Bank regulation and risk-taking in sub-Sahara Africa

Sopani Gondwe
School of Economics and Finance, Faculty of Commerce Law and Management, University of the Witwatersrand, Johannesburg, South Africa and Financial Sector Regulation Department, Reserve Bank of Malawi, Blantyre, Malawi, and

Tendai Gwatidzo and Nyasha Mahonye
School of Economics and Finance, Faculty of Commerce Law and Management, University of the Witwatersrand, Johannesburg, South Africa

Received 3 December 2021
Revised 8 April 2022
16 May 2022
23 May 2022
Accepted 27 May 2022

Abstract

Purpose – In a bid to enhance the stability of banks, supervisory authorities in sub-Sahara Africa (SSA) have also adopted international bank regulatory standards based on the Basel core principles. This paper aims to investigate the effectiveness of these regulations in mitigating Bank risk (instability) in SSA. The focus of empirical analysis is on examining the implications of four regulations (capital, activity restrictions, supervisory power and market discipline) on risk-taking behaviour of banks.

Design/methodology/approach – This paper uses two dimensions of financial stability in relation to two different sources of bank risk: solvency risk and liquidity risk. This paper uses information from the World Bank Regulatory Survey database to construct regulation indices on activity restrictions and the three regulations pertaining to the three pillars of Basel II, i.e. capital, supervisory power and market discipline. The paper then uses a two-step system generalised method of moments estimator to estimate the impact of each regulation on solvency and liquidity risk.

Findings – The overall results show that: regulations pertaining to capital (Pillar 1) and market discipline (Pillar 3) are effective in reducing solvency risk; and regulations pertaining to supervisory power (Pillar 2) and activity restrictions increase liquidity risk (i.e. reduce bank stability).

Research limitations/implications – Given some evidence from other studies which show that market power (competition) tends to condition the effect of regulations on bank stability, it would have been more informative to examine whether this is really the case in SSA, given the low levels of competition in some countries. This study is limited in this regard.

Practical implications – The key policy implications from the study findings are three-fold: bank supervisory agencies in SSA should prioritise the adoption of Pillars 1 and 3 of the Basel II framework as an effective policy response to enhance the stability of the banking system; a universal banking model is more stability enhancing; and there is a trade-off between stronger supervisory power and liquidity stability that needs to be properly managed every time regulatory agencies increase their supervisory mandate.

Originality/value – This paper provides new evidence on which Pillars of the Basel II regulatory framework are more effective in reducing bank risk in SSA. This paper also shows that the way regulations affect solvency risk is different from that of liquidity risk – an approach that allows for case specific policy

Journal of Financial Regulation and Compliance
Vol. 31 No. 2, 2023
pp. 149-169
Emerald Publishing Limited
1358-1988
DOI 10.1108/JFRC-12-2021-0104

interventions based on the type of bank risk under consideration. Ignoring this dual dimension of bank stability can thus lead to erroneous policy inferences.

Keywords Bank regulation, Basel II, Solvency risk, Liquidity risk, Market discipline, Bank stability

Paper type Research paper

1. Introduction

A sound and stable banking system underpins economic growth and development and is crucial in alleviating poverty and shared prosperity (World Bank, 2019). Some empirical studies also find evidence in support of the bank stability and economic growth relationship (Jayakumar *et al.*, 2018; Lin and Huang, 2012; Pradhan *et al.*, 2017; Levine, 2004). Banks, however, do not always function in a beneficial manner to support this growth objective in the economy. For this reason and to shield safe banks from risky ones, regulators have adopted prudential regulation which is aimed at mitigating excessive risk-taking behaviour by banks, thereby reducing the overall risk exposure in the financial system (Thakor, 2014). However, following the global financial crisis (GFC), there have been divergent views, both in the public policy arena and academic circles about the effectiveness of prudential regulation in mitigating bank risk (see, for example, World Bank Global Financial Development Report, 2013; Organisation of Economic Cooperation (OECD), 2009, 2011; Ayadi *et al.*, 2016; Schaeck and Cihak, 2013). It is, therefore, not surprising that the interaction between bank risk and prudential regulations has become one of the commonly researched areas in banking after the GFC (Barth *et al.*, 2013; Saif-Alyousfi *et al.*, 2020; Danisman and Demirel, 2019; Pasiouras *et al.*, 2009; Delis and Staikouras, 2011; Klomp and de Haan, 2015). However, research that specifically investigates the impact of regulations on bank risk in banking sectors of developing countries has received relatively less attention – yet most of these countries have adopted international regulatory standards as prescribed by the Basel Committee on Banking Supervision (BCBS).

In this paper, we examine the implications of prudential regulations on bank risk (stability) in sub-Sahara Africa (SSA). The focus on the SSA banking sector is relevant for two reasons: First, the banking sector in SSA is critical in serving as a source of investment finance as capital markets are relatively undeveloped in many countries. Its effectiveness in achieving this role can however be undermined by the type of regulatory policies implemented by supervisory authorities (Triki *et al.*, 2017) [1]. Beck and Cull, (2015) suggest that banks can only make a meaningful contribution towards the growth of African economies if regulatory gaps and governance issues are addressed. Second, most countries in SSA have weak supervisory capacity and institutional governance frameworks (Beck and Maimbo, 2013). Because banks behave differently under different institutional environments (Haselmann and Wachtel, 2007), it implies that the way regulations shape risk-taking behaviour in banks, may be different across the different global regions. In fact, questions have been raised (Beck and Maimbo, 2013) as to whether developing countries in SSA need to adopt international bank regulatory standards wholesale – and whether the benefits arising from the adoption of such policies or standards outweigh the costs. On the other hand, correspondent banks in developed countries still require banks operating in SSA to ascribe to and maintain the same international regulatory standards – failure which risks isolating these countries from global trade. The SSA region thus presents a good ground to empirically examine the relevance of international regulatory standards in developing countries.

We examine the regulation-risk relationship by focusing on two dimensions of bank risk: solvency risk and liquidity risk; and four prudential regulations: capital, activity restrictions, supervisory power and private monitoring as in (Barth *et al.*, 2013). We derive the regulatory indices on activity restrictions and the three pillars of Basel II i.e. capital requirements (Pillar 1), official supervisory power (Pillar 2) and private monitoring (Pillar 3) using information from the World Bank Regulatory Surveys (WBRS) databases. These indices are more informative and allow us to explore how regulation affects bank risk-taking behaviour under different institutional and legal environments in a cross-country setting.

The paper makes two contributions to the existing literature on banking studies. First, it identifies which Pillars of Basel II are more effective in mitigating bank risk in SSA. In this way, it offers new evidence on the relevance of international bank regulations in developing countries. Second, it considers the liquidity dimension of bank stability in addition to solvency risk. Most related studies on this topic (Agoraki *et al.*, 2011; Delis and Staikouras, 2011; Klomp and de Haan, 2015; Anginer *et al.*, 2014) mainly use a single indicator of stability – the Z-score or non-performing loan ratio. A few other studies analyse liquidity mainly in the context of the competition-stability relationship (Scopelliti *et al.*, 2015; Carletti and Leonello, 2012; Tabak *et al.*, 2012) in which liquidity risk is treated as exogenous. The GFC crisis, however, demonstrated that liquidity risk can become a crucial source of instability for banks as evidenced by the failure of several banks during the crisis whose causes were largely attributed to liquidity, rather than solvency problems *per se* (Scopelliti *et al.*, 2015). We show that the way in which regulations impact financial stability via the liquidity-risk dimension is different from that of solvency risk. To our knowledge, this is the first study to extend our knowledge on the regulation and bank risk-taking behaviour in this direction in SSA and provide some important insights into the current regulatory reform debate.

The rest of the paper is organised as follows: Section 2 discusses the related literature. Section 3 describes the variables, data and methodological approach. In Section 4, we present and discuss the empirical results. Section 5 concludes the paper.

2. Literature review

In this section, we provide a brief review of some theoretical and empirical studies pertaining to the four regulations to be examined in the current study. Because studies on bank regulation-risk relationship in SSA are very scanty, most of the empirical literature reviewed pertain to developed countries or regions outside Africa.

