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The impact of bank size and funding risk on bank stability

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Abstract: Does bank size significantly explain the variations in bank stability? Does bank funding risk significantly impact bank stability? This paper addresses these two questions with data from the rural banking industry in Ghana. Controlling for credit risk, liquidity risk, diversification in the business model, profitability, inflation, financial structure and gross domestic product, the results suggest that an increase in the size of a rural bank results in an increase in its stability. The results also show that funding risk positively impacts bank stability. The positive relationship between size and bank stability has important repercussions for the current debate on whether or not to constrain bank size to insulate the financial system from future crisis. The positive relationship between funding risk and bank stability also has important implications for the current debate on funding of retail banks.

Subjects: Corporate Governance; Economics; Economics, Finance, Business & Industry; Finance

Keywords: bank size; funding risk; rural bank; stability; Ghana

1. Introduction

The issue of limiting bank size as a way of ensuring stability in the financial system has always been at the centre of bank supervision and regulation. However, the issue has gained much prominence since the 2007/2008 global financial crisis. This is because evidence abounds that large banks accounted for the crisis that caused a significant damage to many economies across the globe. Ever since the world emerged from the crisis, the debate on the optimal size, organizational complexity and a range of activities of banks has heightened (Viñals et al., 2013). This debate has flourished against the backdrop of a financial landscape that has developed markedly over the past two decades, fuelled by financial innovation and deregulation (Laeven, Ratnovski, & Tong, 2014). Regulators in the US (under the Dodd Act, 2010) and in the European Union [as in recommendations by the Liikanen (2012) implemented into EC law as well as the recommendations by the Vickers Report (2011) implemented into UK law] are making strenuous efforts to constrain the size of banks by demanding more capital and liquidity in line with Basel III requirements and also restricting bank's involvement in riskier areas of activity.

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PUBLIC INTEREST STATEMENT

The factors that influence stability of banks have been of immense interest to bank supervisors and regulators in their quest to ensure stability in the financial system. This paper examines the impact of bank size and bank funding risk on bank stability with focus on the rural banking industry in Ghana. The results suggest that size and funding risk support bank stability.

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Employing panel data from the United States of America's (USA) bank holding companies and controlling for quality of management, leverage and diversification, de Haan and Poghosyan (2012) find that bank size reduces returns volatility. However, the effect is non-linear: when bank size exceeds some threshold, size positively impacts returns volatility. This probably explains why one dimension of the debate on the optimal size of banks focuses on whether there should be regulatory restrictions on bank size as a way of circumventing the recrudescence of the global crisis and its attendant problems. One view is the imposition of capital surcharges on large banks as in Basel III. Another view is that policy-makers should reduce the too-big-to-fail subsidies (Farhi & Tirole, 2012; Stein, 2013).

The above points to the importance of bank size to the stability of the financial system in particular and the economy in general. This paper contributes to the debate on the size–stability nexus with data from the rural banking industry in Ghana. The interest of the paper lies in whether or not increasing size of a rural bank [also called rural and community banks (RCBs)][1] has any significant implications for its stability. This interest stems from the design of RCBs as unit banks with geographically demarcated areas of operations which limits the extent to which they can grow.

Interest in the business models of banks is gathering momentum in recent times, especially after the global financial crisis. According to Köhler (2015), business models relate to how banks make profits, the customers they serve and the distribution channels they use. One area of business model is funding structure. So far, the debate has revolved around whether or not it is more advisable for a bank to adopt wholesale funding than deposit funding (Calomiris & Kahn, 1991; Huang & Ratnovski, 2011; Shleifer & Vishny, 2010). This paper joins the debate by exploring the effect of a bank's funding risk on its stability.

The results of this study indicate that bank size (measured as natural logarithm of total assets and natural logarithm of deposits), bank funding risk (measured as funding risk *Z*-score), profitability (measured as return on equity-ROE), inflation and gross domestic product (GDP) have generally supported bank stability. The results also indicate that diversification, credit risk and financial development or structure have generally undermined bank stability.

