
RTA	72	0.1234	0.0175	0.0918	0.1865
ROA	72	0.0162	0.0150	-0.0560	0.0530
ROE	72	0.0543	0.4948	-3.9400	0.2960
LTA	72	0.3799	0.1243	0.0260	0.6134
LTD	72	0.5560	0.1661	0.2211	0.9984
MKR1	72	0.0526	0.0153	0.0236	0.0845

MKR2	72	0.1040	0.1438	-0.2411	0.4939
SIZE	72	20.9503	0.6707	19.3196	22.1781
AGE	72	3.4795	0.6885	1.7918	4.8040
SIM	72	0.4028	0.4939	0.0000	1.0000
PEN	72	10.0838	2.3290	0.0000	14.9037

Source: Author's computation, 2017 based on Stata 14 Outputs

4.2. Correlation Analysis

The correlation analysis is presented in two different correlation matrices depicted in Tables 3 and 4 for independent and other explanatory variables respectively. From Table 3, it is evident that most of these capital ratios are highly correlated with correlation co-efficient >0.80. This is a sign of multi-collinearity (Gujarati & Porter, 2009). Conversely, since these capital ratios are not used together in a model, the effect of multi-collinearity has been mitigated. The high correlation between these capital ratios is also suggestive of their similar explanatory potential which can only be revealed by the regression results. Furthermore, there is no any evidence of multi-collinearity among other explanatory variables as revealed in Table 4 because there is no any correlation co-efficient >0.80.

Table 3. Correlation Matrix of Independent Variables

VAR.	TCAR	T1CR	ETA	TER	LVR	GRR	NPAR
TCAR	1.0000						
T1CR	0.9692	1.0000					
ETA	0.1772	0.1874	1.0000				
TER	0.3426	0.3722	0.9485	1.0000			
LVR	0.9320	0.9606	0.1509	0.3238	1.0000		
GRR	0.9135	0.9514	0.1685	0.3459	0.9744	1.0000	
NPAR	0.8825	0.8926	0.0507	0.1996	0.9362	0.9134	1.0000

Source: Author's computation, 2017 based on Stata 14 Output

Table 4. Correlation Matrix of Other Variables

VAR	LLP/NIR	NPL/GL	CIR	RTA	ROA	ROE	LTA	LTD	MKR1	MKR2	SIZE	AGE	SIM	PEN
LLP/NIR	1.00													
NPL/GL	0.58	1..00												
CIR	0.50	0.3	1.00											
RTA	0.59	0.57	0.29	1.00										
ROA	-0.49	-0.27	-0.71	-0.16	1.00									
ROE	-0.27	-0.12	-0.49	-0.07	0.52	1.00								
LTA	-0.22	-0.37	-0.41	-0.28	0.34	0.31	1.00							
LTD	-0.12	-0.29	-0.3	-0.09	0.30	0.30	0.91	1.00						
MKR1	0.11	0.17	0.40	0.37	-0.48	-0.28	-0.28	-0.15	1.00					
MKR2	-0.01	-0.05	-0.25	0.03	0.34	0.32	0.18	0.18	-0.22	1.00				
SIZE	-0.12	-0.31	-0.51	-0.48	0.49	0.38	0.51	0.44	-0.65	0.34	1..00			
AGE	-0.01	0.03	0.05	-0.27	-0.09	-0.14	-0.11	-0.1	-0.17	-0.24	0.14	1.00		
SIM	0.05	-0.17	-0.3	-0.37	0.23	0.14	0.22	0.13	-0.58	0.17	0.72	0.08	1.00	
PEN	0.16	-0.02	0.05	-0.09	-0.16	-0.00	0.08	0.02	-0.01	0.03	0.25	0.19	0.18	1.00

Source: Author's computation, 2017 based on Stata 14 Outputs

4.3. Regression Results

The regression estimates are presented in the Tables 5a, 5b, 6a and 6b. In Tables 5a and 5b, 4 and 3 capital adequacy measures respectively, first set AMELS indicators and other control variables are regressed on bank's z-score. The results, as evident in Tables 5a and 5b, show that only the models with equity-to-assets (ETA) and tangible-common-equity (TER) ratios which are RIC ratios significantly and positively predict DMBs' solvency in Nigeria. Using their explanatory potential based on the results of adjusted R-square (Adj.R^2), model with ETA outperforms others given the Adj.R^2 of 73.38% compared to models with other capital ratios including TER with an Adj.R^2 of 61.56%. The significant influence of AMELS indicators is also evident except that results of the measures of asset quality, management soundness and sensitivity to market risk are against their prior expectations.