2.1 Capital Regulation

Hellman *et al.* (2000) present two opposing effects of capital on bank stability. They argue that when banks operate using their own capital, they bear part of the risk for their activities and hence are more disciplined and cautious to engage in excessive risk taking – the so-called capital-at-risk effect. On the contrary, because holding capital is costly, higher capital requirements may decrease financial stability by inducing banks to take more risks to restore their profits and franchise – the so-called franchise-value effect (Tabak *et al.*2012). The majority of the studies find empirical support in favour of capital regulations (Saif-Alyousfi *et al.*, 2020; Triki *et al.*2017; Danisman and Demirel, 2019; Khurshid and Jens, 2016; Klomp and de Haan, 2015; Agoraki *et al.*, 2011). A few other studies however report contrasting findings and evidence. Oduor *et al.* (2017) find that higher capital requirements significantly increase financial instability in Africa, except for big banks. Beck *et al.* (2006) and Delis and Staikouras (2011) do not find evidence that capital regulations reduce the fragility of the banking system. Bermpei *et al.* (2018) find that the effectiveness of capital regulation subdues when good quality institutions that induce loan repayments, such as strong creditor rights and the rule of law are present. The effect of capital on bank risk can thus take either direction.

2.2 Activity restrictions

Barth *et al.* (2004) discuss four theoretical justifications for restricting bank activities. First, increased scope of activities has the potential to create conflict of interest in bank management. Second, it provides bank management more opportunity to raise risk. Third, complex financial institutions are difficult to supervise and may grow "too big to regulate." Finally, large financial conglomerates may reduce competition and efficiency. However, some alternative views suggest that banks benefit more from economies of scale and revenue streams when they are allowed to engage in a broader set of activities (Claessens *et al.*, 2000). Also, because increased scope of activities entails more growth, allowing banks to engage in more activities potentially raises their franchise value. This can create incentives for lower risk (Hellman *et al.*, 2000). Empirical findings are mixed. Danisman and Demirel (2019), Saif-Alyousfi *et al.*, (2020) and Delis and Staikouras, (2011), find that activity restrictions reduce risk-taking, while Barth *et al.* (2013), Beck *et al.* (2006) and Agoraki *et al.* (2011), find that restricting bank activities do not necessarily reduce financial fragility. Klomp and de Haan (2015) observe that activity restrictions only reduce the risk of large and foreign-owned banks. Like capital, activity restrictions can impact bank risk taking behaviour in either direction.

2.3 Supervisory power

Stronger official supervisory power can mitigate excessive risk-taking behaviour in banks because authorities are able to enforce sanctions on banks and their shareholders, directors and senior management officials (Danisman and Demirel, 2019). Strong supervision also protects the public because it is not feasible for individual depositors and creditors to effectively monitor the operations and performance of banks on an ongoing basis (Alexander, 2006). Strong official supervision under such circumstances, thus serves a "social" policy objective – and helps to prevent banks from engaging in excessive risk-taking behaviour (Barth *et al.*, 2004). From a "private interest view" however, supervisory authorities may be "captured" by the industries or businesses – or they may serve their "own" interests (Boot and Thakor, 1993). In such a case, stronger supervisory mandate could instead, breed corruption and retard, rather than promote financial stability and development (Quintyn and Taylor, 2002). Empirical evidence is also mixed. Saif-Alyousfi *et al.* (2020), Klomp and de Haan (2015); Delis and Staikouras (2011) find that supervisory power significantly reduces banking risk. However, Demirgüç-Kunt and Detragiache (2011) fail to find a significant relationship between countries' compliance with the Basel Core Principles for Effective Bank Supervision (BCPs) and banking risk. Bermpei *et al.* (2018) and Anginer and Demirgüç-Kunt (2014) find a negative relationship between supervisory power and bank stability. The effect of supervisory power on bank risk thus remains an empirical issue.

2.4 Market discipline

There are also divergent views about whether the public and private sector are active and effective in monitoring banks and whether their actions or decisions can deter banks from excessive risk-taking behaviour. The supporting argument is that market disclosures allow private investors and the public to make informed decisions thereby help "discipline" banks whose risk management practices are inept (BCBS, 2004). Pillar 3 of the Basel II accord is primarily based on this disclosure notion. Some empirical findings find evidence in support of market disclosures (Pasiouras *et al.*, 2009; Bermpei *et al.*, 2018; Delis and Staikouras, 2011). The countervailing argument, however, is that in most developing countries, literacy levels are low and legal systems are inadequate for market discipline to be an effective mechanism tool in mitigating bank risk (Barth *et al.*, 2013). In addition, most banking products and transactions are sophisticated and complex – making it difficult for ordinary market players to comprehend and distinguish between more risky banks from less-risky ones. Saif-Alyousfi *et al.* (2020) find a positive impact of market disclosures on bank stability in Gulf Cooperating Countries. Some empirical studies only find a significant relationship between market disclosures and bank stability, if other preconditions are in place (Semenova, 2012; Allenspach, 2009).

With respect to the implications of regulation on liquidity risk, the literature is quite new and generally scanty. Wu *et al.* (2017) and Tabak *et al.* (2012) include liquidity as an additional control variable in their analyses of foreign banks and competition on bank stability in emerging countries. Scopelliti *et al.*, (2015) and Le and Tran, (2017) analyse bank liquidity in the context of bank competition-stability relation in Middle East and North Africa (MENA) and the Brazil, Russia, China and South Africa countries, respectively.

3. Variables and data

In this section, we describe the variables used in the study, their measurement and their sources.

3.1 Measuring Bank stability

We employ two measures of risk at the bank level: solvency risk and liquidity risk. Solvency risk refers to the possibility that a bank will be unable to satisfy its maturing commitments because the value of its assets is less than the value of its liabilities (Scopelliti *et al.*, 2015), i.e. it has a negative net worth. We employ the Z-score as a measure of solvency risk in line with other studies (Kasman and Kasman, 2015; Beck *et al.*, 2013; Schaeck and Cihak, 2013) using the following formula:

$$Z_{ikt} = \frac{ROA_{ikt} + ETA_{ikt}}{\sigma ROA_{ikt}} \quad (1)$$

where ROA_{ikt} is the return on assets; ETA_{ikt} is the leverage ratio (equity to total assets) and σROA_{ikt} is the bank standard deviation of return on assets. Subscripts *i, k and t* denote bank, country and time, respectively. A higher Z-score implies more stability i.e. less risk.

We use the ratio of liquid assets to total deposits and short-term borrowing as another indicator of bank risk. Liquidity risk arises when a bank is unable to satisfy its short-term obligations (BCBS, 2004), either because it is unable to convert its assets into cash without incurring a capital loss or because it is unable to raise money to cover the gap. A higher ratio indicates less liquidity risk (greater stability), whilst a lower ratio indicates a deterioration in liquidity strength (less stability). As highlighted under the literature review, the effect of regulation on bank liquidity risk is still substantially unexplored, and we are unaware of any specific studies specifically on SSA.

3.2 Bank regulation measures

To quantify the four regulations, we derive the regulatory variables from the WBRS databases. Specifically, for years 2009–2011, we use scores from Survey IV compiled by (Barth *et al.*, 2013) while for years 2012–2019, we derive the scores directly from the WBRS. For each index, higher scores indicate more stringency of the regulation. A full description and derivation of each index is provided in Appendix 1.