The contributions of this paper to knowledge are largely twofold. The first contribution of this paper to knowledge is that it analyses bank stability which is one of the risks that are of much significance to policy-makers in their quest to achieve financial development and economic growth. The finding that size promotes bank stability makes a contribution to the ongoing debate on the effect of bank size on bank stability. At least the finding suggests that the push for bank size restrictions in the name of ensuring stability in the financial system must be pursued with considerable tact and circumspection. Blanket implementation of size constraints aimed at taming the growth rate of bank size may be inimical to the stability of banks such as RCBs in Ghana.

The second contribution of this study to knowledge is that it shows that the funding risk of a rural bank has a positive statistically significant effect on its stability. The postulation is that RCBs that improve their funding risk *Z*-scores should anticipate better stability. This represents an addition to the determinants of bank stability. It is expected that future researchers will test the effect of the funding risk *Z*-score on bank stability with data from different parts of the world.

2. Theoretical review

The connection between bank size and bank stability can be understood in the context of the agency theory of the firm. The crux of the agency theory (Jensen & Meckling, 1976) is that owners and managers of the firm have incompatible goals with the latter postulated as running the firm to pursue their personal aggrandizement at the expense of the former. In other words, the theory submits that the decisions and actions of managers are inordinately skewed towards personal gains. Thus, an increasing firm size is a consequence of managerial empire-building and that large firms are characterized by bad governance. The contention is that managers may increase the size of a firm to receive larger compensation or to enjoy private benefits from the prestige of running a large firm (Gabaix & Landier, 2008; Jensen, 1986; Murphy, 1985). This theory, by extrapolation, predicts a negative relationship between bank size and bank stability.

Another theory that offers an explanation for the possible relationship between bank size and bank stability is the stewardship theory. The theory argues that managers are inherently trustworthy and thus are not susceptible to misappropriate the resources of the firm (Davis, Schoorman, & Donaldson, 1997; Donaldson & Davis, 1991). It posits that there are non-financial motivators, and that corporate managers are seen as drawing motivation from the need to achieve, to gain intrinsic satisfaction via successful execution of intrinsically challenging work, to exercise responsibility and authority and by it draw recognition from peers and bosses (McClelland, 1961). When corporate managers identify with the firm (more likely if they have been with the firm for a long time and have shaped its form and directions), this facilitates the merging of individual ego and the corporation, thus melding individual self-esteem with corporate prestige. The theory argues that it is possible for a corporate manager to find a course of action personally unrewarding, nonetheless, they are likely to pursue it from a sense of duty. This compliance with a duty when there is no personal reward is referred to as normally induced compliance (Etzioni, 1975). When corporate managers perceive that their fortunes are inextricably tied to their current employers through an expectation of future employment or pension rights, they may view their interest as aligned with that of the firm and its owners even if they do not own shares in the firm. In essence, the stewardship theory submits that there is no inner motivational problem among corporate managers; corporate managers aspire to achieve good corporate performance. Performance variations, in the view of the theory, emanates from the structural situation in which corporate managers find themselves. If the structural situation is convenient, one should expect good corporate performance from corporate managers. The question arises as to whether or not the organizational structure supports corporate managers to formulate and implement plans for high corporate performance. Structures support goals to the extent that they "provide clear, consistent expectations and authorize and empower senior management" (Donaldson & Davis, 1991). In a nutshell, unlike agency theory that predicts a short-run aggrandizement-induced increasing size that may be inimical to stability in the long-run, stewardship theory suggests that increasing size is indicative of structural convenience that may enhance stability. By deduction, the stewardship theory predicts a positive relationship between bank size and bank stability.