Table 5a. Regression Estimates of Models 1-4 using First Set of AMELS Indicators with some capital measures

Variable	MODEL 1	MODEL 2	MODEL 3	MODEL 4
TCAR	8.316(5.796)	……………	……………	……………
T1CR	…………..	13.31(9.90)	……………	……………
ETA	……………	……………	122.86(31.06)*	……………
TER	……………	……………	……………	102.59(29.67)*
LLP/NIR	5.995(2.00)*	7.09(2.48)*	1.31(2.52)	2.24(2.75)
CIR	13.441(3.38)*	12.29(3.10)*	14.58(3.01)*	14.62(3.41)*
ROA	460.25(101.51)*	438.37(92.12)*	325.88(76.19)*	350.57(94.12)*
LTA	15.39(7.35)**	13.56(8.00)***	4.09(7.42)	5.58(8.84)
MKR1	125.63(52.47)**	123.17(51.35)**	25.25(42.84)	58.22(48.41)
SIZE	2.09(3.31)	2.19(3.16)	0.33(2.12)	1.17(1.98)
AGE	1.90(3.93)	1.76(3.79)	0.87(3.95)	-0.81(3.62)
SIM	0.68(1.82)	0.55(1.70)	0.46(0.99)	0.64(1.23)
PEN	0.17(0.24)	0.19(0.23)	0.12(0.14)	0.16(0.17)
_cons	-56.98(65.88)	-57.29(62.31)	-19.76(42.04)	-31.29(41.74)
Adj.R^2	0.4375	0.4594	0.7338	0.6156
W.stat	338.33(0.000)*	663.23(0.000)*	239.80(0.000)*	207.82(0.000)*
HauM	5.31(0.869)	7.24(0.702)	8.07(0.622)	4.99(0.892)
LMtest	81.62(0.000)*	82.77(0.000)*	79.94(0.000)*	84.06(0.000)*
Heter.	1356(0.000)*	665.08(0.000)*	4158.69(0.000)*	12734.12(0.000)*
mVIF	3.38	3.43	3.44	3.44

*Source: Author's computation, 2017 based on Stata 14 Outputs. The regression co-efficients and robust standard errors are reported with robust standard errors in parentheses. Wald Statistics (W.stat), Hausman tests (HauM), Test of Heteroscedasticity (Heter.) and Breusch-Pagan Lagrange Multiplier (LMtest) report X^2 with p-value in parentheses. mVIF indicates the overall variance inflation factor of each model, while *, **, and *** stand for significance at 1%, 5% and 10% respectively.*

Table 5b. Regression Estimates of Models 5-7 using First Set of AMELS Indicators with some capital measures

Variable	MODEL 5	MODEL 6	MODEL 7
LVR	7.46(8.45)	……………	……………
GRR	……………	1.49(1.48)	……………
NPAR	……………	……………	4.91(4.94)
LLP/NIR	5.23(2.17)**	5.71(2.23)**	5.05(2.09)**
CIR	13.78(3.55)*	13.75(3.49)*	13.85(3.82)*
ROA	469.92(103.07)*	474.48(105.91)*	471.29(109.77)*
LTA	15.78(7.63)**	15.13(7.79)***	16.41(7.40)**
MKR1	120.72(52.46)**	121.18(53.15)**	119.55(53.54)**
SIZE	2.42(3.52)	2.15(3.56)	2.32(3.66)
AGE	1.29(3.96)	1.42(3.93)	1.40(4.10)
SIM	0.55(1.71)	0.63(1.76)	0.55(1.73)
PEN	0.18(0.24)	0.19(0.25)	0.17(0.24)