We also control for other bank and country-specific factors that may affect bank solvency and liquidity risk. The choice of these variables has largely been informed by economic theory and other empirical studies. The first group of control variables are bank-specific, namely: asset growth (to capture the effect of bank size), the ratio of non-interest to total income (income diversification) and the Lerner index (as a measure of competition). Bigger banks own more advanced risk management skills and systems (Tabak *et al.*, 2012), as such have the capacity to withstand shocks than smaller banks, hence more stable. However, larger banks can be more unstable if they assume they are “too big to fail”

(Fungacova and Weill, 2013; Tabak *et al.*, 2012). The impact of higher diversification is ambiguous as well because, depending on how risky the non-intermediation services are, higher diversification can result in either lower or higher risk for the bank. Competition can reduce the margins of banks and thus encourage banks to take more risks (Keeley, 1990; Allen and Gale, 2004). This has the potential to cause instability. However, it can also enhance bank stability by reducing risk because of lower interest rates associated with high competition (Boyd and De Nicoló, 2005). The methodological approach used in the study to derive the Lerner index is presented in Appendix 3. We exclude leverage ratio (equity to assets), return on assets (ROA) and return on equity (ROE) from our list of explanatory variables to avoid a spurious relationship as these variables are also used to derive the Z-score. ROA is also used to derive the Lerner index. We also exclude the loan to asset ratio as its impact is indirectly captured by the asset growth variable – the asset mix of banks in SSA countries is heavily dominated by loans.

Second, we control for macroeconomic conditions and the institutional legal environment by including the GDP growth rate (to capture the impact of business cycles) and the Financial Freedom Index (to capture the extent of government intervention in the financial system). Increased economic activity can positively impact bank stability through increased income and profitability from the banking business. However, some studies (Jiménez *et al.*, 2013; Wu *et al.*, 2017), show that banks adopt relaxed or liberal credit policies when the economy is expanding. As a result, bank fragility increases during boom periods. Fewer government obstacles to bank operations or meddling in the financial system could boost efficiency and diversification, which is good for stability. However, greater banking freedom, may result in disruptive competition (Wu *et al.*, 2017) and hence increase instability.

3.3 Data and sample

The individual bank data (balance sheets and income statements) have been sourced from Bankfocus database. The four regulatory variables have been obtained from World Bank's Regulatory Surveys while the indices on the degree of financial freedom have been obtained from the Heritage Foundation. The GDP growth rate series for each country have been sourced from the IMF International Financial Statistics. The sample is comprised of 273 banks from 25 SSA countries for the period 2009 to 2019. The choice of countries was largely informed by extent of availability of bank-level data. As our focus is at bank level, we use unconsolidated data and only include commercial banks with a minimum of three-year consecutive data. The panel is thus unbalanced.

3.4 Descriptive Statistics

A summary of key statistics of the variables used in the study is presented in Table 1. The relatively wide range of the Z-scores and liquidity ratios show that there are material variations in the riskiness of banks across countries in the sample. The variations in regulatory frameworks across countries are, however, relatively small. This is mainly because almost all supervisory authorities in the region base their regulatory policies on the same Basel Core Principles (BPCs). Full variable definitions are provided in Appendix 1. The pairwise correlations are reported in Appendix 2. The correlation between the risk measures (Z-score and Liquidity ratio) and the four regulations is positive and significant for capital and market discipline and negative for activity restrictions. Overall, the correlations do not show any problem of multicollinearity among the explanatory variables.

Figures 1(a) and 1(b) show the evolution (average) in bank risk over the study period. The figures show that although there have been sharp volatilities, banks in SSA are generally very liquid (with liquidity ratio of over 30%) and solvent. Contrary to developed banking

Variable	Obs	Mean	SD	Min	Max
Z-score	2,645	18.3	16.555	−7.592	114.873
Liquidity ratio	2,626	33.486	20.314	0.85	106.54
Capital regulation	2,554	6.74	2.167	2	10
Activity restriction	2,610	7.668	1.558	5	12
Supervisory power	2,622	11.453	2.292	3	14
Market discipline	2,587	8.478	1.854	2.5	11
Lerner	2,500	0.237	0.239	−2.796	0.93
Income diversification	2,631	30.296	16.64	0.022	100
Asset growth	2,361	0.084	0.306	−3.791	2.941
GDP growth rate	2,649	4.649	3.043	−7.7	19.7
Financial freedom index	2,637	48.093	11.798	10	70

Table 1.
Descriptive statistics

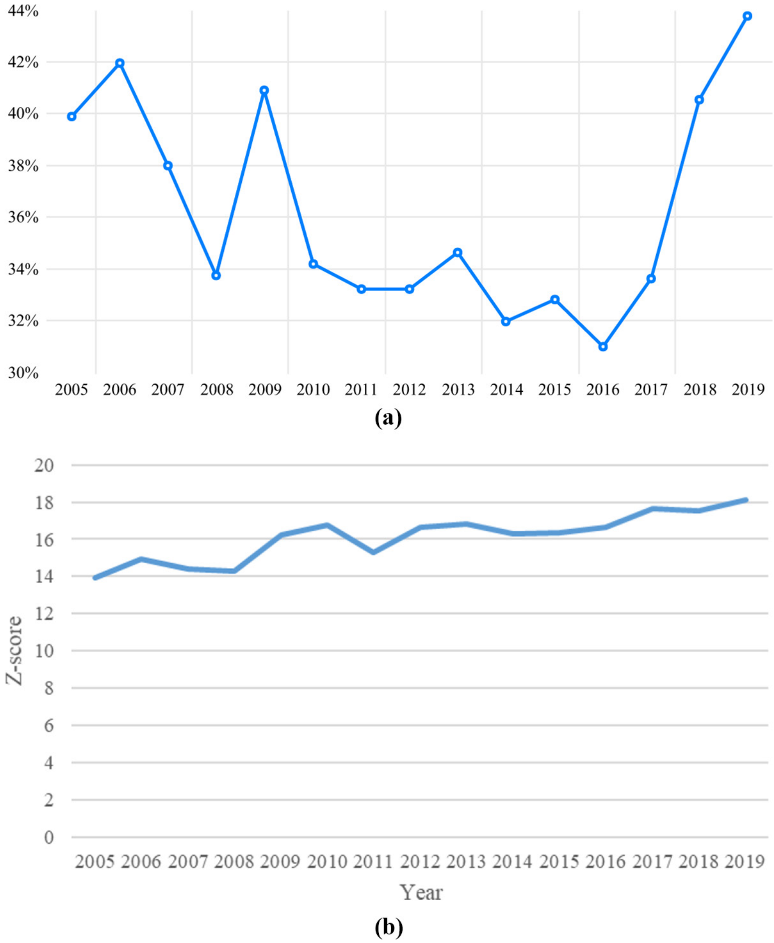

Figure 1.
(a) Trend in liquidity ratio and (b) trend in solvency risk

systems, banks were more stable (bank risk was low) in 2009 – the time of the global financial crisis – highlighting the commonly documented observation that banks in SSA were least affected by the crisis.

3.5 Methodology

Two considerations inform our selection of the estimation method: persistence of bank risk-taking behaviour (Agoraki *et al.*, 2011) and potential endogeneity of bank risk and the bank specific and regulation variables (Delis *et al.*, 2016). Endogeneity in this case could arise because of omitted variable bias or when causality is reversed. For instance, supervisory authorities will usually direct banks that are riskier to hold more capital – in this case, the higher risk (instability) causes higher capital requirements as much as higher capital requirements may be a source of more stability. We thus adopt a dynamic panel model – the 2-step system generalised method of moments (GMM) estimator as advanced by (Arellano and Bover, 1995) and (Blundell and Bond, 1998).

We classify exogenous and endogenous variables based on theoretical considerations and other related empirical literature on bank risk behaviour (Agoraki *et al.*, 2011; Männasoo and Mayes, 2009; Delis and Staikouras, 2011). Bank strategic and business decisions are usually guided or based on past bank performance. In this case, bank-specific variables can be considered as forward-looking – which means that the current bank performance can impact bank-specific variables in later periods. For this reason, we treat bank-specific variables as weakly endogenous (pre-determined) and instrument them with their first and higher lags. On the other hand, supervisory authorities usually enact new rules or policies in response to fragilities in the banking system. Risk levels, thus inform or drive regulatory initiatives [2]. For this reason, we treat the four regulations as endogenous and instrument them with their second and higher lags. Year dummies, macro-economic and institutional legal framework variables are treated as exogenous. To avoid instrument proliferation, we report the GMM estimates with "collapsed" instruments. We check the overall validity of the instruments using the Hansen statistic and second order autocorrelation (AR) test. Because of instrument proliferation issues, we cannot include too many potential control variables in the baseline models. Also as highlighted under section 3, we exclude the other bank specific variables (leverage ratio, ROA and ROE) to avoid a spurious relationship as these variables are also used to derive the Z-score.