The effect of bank size on bank stability can also be viewed from the perspective of the concentration-stability and concentration-fragility hypotheses (Uhde & Heimeshoff, 2009). The concentration-stability hypothesis argues that larger banks in concentrated banking sectors decrease financial fragility through at least five channels: (1) larger banks may increase profits, building up high "capital buffers", thus allowing them to be less susceptible to liquidity or macroeconomic shocks; (2) larger banks may improve their charter value, dissuading bank managers from extreme risk-taking behaviour. The argument of Boot and Thakor (2000) is that larger banks tend to resort to credit rationing; thus, they record fewer but higher quality credit investments which improve their financial stability; (3) supervisory bodies find larger, but fewer, banks easier to monitor, thus, there is effective supervision in concentrated banking markets which reduces the risk of system-wide contagion; (4) larger banks tend to be subject to providing credit monitoring services; and (5) larger banks enjoy higher economies of scale and scope, therefore, they have the potential to diversify loan-portfolio risks efficiently and geographically through cross-border activities (Mirzaei, Moore, & Liu, 2013). However, there are two angles to this. The first argument is that size promotes better diversification which reduces risks and permits banks to support their operations with less capital and less-stable funding. The second argument centres on the ability of larger banks to operate in a different market segment. Larger banks may have a comparative advantage in market-based activities which require significant fixed costs and enjoy economies of scale (Laeven et al., 2014). Consequently, the prognosis of the concentration-stability hypothesis is that there is a positive relationship between bank size and bank stability.

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The concentration-fragility view submits that larger banks in a concentrated market decrease stability through three channels: (1) exacerbation of moral hazard problem due to the fact that larger banks are seen as “too big to fail” institutions and are, thus, given government guarantees. According to Mishkin (1999), as banks increase in size, the moral hazard problem is exacerbated for the manager whose risk-loving behaviour is inflated with the knowledge of being shielded by government’s safety net (i.e. the effect of too-big-to-fail subsidies, an intervention usually implemented by central banks to bail out financially distressed large banks). It posits that larger banks respond to too-big-to-fail subsidies. Owing to the perception that the creditors of larger banks will be rescued by the bailout subsidies in case of bank distress, the cost of debt for larger banks is lower, thus encouraging them to develop the penchant for use of leverage and unstable funding, and to engage in risky market-based activities (Laeven et al., 2014); (2) due to the fact that larger banks tend to charge higher loan interest because of their market power, borrowers may be compelled to undertake risky projects to be able to pay off the loans which may increase default risks; and (3) managerial efficiency such as risk diversification in assets and liabilities may deteriorate in a concentrated banking market, causing high operational risk (Mirzaei et al., 2013). Hence, the prediction of the concentration-fragility hypothesis is that the effect of size on bank stability is negative.

According to Köhler (2015), retail banks fund their activities with customer deposits. Since RCBs are retail banks, the paper adopts the funding risk *Z*-score developed by Adusei (2015) that measures the number of deviations customer deposits mobilized by a bank would have to fall from the mean to wipe out equity capital or to call for equity recapitalization to measure the funding risk of RCBs. The higher the funding risk *Z*-score, the more stable the funding sources of the bank. It is, therefore, expected that funding risk will positively impact bank stability.

3. Empirical review

Empirically, not much attention has been given to the size–stability relationship. So far studies have focused on how competition affects bank stability (Amidu & Wolfe, 2013; Beck, De Jonghe, & Schepens, 2013; Fiordelisi & Mare, 2014). One study that specifically explores size–stability connection is Laeven et al. (2014). It analyses the relationship between bank size and bank stability with data from 52 countries and finds that larger banks, on average, create more risks than smaller banks. Köhler (2015) analyses the impact of business models on bank stability in the EU banking sector for the period between 2002 and 2011. Among other things, the study reports that bank size has a significant negative impact on bank stability, implying that larger banks are less stable than smaller banks. However, Altaee, Talo, and Adam (2013) test the stability of banks in the Gulf Cooperation Council countries and find, among other things, that size (represented by total assets) has no statistically significant impact on bank stability. The obvious conclusion from the above is that the relationship between size and stability is inconclusive. Thus, there is scope for the further interrogation of this relationship. What is the effect of the size of a rural bank on its stability.