_cons	-61.21(70.99)	-56.58(70.77)	-59.47(74.08
Adj.R^2	0.4199	0.4242	0.4168
W.stat	297.77(0.000)*	313.80(0.000)*	188.76(0.000)*
HauM	4.72(0.909)	4.88(0.899)	5.17(0.880)
LMtest	80.31(0.000)*	80.29(0.000)*	81.02(0.000)*
Heter.	2334.11(0.000)*	2229.28(0.000)*	2808.78(0.000)*
mVIF	3.36	3.52	3.36

*Source: Author's computation, 2017 based on Stata 14 Outputs. The regression co-efficients and robust standard errors are reported with robust standard errors in parentheses. Wald Statistics (W.stat), Hausman tests (HauM), Test of Heteroscedasticity (Heter.) and Breusch-Pagan Lagrange Multiplier (LMtest) report X^2 with p-value in parentheses. mVIF indicates the overall variance inflation factor of each model, while *, **, and *** stand for significance at 1%, 5% and 10% respectively .*

In Tables 6a and 6b where each measure of capital adequacy is modelled with the second set of AMELS indicators and other control variables, results show that all the adopted capital ratios positively and significantly predict the Nigerian DMBs' solvency as hypothesised. This suggests that all the measures of capital adequacy whether RIC or RBC equally explain bank's financial condition measured by bank's z-score. Alternatively, in the model with leverage ratio (LVR), LVR appears superior to others given its significance at the least type 1 error, that is, p-value<0.01 but using the explanation of changes in bank's solvency by the explanatory variables of each model, model with ETA as independent variable maintains its superiority with the highest Adj.R^2 of 65.68% followed by the model with NPAR having the Adj.R^2 of 53.39%. The ratio of non-performing loans to gross loans (NPL/GL) also explains Nigerian DMBs' z-score except that the results are according to the prior expectation in the models with ETA and TER. Other significant results are those of ROE with positive influence in the models with LVR and GRR and those of SIZE with positive impact in the models comprising core capital ratio (T1CR) and tangible common equity ratio (TER).

Table 6a. Regression Estimates of Models 8-11 using Second Set of AMELS Indicators with some capital measures

Variable	MODEL 8	MODEL 9	MODEL 10	MODEL 11
TCAR	27.87(14.40)***	……………	……………	……………
T1CR	……………	48.81(22.40)**	……………	……………
ETA	……………	……………	128.22(51.62)**	……………
TER	……………	……………	……………	124.16(49.47)**
NPL/GL	15.37(8.45)***	26.11(12.64)**	-5.20(2.78)***	-6.38(2.92)**
RTA	120.72(50.22)**	102.19(42.38)**	16.28(35.20)	22.1(39.25)
ROE	0.72(1.19)	n0.14(1.39)	-0.91(1.47)	-1.49(1.30)
LTD	4.76(4.46)	0.74(4.27)	3.23(4.06)	2.89(4.85)
MKR2	0.67(2.73)	0.21(2.90)	0.41(1.61)	1.11(1.81)
SIZE	2.05(2.83)	3.61(2.11)***	-3.00(2.55)	2.92(1.65)***
AGE	0.16(4.19)	0.58(3.59)	6.18(7.71)	-3.91(3.49)
SIM	-0.40(1.70)	-0.43(1.28)	-0.68(1.06)	-1.08(1.23)
PEN	0.098(0.19)	0.195(0.188)	0.15(0.17)	0.16(0.19)

_cons	-39.41(58.40)	-72.85(46.74	47.27(39.23)	-40.66(31.75)
Adj.R²	0.4525	0.5222	0.6568	0.527
W/F.stat	2154.18(0.000)*	1233.44(0.000)*	25.85(0.000)*	275.10(0.000)*
HauM	7.62(0.666)	2.14(0.995)	86.51(0.000)*	5.65(0.844)
LMtest	87.79(0.000)*	92.08(0.000)*	……………	98.76(0.000)*
Heter.	8512.34(0.000)*	905.91(0.000)*	1820.46(0.000)*	4570.27(0.000)*
mVIF	3.34	3.48	2.02	2.02