3.6 Empirical model

The empirical models take the following specifications:

$$Zscore_{ijt} = \delta Zscore_{ijt-1} + \quad \varphi REG_{jt-1} + \sum_{k=1}^{3} \beta_k BANK_{ijt} + \zeta COUNTRY_{jt} + \theta_j + \gamma_t + v_{ijt} \tag{2.1}$$

$$LRisk_{ijt} = \quad \tau LRisk_{ijt-1} + \varphi REG_{jt-1} + \sum_{k=1}^{3} \beta_k BANK_{ijt} + \theta COUNTRY_{jt} + \eta_j + \mu_t + \varepsilon_{ijt} \tag{2.2}$$

where i and t, represent bank and time, respectively. The dependent variables, $Zscore_{it}$ and $LRisk_{it}$ are bank-level measures of solvency risk and liquidity risk, respectively and REG_t

represents the four regulations (capital, activity restriction, supervisory power and market discipline). Both models include bank-level balance sheet variables ($BANK_{it}$) and country control variables ($COUNTRY_t$) as described in Section 3. YD_t represents year dummies. The lagged stability indices i.e. $Zscore_{it-1}$ and $LRisk_{it-1}$ capture the persistence in the risk-taking behaviour of banks. If persistence is present, we expect positive and significant coefficients of the lagged stability indicators.

It should be highlighted that new regulatory reforms or regulations are unlikely to have an immediate impact on banks' risk-taking behaviour (Agoraki *et al.*, 2011). There will usually be a lag between the time regulatory authorities enact new regulations and when the policies are translated into a change in bank risk-taking behaviour. For this reason, in estimating equations 2.1 and 2.2, all the regulatory variables enter with their first lags. To allow for meaningful comparability in terms of economic significance (Beck *et al.*, 2013), all explanatory variables have also been normalised.

4. Results and discussion

Tables 2 and 3 present the results from the estimation of regression models (2.1 and 2.2) respectively. The dependent variables in these models are solvency risk (Z-score) and

Model:	(1) CAPR	(2) ACTR	(3) SUPP	(4) MKTD
Zscore_1	0.793***	0.794***	0.793***	0.783***
	(0.0466)	(0.0432)	(0.0443)	(0.0498)
Regulation_1	0.689**	−0.396	0.180	0.636**
	(0.284)	(0.296)	(0.280)	(0.297)
Competition	0.446*	0.424*	0.360	0.400
	(0.244)	(0.244)	(0.244)	(0.253)
Size	−0.462***	−0.525***	−0.488***	−0.452***
	(0.149)	(0.149)	(0.149)	(0.145)
Diversification	0.538**	0.643**	0.700***	0.659***
	(0.257)	(0.263)	(0.258)	(0.250)
GDP growth rate	−0.0827	−0.113	−0.316*	−0.227
	(0.206)	(0.171)	(0.182)	(0.210)
FINDEX	0.427**	0.768***	0.650***	0.379
	(0.211)	(0.258)	(0.217)	(0.261)
No. of observations	2,106	2,160	2,172	2,148
AR(2)	0.985	0.994	0.991	0.926
Hansen *p*-value	0.492	0.404	0.439	0.205
F-statistic	597.2***	671.3***	633.9***	578.1***
No/ of banks	273	273	273	273
Year Dummies	Yes	Yes	Yes	Yes

Notes: The table reports the effect of each regulation on solvency risk. The dependent variable in all the models is Z-score. We add one regulation index at a time. CAPR = capital regulation index; ACTR = activity restriction index; SUPP = supervisory power index; MKTD = market discipline index; and FINDEX = financial freedom index. The definitions of the other variables are presented in Appendix 1. For ease of comparability (in terms of economic significance), all explanatory variables have been normalised to have zero mean and unit variance. The models are estimated using two-step system GMM. AR(2) shows the *p*-values of the tests for the Allerano-Bond second order autocorrelation. Hansen *p*-value is the test of over-identifying restrictions. The results indicate that the over identifying restrictions are valid, and there is no second order autocorrelation. The *F*-statistic reports the joint significance of the coefficients. *, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively. Robust standard errors are shown in parentheses

Table 2. Effect of banking sector regulations on solvency risk in SSA (2009–2019)

Model:	(1) CAPR	(2) ACTR	(3) SUPP	(4) MKTD
Liquidity ratio_1	0.653***	0.684***	0.693***	0.657***
	(0.0457)	(0.0449)	(0.0476)	(0.0450)
Regulation_1	1.816**	−3.679***	−3.669***	0.389
	(0.851)	(1.241)	(1.110)	(0.819)
Competition	−2.043	−2.314	−1.486	−2.193
	(1.476)	(1.430)	(1.354)	(1.441)
Size	−3.580**	−4.731**	−4.237*	−3.524**
	(1.793)	(2.072)	(2.480)	(1.616)
Diversification	0.0827	−0.106	−2.194	−0.0185
	(1.978)	(1.519)	(1.609)	(1.771)
GDP growth rate	−0.238	0.765	0.0515	−0.630
	(0.578)	(0.802)	(0.660)	(0.457)
FINDEX	0.126	1.811*	0.0814	0.332
	(0.746)	(0.922)	(0.770)	(0.604)
No. of Observations	1,854	1,890	1,897	1,886
AR(2)	0.274	0.361	0.142	0.344
Hansen *p*-value	0.321	0.306	0.244	0.475
F-statistic	696.5***	567.4***	663.3***	785.5***
No/ of banks	273	273	273	273
Year dummies	Yes	Yes	Yes	Yes

Notes: The table reports the effect of each regulation on liquidity risk. The dependent variable in all the models is Liquidity ratio. We add one regulation index at a time. CAPR = capital regulation index; ACTR = activity restriction index; SUPP = supervisory power index; MKTD = market discipline index; and FINDEX = financial freedom index. The definitions of the other variables are presented in Appendix 1. For ease of comparability (in terms of economic significance), all explanatory variables have been normalised to have zero mean and unit variance. The models are estimated using two-step system GMM. AR(2) shows the *p*-values of the tests for the Allerano-Bond second order autocorrelation. Hansen *p*-value is the test of over-identifying restrictions. The results indicate that the over identifying restrictions are valid, and there is no second order autocorrelation. The *F*-statistic reports the joint significance of the coefficients. *, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively. Robust standard errors are shown in parentheses

Table 3.
Effect of banking sector regulations on liquidity risk in SSA (2009–2019)

Liquidity risk (Liquidity ratio), respectively. Because the effect of each of the four dimensions of bank regulation may be different (Klomp and de Haan, 2015), we add one regulation index at a time. For example, column (1) in Table 2 shows results when using the capital regulation (CAPR) as the regulation measure, in column (2) only activity restriction (ACTR) is used as a measure of regulation, in column (3) only supervisory power regulation (SUPP) is used while in column (4), we use only the regulation on market discipline (MKTD). We also include, as control variables, the Lerner index (competition), asset growth (size), the ratio of other operating income to total income (income diversification index), GDP growth rate and an index on financial freedom. First, we observe that the lagged dependent variables (Z-score and Liquidity ratio) are positive and statistically significant in both tables. This confirms the existence of strong persistence in the risk-taking behaviour of banks, as has been observed in most papers which have used dynamic bank stability models.

From Table 2, the findings support the effectiveness of Pillars 1 and 3 of Basel II in mitigating solvency risk in banks. Capital regulation is positively related to the Z-score, implying that it significantly reduces solvency risk (Column 1). Recall, that a higher Z-score or liquidity ratio, implies higher banking sector stability i.e. lower risk. Our findings are consistent with those reported by (Agoraki *et al.*, 2011; Danisman and Demirel, 2019; Klomp and de Haan, 2015), who also observe a positive effect of capital regulation on bank stability. We also find that market discipline reduces solvency risk as evidenced by a positive coefficient of the market discipline regulation (Column 4). Delis and Staikouras (2011) and Saif-Alyousfi *et al.*, 2020) find similar results. Our result supports the view that improved disclosure of correct information to the public is an effective way of enhancing bank stability. On the other hand, the coefficients of activity restriction (Column 2) and supervisory power (Column 3) are both insignificant – suggesting that these regulations have no significant impact on solvency risk. The non-significance of supervisory power regulation appears to question the relevance and effectiveness of Pillar 2 of the Basel II framework in SSA and support the view that supervisory capacity is significantly constrained in most SSA supervisory agencies (Beck and Maimbo, 2013).