The relationship between funding structure and bank stability has been receiving accumulating empirical attention. Whereas Calomiris and Kahn (1991) submit that wholesale funding may lessen bank risk via a better monitoring of banks by sophisticated fund providers and a better diversification of funding resources, Huang and Ratnovski (2011) are of the view that the price of wholesale funds is less stable and that wholesale funds are repriced more quickly to reflect bank’s riskiness. On the other hand, customer deposits are repriced more slowly and are relatively more stable (Shleifer & Vishny, 2010). Demirgüç-Kunt and Huizinga (2010) find that a larger share of non-deposit funding is associated with greater instability. However, Köhler (2015) reports different impact of non-deposit funding for different types of banks. Whereas an increase in the share of non-deposit funding decreases the stability of retail-oriented banks, an increase in the share of non-deposit funding increases the stability of investment banks (Köhler, 2015). The current study examines the effect of funding risk on the stability of RCBs in Ghana.

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In the banking context, it is important to distinguish funding risk from funding liquidity and funding liquidity risk. According to Drehmann and Nikolaou (2010, p. 2), funding liquidity is "the ability to settle obligations with immediacy". The definition offered by the IMF (2008) is in line with the foregoing definition. It defines funding liquidity as "the ability of a solvent institution to make agreed-upon payments in a timely fashion" (IMF, 2008, p. xi). Funding liquidity risk is "the possibility that over a specific horizon the bank will become unable to settle obligations with immediacy" (Drehmann & Nikolaou, 2010, p. 2). The above definitions carry the notion of the ability of a bank to meet its financial obligations as and when they fall due. In contrast, funding risk, in this paper, is defined as the probability that the deposit mobilization strategies of a rural bank will fail or the probability that depositors of a rural bank will withdraw their deposits, resulting in the deterioration of the bank's deposits which compels it to fall on equity sources of funding. It is different from funding liquidity and funding liquidity risk, in the sense that it focuses on the reliability of customer deposits documented in the extant literature as the main source of funding retail banks.

4. Overview of rural banking in Ghana

The rural banking model started in Ghana in the late 1970s as a means of encouraging rural savings as well as meeting the peculiar financial needs of rural dwellers. Deposit mobilization, credit and investment extension and involvement in the payments system were the traditional banking functions penciled as the mandate of rural banks. Rural banks are limited liability companies owned by residents of the localities where they are set up with limits placed on the number of shares an individual can acquire.

There are four major services offered by rural banks. These are microfinance loans, susu loans, salary loans and commercial loans (Nair & Fissha, 2010). Table 1 provides details of major products marketed by RCBs.

Table 2 summarizes the legal, regulatory and tax framework of RCBs. As can be observed, the minimum capital requirement for establishing a rural bank is GH¢ 150,000[2] an equivalent of US$37,500.[3]

Table 1. Major rural bank credit products

Loan type	Description
Microfinance loans	These loans are provided to groups of individuals to finance small and micro income generating activities. For some banks, the group is the borrower. For others, each member of the group is a borrower. In both cases, the group is jointly liable for the loan. The size of a microfinance loan ranges between GH¢ 50[a] and GH¢ 1,000; however, most loans are between GH¢ 100 and GH¢ 500. The term of a microfinance loan is four to six months, and the interest rate ranges between 30 and 36%
Susu loans	These loans are provided to individuals following a three-month *susu* deposit. The size and term of *susu* loans are similar to those of microfinance loans, but *susu* loans are provided to individuals whereas microfinance loans are group loans
Salary loans	These loans provided to salaried individuals, are secured by the individual's salary, which is paid through the bank. The bank automatically deducts the loan repayment installment from the salary payments
	Salary loans are used for consumption and investment, as well as social purposes. The size of the loan is determined by the salary of the borrower. The maximum term of a salary loan is 48 months, and the interest rate ranges between 30 and 33%
Commercial loans	These loans are provided to companies and individual entrepreneurs for working capital or fixed capital. The maximum loan size is GH¢ 100,000, the maximum term is 36 months, and the interest rate ranges between 28 and 35%

[a]US$1 = GH¢ 4.