*Source: Author's computation, 2017 based on Stata 14 Outputs. The regression co-efficients and robust standard errors are reported with robust standard errors in parentheses. Wald Statistics (W.stat), Hausman tests (HauM), Test of Heteroscedasticity (Heter.) and Breusch-Pagan Lagrange Multiplier (LM) report X^2 with p-value in parentheses while F-Statistics (F-stat) reports F-values with p-value in parentheses. mVIF indicates the overall variance inflation factor of each model, while *, **, and *** stand for significance at 1%, 5% and 10% respectively.*

Table 6b. Regression Estimates of Models 12-14 using Second Set of AMELS Indicators with some capital measures

Variable	MODEL 12	MODEL 13	MODEL 14
LVR	57.82(21.53)*	……………	……………
GRR	……………	6.018(2.897)**	……………
NPAR	……………	……………	36.94(17.96)**
NPL/GL	31.40(11.78)*	16.75(8.55)**	24.28(12.58)***
RTA	62.44(40.87)	115.06(56.04)**	95.38(52.13)***
ROE	1.41(0.69)**	1.674(0.691)**	2.157(0.573)*
LTD	2.59(5.12)	3.48(4.93)	6.42(4.88)
MKR2	-0.12(2.25)	0.832(2.79)	2.503(1.99)
SIZE	0.089(2.3)	0.106(2.367)	-1.98(2.63)
AGE	0.075(4.13)	0.349(4.029)	1.145(4.753)
SIM	-0.45(1.49)	-0.408(1.609)	-0.314(1.599)
PEN	0.224(0.216)	0.211(0.224)	0.110(0.186)
_cons	7.9(43.73)	0.750(43.76)	44.18(47.71)
Adj.R²	0.4837	0.4506	0.5339
W/F.stat	3333.65(0.000)*	1002.70(0.000)*	14688.96(0.000)*
HauM	7.10(0.716)	7.25(0.702)	15.60(0.112)
LMtest	90.76(0.000)*	85.79(0.000)*	82.78(0.000)*
Heter.	3461.74(0.000)*	12563.86(0.000)*	22720.70(0.000)*
mVIF	4.37	3.62	3.43

*Source: Author's computation, 2017 based on Stata 14 Outputs. The regression co-efficients and robust standard errors are reported with robust standard errors in parentheses. Wald Statistics (W.stat), Hausman tests (HauM), Test of Heteroscedasticity (Heter.) and Breusch-Pagan Lagrange Multiplier (LM) report X^2 with p-value in parentheses while F-Statistics (F-stat) reports F-values with p-value in parentheses. mVIF indicates the overall variance inflation factor of each model, while *, **, and *** stand for significance at 1%, 5% and 10% respectively.*

Having established the superiority of equity-to-assets ratio (ETA) and that it only highly correlates with tangible-common-equity ratio (TER), each of other capital ratios other than TER is included in a model with ETA to further confirm the superiority of ETA. Based on the results depicted in Table 7, the superiority of ETA is further established with its positive influence on z-score at 1% level of significance across all models. However, the two capital ratios that jointly predict bank's solvency are ETA (a RIC) and T1CR (a RBC) on one hand and the ETA and NPAR (both RICs) on the other hand given their significant results but in contrast model with ETA and NPAR (both RICs) is superior considering the Adj.R^2.