In Table 3, the results show that only capital regulation is effective in reducing liquidity risk (Column 1). A one-standard-deviation increase in regulatory capital requirements leads to a 1.8-unit reduction in liquidity risk – a much stronger impact compared to that on solvency risk in Table 2. A mandatory capital regulatory regime compels management to manage their liquidity prudently because they must avoid transient liquidity shocks that could result in insolvency. Regulations pertaining to activity restriction and stronger supervisory mandate, however, increase liquidity risk (Columns 2 and 3). The former outcome confirms the view that bank profitability and revenue streams are significantly impacted when restrictions are imposed on bank activities (Barth *et al.*, 2004; Agoraki *et al.*, 2011). On the other hand, the negative impact of stronger supervision can be interpreted in terms of how strong supervision alters bank management's latitude or incentives for managing liquidity. Liquidity is a complex and dynamic facet of banking that cannot be effectively managed through supervisory rules or directions. Stringent supervision rules impede dynamism in the management of bank liquidity. Danisman and Demirel, (2019) find that increased supervisory mandate is associated with increased risk-taking in the banking sector. Finally, we do not find significant evidence of a significant effect of market discipline on liquidity risk. This could partly reflect the prevalence of asymmetric information as most banks in our sample are from countries with very shallow and undeveloped financial markets. This information problem in developing countries makes private monitoring of bank liquidity less effective (Agoraki *et al.*, 2011).

With respect to the control variables, the coefficient of size is negative and significant in all the models in both, Table 2 (for solvency risk) and 3 (for liquidity risk). These results indicate that bigger banks are associated with more risk – consistent with the "too big to fail" syndrome. Other studies (Albaity *et al.*, 2019; Kasman and Kasman, 2015; Tabak *et al.*, 2012) report similar results. Well diversified banks are also associated with lower solvency risk as evidenced by the positive coefficients of the diversification index in Table 2. Finally, in Table 2 (although not robust across all the models), we find some evidence of the positive impact of market power (Columns 1 and 2) and financial freedom (i.e. less government intervention and control in the financial system, Columns 1–3) on solvency risk.

4.1 Robustness checks

We carry out two robustness tests to validate our baseline results. First, we relax the assumption that regulations impact bank risk with a lag because, in practice, regulatory authorities notify banks in advance of the impending new laws or regulations. Regulatory policies can thus also have a contemporaneous effect on bank risk. We follow other empirical studies (Beck *et al.*, 2013; Kasman and Kasman, 2015; Albaity *et al.*, 2019) and derive the Z-scores using three-year rolling windows. A 3-year rolling time window allows the standard deviation of return on assets (ROA) – i.e. the denominator of the Z-score, to vary with time (Beck *et al.*, 2013). We then transform the Z-scores by taking their natural logarithm to reduce skewness and re-estimate equation (2.1). The results are presented in Table 4. The impact of regulations on bank risk is basically the same as that presented in Table 2.

Next, we follow the approach by Klomp and de Haan, (2012) and use regulatory indices which we construct using principal component analysis (PCA). Based on the Kaiser criterion, we use one principal component as all factors with eigenvalues below one are dropped [3]. The regression results based on PCA constructed regulatory variables are presented in Table 5. The first column reports the results when using the Z-score and dependent variable, while the second column reports the results when the liquidity ratio as the dependent variable. The overall impact of regulations on solvency and liquidity risk is positive – implying that regulations reduce bank risk in general.

Model:	(1) CAPR	(2) ACTR	(3) SUPP	(4) MKTD
lnZscore_1	0.582***	0.621***	0.614***	0.610***
	(0.0506)	(0.0543)	(0.0620)	(0.0523)
Regulation	0.112**	0.146	0.0695	0.109**
	(0.0481)	(0.187)	(0.120)	(0.0464)
Competition	0.231**	0.263***	0.283***	0.254**
	(0.0973)	(0.0939)	(0.0925)	(0.102)
Size	−0.00543	0.00592	−0.000342	−0.00236
	(0.0429)	(0.0426)	(0.0424)	(0.0428)
Diversification	0.0719	0.0625	0.0691	0.0934
	(0.0798)	(0.0915)	(0.0738)	(0.0825)
GDP growth rate	0.0977**	−0.00166	0.0629	0.0863**
	(0.0380)	(0.0864)	(0.0382)	(0.0367)
FINDEX	0.0172	0.00538	0.0554	0.0182
	(0.0397)	(0.0704)	(0.0382)	(0.0356)
No. of observations	1,594	1,594	1,594	1,594
AR(2)	0.345	0.400	0.404	0.385
Hansen *p*-value	0.256	0.188	0.225	0.303
F-statistic	1,291.6***	1453.2***	1,529.3***	1,469.5***
No. of banks	258	258	258	258
Year dummies	Yes	Yes	Yes	Yes

Notes: The table reports the contemporaneous effect of each regulation on solvency risk. The dependent variable in all the models is the lnZ-score derived using three-year rolling windows. We add one regulation index at a time. CAPR = capital regulation index; ACTR = activity restriction index; SUPP = supervisory power index; MKTD = market discipline index; and FINDEX = financial freedom index. The definitions of the other variables are presented in Appendix 1. For ease of comparability (in terms of economic significance), all explanatory variables have been normalised to have zero mean and unit variance. The models are estimated using two-step system GMM. AR(2) shows the *p*-values of the tests for the Allerano-Bond second order autocorrelation. Hansen *p*-value is the test of over-identifying restrictions. The results indicate that the over identifying restrictions are valid, and there is no second order autocorrelation. The *F*-statistic reports the joint significance of the coefficients. *, ** and *** denote statistical significance at 10%, 5% and 1% level, respectively. Robust standard errors are shown in parentheses

Table 4.
Robustness check: the contemporaneous effect of banking sector regulations on solvency risk using log Z-score in SSA (2009–2019)

Model: Dependent variable:	(1) Z−score	(2) Liquidity ratio
Risk_1	0.784***	0.544***
	(0.0477)	(0.053)
Regulation_PCA	1.028***	2.390**
	(0.387)	(1.175)
Competition	0.350	−1.784
	(0.255)	(1.293)
Size	−0.419***	0.351
	(0.149)	(0.373)
Diversification	0.764***	3.124***
	(0.242)	(1.029)
GDP growth rate	−0.300	−1.573***
	(0.190)	(0.429)
FINDEX	0.173	0.962
	(0.323)	(0.957)
No. of Observations	2,082	2,059
AR(2)	0.993	0.919
Hansen *p*-value	0.738	0.232
F-statistic	571.3***	307.1***
No. of banks	273	273
Year Dummies	Yes	Yes

Notes: The table reports the overall effect of banking sector regulations on solvency and liquidity risk when the regulatory indices are constructed using principal component analysis (PCA). The dependent variable in column 1 is the Z-score while in column 2 is the Liquidity ratio. Regulation_PCA is the composite regulation index based on PCA. FINDEX is the financial freedom index. All other variables are as defined in Appendix 1. The models are estimated using two-step system GMM. AR(2) shows the p-values of the tests for the Allerano-Bond second-order autocorrelation. Hansen p-value is the test of over-identifying restrictions. The results indicate that the over-identifying restrictions are valid, and there is no second-order autocorrelation. The *F*-statistic reports the joint significance of the coefficients. *, **, and *** denote statistical significance at 10%, 5% and 1% level, respectively. Robust standard errors are shown in parentheses

Table 5. Robustness check: the effect of banking sector regulations on solvency and liquidity risk in SSA using principal component analysis (PCA) (2009–2019)

5. Conclusion

In this paper, we investigated the impact of prudential regulations on bank stability in 25 SSA countries using bank-level data for the period 2009–2019. We restricted our analysis to regulations related to capital, activity restrictions, supervisory power and market discipline. Our focus of the empirical analysis was on whether regulations increase or reduce bank risk (stability). Two measures of bank risk were used: Z-score (for solvency risk) and liquidity ratio (for liquidity risk). We employed two-step system GMM estimator and performed some robustness tests to validate our results using principal component analysis to construct the regulatory indices as well as transforming our solvency risk indicator. We find two main results. First, regulations pertaining to capital and market discipline are effective in mitigating solvency risk. This finding supports the effectiveness of Pillars 1 and 3 of Basel II (minimum capital requirements and disclosure requirements) in enhancing bank stability (solvency) in SSA. Second, increased activity restrictions and supervisory power increase liquidity risk.