Source: Nair and Fissha (2010).

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Table 2. The legal, regulatory and tax framework of RCBs

Licensing requirements	Minimum paid-up capital of GH¢ 150,000[a]
	Ownership of shares by residents
	Operation within a radius of about 25 miles
Prudential requirements	Minimum paid-up capital of GH¢ 150,000
	Capital adequacy ratio of 10%
	Liquidity reserve ratio of 43%
	Exposure limits of 25% for secured loans, 10% for unsecured loans, and 2% for loans to members of board of directors
Tax requirements	Corporate income tax rate of 8%
	Value-added tax of 15%
	National Health Insurance Scheme tax of 2.5%

[a]US$1 = GH¢ 4.

Source: Nair and Fissha (2010).

5. Methodology

5.1. Variables

In this section, the variables used for analysing bank stability are presented. A summary of the variables and how they are measured is presented in Table 3.

5.1.1. Dependent variables

One measure of bank stability is *Z*-score. Also called bank stability (BSTAB), *Z*-score comprises accounting measures of profitability, leverage and volatility (Demirgüç-Kunt & Huizinga, 2010; Stiroh, 2004a, 2004b). It is computed as:

$$Z\text{- score }\left(\mathrm{BSTAB}\right)_{i,t} = \left[\frac{\mathrm{ROA}_{i,t} + \frac{E_{i,t}}{A_{i,t}}}{\sigma \mathrm{ROA}_{ip}}\right] \tag{1}$$

where $\mathrm{BSTAB}_{i,t}$ is the stability *Z*-score of bank *i* in quarter *t*, ROA_{it} is the return on assets ratio, *E*/*A* is the equity-to-asset ratio of bank *i* in quarter *t* and $\sigma\mathrm{ROA}_{ip}$ is the standard deviation of the ROA of bank *i* over the whole sample period *p* (Köhler, 2015). *Z*-score is defined as the number of standard deviations by which a bank's ROA has to fall for the bank to become insolvent. It is, thus, an indicator of insolvency risk. Thus, a higher *Z*-score predicts a lower risk of instability or insolvency. In this study, *Z*-score is used to measure the overall bank stability. Following the example of Köhler (2015), the two components of the *Z*-score are also used as dependent variables to gain an insight into the component that is driving the relationship between the *Z*-score and the independent variables. The components are:

$$\mathrm{RAROA}_{it} = \frac{\mathrm{ROA}_{it}}{\sigma(\mathrm{ROA}_{ip})} \tag{2}$$

$$\mathrm{RAEA}_{it} = \frac{E/A_{it}}{\sigma(\mathrm{ROA}_{ip})} \tag{3}$$

5.1.2. Independent and control variables

Bank size is one of the two independent variables and is measured as the natural logarithm of total assets of a rural bank (Amidu & Wolfe, 2013). Another measure of bank size is the natural logarithm of customer deposits. This is used as the ancillary measure of bank size. The second independent variable is funding risk (FUNDRISK) which is measured by a *Z*-score.[4] The *Z*-score is computed as follows:

$$Z\text{-score}\left(\text{FUNDRISK}\right)_{i,t} = \left[\frac{\text{DEP/TA}_{i,t} + E/\text{TA}_{i,t}}{\sigma\left(\text{DEP/TA}_{ip}\right)}\right] \tag{4}$$

where *Z*-score (FUNDRISK) is the funding risk *Z*-score of bank *i* in time *t* which measures the number of deviations customer deposits would have to fall to compel the bank to wipe out equity finance; DEP/TA_{it} is the deposit to total assets ratio of bank *i* in time *t*; E/TA_{it} is the equity to total assets ratio of bank *i* in time *t*; and $\sigma(\text{DEP/TA}_{ip})$ is the standard deviation of the deposit-to- asset ratio. This measure of funding risk of RCBs is important because retail-oriented banks fund their activities with customer deposits (Köhler, 2015). It is, therefore, expected that funding risk will positively impact bank stability.