Table 7. Regression Results Using ETA with each of other Capital Ratios in Separate Models

VARIABLE	MODEL (ETA/TCAR)	MODEL (ETA/T1CR)	MODEL (ETA/LVR)	MODEL (ETA/GRR)	MODEL (ETA/NPAR)
ETA	114.44(13.65)*	113.15(13.55)*	115.74(13.49)*	116.18(13.72)*	116.59(13.38)*
TCAR	5.01(3.69)	……………	……………	……………	……………
T1CR	……………	7.39(4.06)***	……………	……………	……………
LVR	……………	……………	6.91(4.93)	……………	……………
GRR	……………	……………	……………	0.948(0.841)	……………
NPAR	……………	……………	……………	……………	7.161(3.904)***
_cons	11.58(3.68)*	11.55(3.61)*	11.61(3.65)*	11.44(3.61)*	11.52(3.54)*
Adj.R^2	0.599	0.6074	0.5992	0.5936	0.6081

*Source: Author's computation, 2017 based on Stata 14 Outputs. The regression co-efficients and robust standard errors are reported with robust standard errors in parentheses where *, **, and *** represent significance at 1%, 5% and 10% respectively.*

The findings of this study are not in isolation as relatively similar results have been found in the past. Regarding the superiority of ETA on one hand and that of ETA and NPAR on the other hand, the findings of this study are in agreement with findings of Hogan (2015) and Chernykh and Cole (2015). On the concurrence of both RICs and RBCs in predicting bank's financial condition as evident in Tables 6a and 6b as well as in Table 7 where both ETA and T1CR jointly and significantly predict DMBs' financial condition as expected, the results accord to some extent with the findings of Estrella et al. (2000), Mayes and Stremmel (2014), Schütz (2014) and Yang (2015).

5. Conclusion and Policy Implications

The process of entrenching good financial condition of banks is never halted in any economy. This prompts the need to identify the measure of capital adequacy (from RBC and RIC) that best predicts bank's solvency in Nigeria. The rationale for this is not far-fetched as the capital adequacy measured in several ways remains the centrepiece of bank regulation world over. The data for the study are obtained at bank-level from the annual reports and account of 15 DMBs listed on the Nigerian Stock Exchange between 2012 and 2016. With the aid of random-effects model of panel regression of all study's models except one, the findings reveal the superiority of equity-to-assets ratio. Specifically, the findings show that the predictive potential of any measure of capital adequacy regarding bank's solvency depends on the nature of its co-explanatory variables in a model. This is evident in Tables 6a and 6b where all adopted measures of capital adequacy predict bank's z-score as hypothesised regardless of whether they are risk-weighted or not. Nevertheless the superiority of equity-to-assets (ETA) ratio, tangible common equity ratio (TER), and non-performing assets coverage ratio (NPAR) has been empirically established. A number of other variables of AMELS indicators and other control variables (OCV) are found to be significant but not without the reversal of a number of prior expectations.

Based on these findings, it is concluded that risk-independent capital (RIC) is superior to the risk-based capital in explaining changes in bank's solvency. It is also evident that, of the measures of RIC, the non-regulatory ones (ETA, TER and NPAR) outperform the regulatory capital. Of RBCs, core capital ratio (T1CR) is superior to total regulatory capital ratio (TCAR). For the explanatory potential of the measure of profitability, ROA is superior to ROE while liquid assets to total assets (LTA) is superior to liquid assets to deposit (LTD) for measure of liquidity. By these findings, there is sufficient evidence for bank regulators and supervisors, CBN, to consider incorporating non-regulatory RICs (ETA, TER and NPAR) into the bank's regulatory regime. It is also expedient for CBN to investigate the reversal of prior expectations of measures of asset quality and management soundness as it is not economically defendable to conclude that the higher the non-performing loans and cost-to-income ratio the better the solvency of a bank. The investors and depositors are also expected to look inward while analysing the performance of banks using their capital adequacy and solvency. This is better achieved when several measures of capital adequacy and bank's default risk are considered. Since there are several measures of capital adequacy (Schütz, 2014) even in excess of the number adopted in this study, future studies especially in the Nigerian context should consider a factor analysis of these measures (Klomp & De Haan, 2012) before their predictive power on bank's solvency is tested. Also, a similar study of this nature can be replicated for the microfinance sub-sector of Nigerian banking sector.

6. Bibliography

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