Our findings have important policy implications. First, bank supervisory agencies in SSA should prioritise the adoption of Pillars 1 and 3 of the Basel II framework as an effective policy response to enhancing the stability of the banking system. Secondly, our finding that activity restrictions increase liquidity risk suggests that the adoption or continued implementation of a universal banking model (which allows banks to diversify their revenue streams) appears a more appropriate regulatory policy to enhance bank stability in SSA. Finally, the finding that stronger supervisory mandate increases liquidity risk implies that there is a trade-off (between increased supervisory power and liquidity stability) which needs to be properly managed whenever regulatory authorities opt to increase their supervisory mandate. Overall, our results show that ignoring the dual dimension of bank stability would lead to erroneous policy inferences on the impact of regulations in mitigating overall bank risk.

Notes

1. The IMF's Financial Soundness Indicators (FSIs) for countries and regions, show that the financial development index (Findex) for SSA at 0.16 as at end 2019, remains substantially low – over 50.0 percent lower than that of other emerging regions. Similarly, SSA has the lowest number of bank branches/1,000 adults (a measure of financial inclusion) at 5 as at end 2018, compared to 13.8 for MENA; 14.1 for Latin America and 7.8 for South Asian countries (Global Financial Development Report, 2013).
2. Delis and Staikouras, (2011) provide a good discussion on the interplay between banks and supervisory agencies with respect to risk and regulation.
3. There is no "optimal" criterion for deciding on the proper number of principal components (Klomp and de Haan, 2012). Some authors base the number on the proportion of unexplained/explained variance, others use the scree-plot while other apply the so called Kaizer rule.

References

Agoraki, E., Delis, M. and Pasiouras, F. (2011), "Regulations, competition and bank risk-taking in transition countries", *Journal of Financial Stability*, Vol. 7 No. 1, pp. 38-48.

Albaity, M., Mallek, R.S. and Noman, A.H.M. (2019), "Competition and bank stability in the MENA region: the moderating effect of Islamic versus conventional banks", *Emerging Markets Review*, Vol. 38, pp. 310-325, doi: 10.1016/j.ememar.2019.01.003.

Alexander, K. (2006), "Corporate governance and banks: the role of regulation in reducing the principal-agent problem", *Journal of Banking Regulation*, Vol. 7 Nos 1/2, pp. 17-40, doi: 10.1057/palgrave.jbr.2340003.

Allen, F. and Gale, D. (2004), "Competition and financial stability", *Journal of Money, Credit, and Banking*, Vol. 36 No. 3b, pp. 453-480, doi: 10.1353/mcb.2004.0038.

Allenspach, N. (2009), "Banking and transparency: is more information always better?", Working Papers, Swiss National Bank, available at: https://ideas.repec.org/p/snb/snbwpa/2009-11.html

Anginer, D. and Demirgüç-Kunt, A. (2014), "Bank capital and systemic stability", Social Science Research Network, available at: https://papers.ssrn.com/abstract=2459698

Anginer, D., Demirguc-Kunt, A. and Zhu, M. (2014), "How does competition affect bank systemic risk?", *Journal of Financial Intermediation*, Vol. 23 No. 1, pp. 1-26, doi: 10.1016/j.jfi.2013.11.001.

Arellano, M. and Bover, O. (1995), "Another look at the instrumental variable estimation of error-components models", *Journal of Econometrics*, Vol. 68 No. 1, pp. 29-51, doi: 10.1016/0304-4076(94)01642-D.

Ayadi, R., Ferri, G. and Pesic, V. (2016), "Regulatory arbitrage in EU banking: do business models matter?", *SSRN Electronic Journal*, doi: 10.2139/ssrn.2829027.

Bank Regulation and Supervision Survey (2019), *World Bank*, available at: www.worldbank.org/en/publication/gfdr/data/the-bank-regulation-and-supervision-survey (accessed 27 March 2022).

Barth, J.R., Caprio, G. and Levine, R. (2004), "Bank regulation and supervision: what works best?", *Journal of Financial Intermediation*, Vol. 13 No. 2, pp. 205-248, doi: 10.1016/j.jfi.2003.06.002.

Barth, J.R., Caprio, G. and Levine, R. (2013), "Bank regulation and supervision in 180 countries from 1999 to 2011", *Journal of Financial Economic Policy*, Vol. 5 No. 2, pp. 111-219, doi: 10.1108/17576381311329661.

BCBS (2004), "Basel II: Revised international capital framework", available at: www.bis.org/publ/bcbsca.htm (accessed 20 March 2022).

Beck, T., Demirguc-Kunt, A. and Levine, R. (2006), "Bank concentration, competition, and crises: first results", *Journal of Banking and Finance*, Vol. 30 No. 5, pp. 1581-1603.

Beck, T., Jonghe, O. and Schepens, G. (2013), "Bank competition and stability: cross-country heterogeneity", *Journal of Financial Intermediation*, Vol. 22 No. 2, pp. 218-244.

Beck, T. and Maimbo, S.M. (2013), "Financial sector development in Africa: opportunities and challenges", *World Bank*, doi: 10.1596/978-0-8213-9628-5.

Beck, T. and Cull, R. (2015), "Banking in Africa", *The Oxford Handbook of Banking*, 2nd ed., Oxford university press, Oxford, pp. 913-937.

Bermpei, T., Kalyvas, A. and Nguyen, T.C. (2018), "Does institutional quality condition the effect of bank regulations and supervision on bank stability? Evidence from emerging and developing economies", *International Review of Financial Analysis*, Vol. 59, pp. 255-275, doi: 10.1016/j.irfa.2018.06.002.

Blundell, R. and Bond, S. (1998), "Initial conditions and moment restrictions in dynamic panel data models", *Journal of Econometrics*, Vol. 87 No. 1, pp. 115-143.

Boot, A.W.A. and Thakor, A.V. (1993), "Self-interested bank regulation", *The American Economic Review*, Vol. 83 No. 2, pp. 206-212.

Boyd, J.H. and De Nicoló, G. (2005), "The theory of bank risk taking and competition revisited", *The Journal of Finance*, Vol. 60 No. 3, pp. 1329-1343, doi: 10.1111/j.1540-6261.2005.00763.x.

Carletti, E. and Leonello, A. (2012), "Credit market competition and liquidity crises", Economics Working Paper, European University Institute, available at: https://ideas.repec.org/p/eui/euiwps/eco2012-14.html

Claessens, S., Glaessner, T. and Klingebiel, D. (2000), "Electronic finance: reshaping the financial landscape around the world", *Social Science Research Network*, Vol. 22 No. 1, pp. 29-61, doi: 10.2139/ssrn.271935.

Danisman, G.O. and Demirel, P. (2019), "Bank risk-taking in developed countries: the influence of market power and bank regulations", *Journal of International Financial Markets, Institutions and Money*, Vol. 59, pp. 202-217, doi: 10.1016/j.intfin.2018.12.007.

Delis, M. and Staikouras, P. (2011), "Supervisory effectiveness and bank risk", *Review of Finance*, Vol. 15 No. 3, pp. 511-543.

Delis, M.D., Kokas, S. and Ongena, S. (2016), "Foreign ownership and market power in banking: evidence from a world sample", *Journal of Money, Credit and Banking*, Vol. 48 Nos 2/3, pp. 449-483.