The control variables obtained from the literature are the investment-to-assets ratio measuring diversification in the business model of the bank (Beccalli, Anolli, & Borello, 2015); liquidity risk measured by the cash and due from balances held at other depository institutions to total assets ratio (Fiordelisi & Mare, 2014; Rose & Hudgins, 2008); the loans-to-assets ratio measuring credit risk (Curak, Poposki, & Pepur, 2012); and profitability measured by ROA and ROE which are common measures of bank profitability. The use of total loans to total assets ratio to measure credit risk is deliberate. The total loans-to-total assets ratio indicates the extent to which the bank is vulnerable to variations in the repayment attitudes of its borrowers. A higher loans-to-total assets ratio indicates that the bank has more of its assets in loans which means that if there should be more borrower default, the bank is closer to insolvency. Indeed, the use of loans-to-assets ratio as measure of credit risk is not novel. Researchers such as Curak et al. (2012) have measured credit risk by this ratio.

To check the robustness of the findings, three external variables are introduced to further examine the impact of bank size and bank funding risk on bank stability. These are inflation, financial development and GDP. Whereas inflation is used to measure macroeconomic stability in Ghana, financial development as measured by growth in private sector credit is used to proxy the financial structure in Ghana. GDP is used to measure the overall health of Ghana's economy.

The effect of inflation on bank performance depends on whether or not the former is anticipated or unexpected. When inflation is anticipated and interest rates are adjusted accordingly, the effect of inflation on profitability and ultimately stability should be positive (Perry, 1992). On the other hand, when inflation is unexpected, a negative effect on bank stability is expected because unexpected increases in inflation cause cash-flow problems for borrowers leading to abrupt abrogation of loan arrangements with accompanying loan losses. Hoggarth, Milne, and Wood (1998) argue that high and variable inflation may create loan planning and negotiation difficulties.

Financial development as measured by the growth in private sector credit could be good or bad for bank stability. If high-quality credit is extended to the private sector, this could yield more profits which will result in banks building up "capital buffers" resulting in improved bank stability. On the other hand, growth in private sector credit could adversely affect bank stability if this growth is associated with falling underwriting standards resulting in more non-performing loans. In other words, the effect of financial development on bank profitability could either be positive or negative. Mirzaei et al. (2013) provide evidence that supports this postulation. They find that financial structure negatively affects bank profitability in emerging economies and positively affects bank profitability in advanced economies.

Due to the fact that increasing GDP suggests an improvement in the general income in an economy, some studies have found GDP growth as profit-enhancing and by extension stability-enhancing

(Kosmidou, 2008). On the other hand, growth in GDP is associated with a reduction in profitability, and by extension, a reduction in bank stability (Tan & Floros, 2012). The intuition is that an improvement in economic growth results in an improvement in the business environment and lowers bank entry barriers. This promotes competition in the banking industry which reduces bank profitability (Tan & Floros, 2012). A reduction in bank profitability implies a reduction in its stability. It is obvious from the above that there are two contrasting positions on the effect of GDP on bank stability (positive and negative).

5.1.3. The models

Using the three measures of bank stability, the following models are to be estimated:

$$\begin{aligned}\mathrm{BSTAB}_{i,t} = {} & \beta_1 + \beta_2\mathrm{BSIZE}_{i,t-1} + \beta_3\mathrm{DEPO}_{i,t-1} + \beta_4\mathrm{FUNDRISK}_{i,t-1} + \beta_5\mathrm{LRISK}_{i,t-1} + \beta_6\mathrm{CRISK}_{i,t-1} \\ & + \mathrm{B}_7\mathrm{DIV}_{i,t-1} + \beta_8\mathrm{ROE}_{i,t-1} + \beta_9\mathrm{INFL}_{t-1} + \beta_{10}\mathrm{FINDEV}_{t-1} + \beta_{11}\mathrm{GDP}_{t-1} + \mu_{it}\end{aligned} \quad (5)$$