Demirgüç-Kunt, A. and Detragiache, E. (2011), "Basel core principles and bank soundness: does compliance matter?", *Journal of Financial Stability*, Vol. 7 No. 4, pp. 179-190, doi: 10.1016/j.jfs.2010.03.003.

Fungacova, Z. and Weill, L. (2013), "Does competition influence bank failures?", *Economics of Transition*, Vol. 21 No. 2, pp. 302-322.

Global Financial Development Report (2013), "Rethinking the role of the state in finance", available at: https://openknowledge.worldbank.org/handle/10986/11848 (accessed 04 April 2022)

Haselmann, R. and Wachtel, P. (2007), "Risk-taking by banks in the transition countries", doi: 10.1057/PALGRAVE.CES.8100214.

Hellman, T., Murdock, K. and Stiglitz, J. (2000), "Liberalization, moral hazard in banking, and prudential regulation: are capital requirements enough?", *American Economic Review*, Vol. 9 No. 1, pp. 147-165.

Jayakumar, M., Pradhan, R.P., Dash, S., Maradana, R.P. and Gaurav, K. (2018), "Banking competition, banking stability, and economic growth: are feedback effects at work?", *Journal of Economics and Business*, Vol. 96, pp. 15-41, doi: 10.1016/j.jeconbus.2017.12.004.

Jiménez, G., Lopez, J.A. and Saurina, J. (2013), "How does competition affect bank risk-taking?", *Journal of Financial Stability*, Vol. 9 No. 2, pp. 185-195.

Kasman, S. and Kasman, A. (2015), "Bank competition, concentration and financial stability in the turkish banking industry", *Economic Systems*, Vol. 39 No. 3, pp. 502-517, doi: 10.1016/j.ecosys.2014.12.003.

Keeley, M.C. (1990), "Risk and market power in banking", *American Economic Review*, Vol. 80 No. 5, pp. 1183-1200.

Khurshid, D. and Jens, H. (2016), "Regulations, market power and stability in the banking sector of transition countries", pp. 1-19.

Klomp, J. and de Haan, J. (2012), "Banking risk and regulation: does one size fit all?", *Journal of Banking and Finance*, Vol. 36 No. 12, pp. 3197-3212, doi: 10.1016/j.jbankfin.2011.10.006.

Klomp, J. and de Haan, J. (2015), "Bank regulation and financial fragility in developing countries: does bank structure matter?", *Review of Development Finance*, Vol. 5 No. 2, pp. 82-90.

Le, M. and Tran, T.M. (2017), "Bank competition and liquidity risk: the case of BRICS countries", Vol. 19.

Levine, R. (2004), "Finance and growth: theory and evidence", Working paper No. 10766; National Bureau of Economic Research, doi: 10.3386/w10766.

Lin, P.C. and Huang, H.C. (2012), "Banking industry volatility and growth", *Journal of Macroeconomics*, Vol. 34 No. 4, pp. 1007-1019, doi: 10.1016/j.jmacro.2012.08.004.

Männasoo, K. and Mayes, D.G. (2009), "Explaining bank distress in Eastern European transition economies", *Journal of Banking and Finance*, Vol. 33 No. 2, pp. 244-253, doi: 10.1016/j.jbankfin.2008.07.016.

Oduor, J., Ngoka, K. and Odongo, M. (2017), "Capital requirement, bank competition and stability in Africa", *Review of Development Finance*, Vol. 7 No. 1, pp. 45-51.

Organisation of Economic Cooperation (OECD) (2011), "Competition issues in the financial sector", p. 117 (accessed 20 March 2022).

Pasiouras, F., Tanna, S. and Zopounidis, C. (2009), "The impact of banking regulations on banks' cost and profit efficiency: cross-country evidence", *International Review of Financial Analysis*, Vol. 18 No. 5, pp. 294-302.

Pradhan, R.P., Arvin, M.B., Bahmani, S., Hall, J.H. and Norman, N.R. (2017), "Finance and growth: evidence from the ARF countries", *The Quarterly Review of Economics and Finance*, Vol. 66, pp. 136-148, doi: 10.1016/j.qref.2017.01.011.

Quintyn, M. and Taylor, M. (2002), "Regulatory and supervisory independence and financial stability", Social Science Research Network, available at: https://papers.ssrn.com/abstract=879439

Saif-Alyousfi, A.Y.H., Saha, A. and Rus, R. (2020), "The impact of bank competition and concentration on bank risk-taking behaviour and stability: evidence from GCC countries", *The North American Journal of Economics and Finance*, Vol. 51, p. 100867, doi: 10.1016/j.najef.2018.10.015.

Schaeck, K. and Cihak, M. (2013), "Competition, efficiency, and stability in banking", *Financial Management*, Vol. 43 No. 1, pp. 215-241.

Scopelliti, A.D. Sami, B.N. and Raja, A. (2015), "How does bank competition affect solvency, liquidity and credit risk? Evidence from the MENA countries", available at: www.imf.org/en/Publications/WP/Issues/2016/12/31/

Semenova, M. (2012), "Market discipline and banking system transparency: do we need more information?", *Journal of Banking Regulation*, Vol. 13 No. 3, pp. 241-248, doi: 10.1057/jbr.2011.21.

Tabak, B., Fazio, D. and Cajueiro, D. (2012), "The relationship between banking market competition and risk-taking: do size and capitalization matter?", *Journal of Banking and Finance*, Vol. 36 No. 12, pp. 3366-3381.

Thakor, A.V. (2014), "Bank Capital and financial stability: an economic trade-off or a Faustian bargain?", *Annual Review of Financial Economics*, Vol. 6 No. 1, pp. 185-223, doi: 10.1146/annurev-financial-110613-034531.

Triki, T., Kouki, I., Dhaou, M. and Calice, P. (2017), "Bank regulation and efficiency: what works for Africa?", *Research in International Business and Finance*, Vol. 39, pp. 183-205.

World Bank (2019), "Overview of the financial sector", available at: www.worldbank.org/en/topic/financialsector/overview (accessed 31 March 2022)

Wu, J., Chen, M., Jeon, B.N. and Wang, R. (2017), "Does foreign bank penetration affect the risk of domestic banks? Evidence from emerging economies", *Journal of Financial Stability*, Vol. 31, pp. 45-61.

Appendix 1

Table A1. Description of Variables and Source

Variable	Description	Source
Dependent Variables		
Z-score	A measure of bank risk-taking (stability) calculated as the sum of return on assets and return on equity divided by the standard deviation on return on assets. Higher values indicate low risk-taking (high stability)	Bankfocus
Liquidity ratio	A measure of liquidity risk – calculated as the ratio of liquid assets to total deposits and short-term liabilities	Bankfocus
Regulatory Variables	**World Bank Regulatory Survey Questions**	
Capital stringency (CAPR)	Capital regulation index measures the overall stringency of the capital requirements regime by examining whether banks have flexible minimum capital-asset ratios under different types of risks, and how banks deduct market value losses from capital before having the pre-determined minimum capital adequacy. The index also considers the initial capital stringency by determining whether some sources of funds used to raise the initial disbursement of capital are allowed. The index ranges from 0-8. The variable is determined by adding 1 if the answer is yes to questions 1-6 and 0 otherwise, while the opposite occurs in case of questions 7 and 8 (i.e. yes = 0 and no = 1). (1). Which regulatory regime did you use as of end 2016? Basel I; Basel II; Basel III? (2–3). Which of the following risks are covered by the current regulatory minimum capital requirements in your jurisdiction? Credit risk? Market risk? (4). Are unrealised losses in fair value exposures deducted from Tier 1 regulatory capital? (5). What fraction of revaluation gains is allowed as part of capital? (6). Are sources of funds to be used as capital verified by the regulatory authorities? (7). Can the disbursement or subsequent injections of capital be done with assets other than cash or government securities? (8). Can initial capital contributions by prospective shareholders be in form of borrowed funds?	Barth *et al.* (2013) Database, and World Bank Regulatory Survey Database (2019)
Supervisory Power (SUPP)	The index on supervisory power measures the extent to which regulatory agencies may take or direct specific actions against bank management, directors, shareholders, and auditors of banks. The index ranges from 0–14. The index is determined by adding 1 if the answer is yes, and 0 otherwise: (1) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? (2) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? (3) In cases where the supervisor identifies that the bank has received an inadequate audit, does the supervisor have the powers to take action against the external auditor? (4) Do banks disclose to supervisory authority off-balance sheet items? Please indicate which of the following powers are available to the supervisory authority: (5) Require banks to constitute provisions and cover actual or potential losses? (6) Require banks to reduce or suspend dividends to shareholders? (7) Require banks to reduce or suspend bonuses and other remuneration to bank directors and managers? (8) Can the supervisory authority force a bank to change its internal organisational structure? (9–11) Which authority has powers to perform the following problem bank resolution activities: declare insolvency; supersede shareholder's rights; remove bank senior management and directors?	Barth *et al.* (2013) Database, and World Bank Regulatory Survey Database (2019)
Activity Restrictions Index (ACTR)	Activity restriction index measures the extent to which banks are allowed to engage in other non-traditional banking activities such as brokerage business, insurance, or real estate. The index ranges from 3–12. It is calculated based on the level of regulatory restrictiveness for bank participation in: (1) securities activities; (2) insurance activities; and (3)	Barth *et al.* (2013) Database, and World Bank Regulatory Survey Database (2019)

(*continued*)

Table A1.

Variable	Description	Source
	real estate activities. These activities can be unrestricted, permitted; restricted or prohibited and are assigned the values of 1–4, respectively. An overall index is derived by summing the scores for the three categories from the following questions: (1) What is the level of regulatory restrictiveness for bank participation in securities activities? (2) What is the level of regulatory restrictiveness for bank participation in insurance activities? (3) What is the level of regulatory restrictiveness for bank participation in real estate activities?	
Market Disclosure (MKTD)	The index on market discipline measures the extent to which banks are compelled to disclose their financial performance and risk appetite to the public. The index captures such aspects as to whether banks have a certified external auditor, whether the ten largest banks are rated by credit rating agencies, whether there is explicit deposit insurance, bank accounting in terms of unpaid interest, non-performing loans, and consolidated financial statements. The index ranges from 0–14. The index is derived by adding 1 if the answer is yes and 0 otherwise, except for questions 11 where the opposite occurs (i.e. yes = 0, no = 1). (1a) Is an audit by a professional external auditor required for all banks in your jurisdiction? (1 b) If yes, does the external auditor have to obtain a professional certification or pass a specific exam to qualify as such? (2) What percentage of the top ten banks (in terms of total domestic assets) are rated by international credit rating agencies (e.g., Moody's, Standard and Poor)? (3) What percentage of the top ten banks (in terms of total domestic assets) are rated by domestic credit rating agencies? (4) Is there an explicit deposit insurance protection system for banks? (5) Were insured depositors wholly compensated (to the extent of legal protection) the last time a bank failed? (6) Does accrued, though unpaid, interest/principal enter the income statement while the loan is still performing? (7) Does accrued, though unpaid, interest/principal enter the bank's income statement while the loan is classified as non-performing? (8) Are banks required to prepare consolidated accounts for accounting purposes? (9) Are bank directors legally liable if information disclosed is erroneous or misleading? (10) Is subordinated debt allowed as part of Tier 1 capital and in what percentages? (11) Is subordinated debt allowed as part of Tier 2 capital and in what percentages? Do banks disclose to the public: (12) Off-balance sheet items? (13) Governance and risk management framework? (14) Are bank regulators/supervisors required to make public formal enforcement actions, which include cease and desist orders and written agreements between a bank regulatory/supervisory body and a banking organization?	Barth *et al.* (2013) Database, and World Bank Regulatory Survey Database (2019)
Other control variables		
Size	Growth in total assets – to capture effect of size	Bankfocus
Diversification (DIV)	Ratio of non-interest income to total income	Bankfoucs
GDP growth rate	Annual growth in real GDP (%) – to capture fluctuations in economic activity	IMF Financial Statistics
Financial Freedom Index (FINDEX)	An indicator of the openness of the banking system. Higher values indicate fewer restrictions on banking freedoms	Heritage Foundation

Appendix 2

Table A2.
Correlation matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Z-score	1.000										
(2) Liquidity ratio	−0.076*	1.000									
(3) Capital Regulation	0.058*	0.240*	1.000								
(4) Activity Restriction	−0.102*	−0.048*	0.152*	1.000							
(5) Supervisory Power	−0.014	−0.040*	0.122*	0.331*	1.000						
(6) Market Discipline	0.066*	0.140*	0.502*	0.237*	0.444*	1.000					
(7) Lerner	0.253*	0.030	0.078*	−0.003	−0.068*	0.022	1.000				
(8) Diversification	−0.111*	0.139*	−0.192*	−0.357*	−0.214*	−0.304*	0.063*	1.000			
(9) Asset growth	−0.069*	−0.019	−0.063*	0.026	−0.020	−0.054*	−0.052*	−0.010	1.000		
(10) GDP growth rate	−0.126*	−0.096*	−0.169*	0.268*	0.167*	−0.128*	−0.082*	−0.004	0.242*	1.000	
(11) FINDEX	0.096*	0.002	0.264*	0.367*	0.080*	0.401*	0.056*	−0.362*	0.024	0.029	1.000

Notes: FINDEX is financial freedom index. The symbol * indicates significance at 5% level

Appendix 3. Derivation of Lerner index

The Lerner index represents the mark-up of price over marginal costs and is an indicator of the degree of market power at firm level. The index is computed as follows (Schaeck and Cihak, 2013):

$$Lerner\quad Index = \frac{P_{it} - MC_{it}}{P_{it}} \tag{3}$$

Where P_{it} is the price of bank i's output (approximated by dividing total operating income by total assets) at time *t*, and MC_{it} is the marginal cost of bank *i* at time, *t*. We assume a one output (total assets) and three inputs (labour, fixed assets and funding) production function as in other empirical studies Albaity *et al.*, 2019; (Anginer *et al.*, 2014); Schaeck and Cihak, 2013). To estimate the Lerner index, a log cost function is first estimated and then the co-efficient estimates of the log cost function are used to estimate marginal costs. We estimate a single log-cost function for all countries in the sample as follows:

$$\begin{aligned}\mathrm{lnTC_{it}} = {} & \alpha_0 + \beta_1 \mathrm{lnQ_{it}} + \frac{1}{2}\beta_2 \mathrm{lnQ_{it}^2} + \sum_{k=1}^{3} \alpha_{kt} \mathrm{lnW_{kit}} + \sum_{k=1}^{3} \theta_k \mathrm{lnQ_{it}lnW_{kit}} \\ & + \frac{1}{2} \sum_{k=1}^{3}\sum_{j=1}^{3} \varnothing_k \quad \mathrm{lnW_{kit}} + \mathrm{lnW_{jit}} + \sum_{t=1}^{T-1} \gamma_t \mathrm{D_t} + \nu_{it}\end{aligned} \tag{4}$$

Where subscripts *i* and *t* denote bank and year, respectively. TC_{it} denotes total costs (interest and non-interest expenses), Q_{it} is total assets (output), W_1 is the ratio of total interest expenses to total deposits and short-term liabilities (proxy of price of funding), W_2 is ratio of personnel expenses to total assets (proxy for input price of labour) and W_3 is ratio of non-interest expenses to total assets (proxy for input price of physical capital). Year dummies, D_t, are included to capture technological progress as well as varying business conditions. Following literature, restrictions are imposed on the regression coefficients to ensure homogeneity of degree one in input prices prior to estimating equation (4). The coefficient estimates from the equation (4) are then used to estimate marginal costs for each bank as follows:

$$MC_{it} = \frac{Cost_{it}}{Q_{it}}\left[\beta_1 + 2\beta_2 \ln(Q_{it}) + \sum_{k=1}^{3} \varnothing \ln(W_{k,it})\right] \quad (5)$$

Using the MC_{it} derived from equation (5), the bank specific Lerner indices are then derived using the formula in equation (3).

Corresponding author
Sopani Gondwe can be contacted at: gsopani@gmail.com