$$\begin{aligned}\mathrm{RAROA}_{i,t} = {} & \beta_1 + \beta_2\mathrm{BSIZE}_{i,t-1} + \beta_3\mathrm{DEPO}_{i,t-1} + \beta_4\mathrm{FUNDRISK}_{i,t-1} + \beta_5\mathrm{LRISK}_{i,t-1} + \beta_6\mathrm{CRISK}_{i,t-1} \\ & + \mathrm{B}_7\mathrm{DIV}_{i,t-1} + \beta_8\mathrm{ROE}_{i,t-1} + \beta_9\mathrm{INFL}_{t-1} + \beta_{10}\mathrm{FINDEV}_{t-1} + \beta_{11}\mathrm{GDP}_{t-1} + \mu_{it}\end{aligned} \quad (6)$$

$$\begin{aligned}\mathrm{RAEA}_{i,t} = {} & \beta_1 + \beta_2\mathrm{BSIZE}_{i,t-1} + \beta_3\mathrm{DEPO}_{i,t-1} + \beta_4\mathrm{FUNDRISK}_{i,t-1} + \beta_5\mathrm{LRISK}_{i,t-1} + \beta_6\mathrm{CRISK}_{i,t-1} \\ & + \mathrm{B}_7\mathrm{DIV}_{i,t-1} + \beta_8\mathrm{ROE}_{i,t-1} + \beta_9\mathrm{INFL}_{t-1} + \beta_{10}\mathrm{FINDEV}_{t-1} + \beta_{11}\mathrm{GDP}_{t-1} + \mu_{it}\end{aligned} \quad (7)$$

where $\mathrm{BSTAB}_{i,t}$, $\mathrm{RAROA}_{i,t}$ and $\mathrm{RAEA}_{i,t}$ are the bank stability, bank-risk adjusted ROA and bank risk-adjusted capitalization; SIZE is the Bank size; DEPO is the Bank deposits; FUNDRISK is the Bank funding risk; LRISK is the Liquidity risk; CRISK is the Credit risk; DIV is the diversification in the business model; ROE is the Return on equity; ROA is the Return on assets; INFL is the Inflation rate; FINDEV is the Financial development; GDP is the Gross domestic product; β and μ are the parameter and stochastic error term respectively; *i*, *t* are the individual bank and time effect respectively.

A two-stage approach is used to estimate the above models. The first stage involves the estimation of the models with natural logarithm of total assets as proxy for bank size (BSIZE). The second stage involves the estimation of the models with bank deposits (DEPO) as the second measure of bank size. These estimations are initially done with only the bank-specific factors as control variables. The robustness of the results from each stage is checked with the re-estimation of the three models with the macroeconomic variables (inflation, financial development and GDP) as additional control variables.

In estimating the above models, the dependent variable in time (t) is related to the explanatory variables in time ($t - 1$). In other words, all explanatory variables are lagged to mitigate potential endogeneity concerns (Hannan & Prager, 2009). The logic is that bank stability in time t is a function of the combined lagged values of the explanatory variables. All data are log-transformed to deal with skewness.

The definitions of these variables and their expected relationships with the dependent variables are presented in Table 3.

5.1.4. Model suitability checks

Three tests are performed to check the suitability of the panel model used in this study. First is the Hausman test. It assesses the null hypothesis that the difference between the fixed effect (FE) and the random effect (RE) of the model is not systematic. The results of this test determine whether the FE or RE model is suitable for analysis.[5] The FE model assumes that each of the banks in the sample is different, therefore, the bank's error term and the constant (which captures individual characteristics) should not be correlated with those of other banks. Thus, if the error terms are correlated, then the FE model is not suitable since inferences may not be correct. In that case, the RE model is

Table 3. Variables, definitions, notations and expected signs

Variable	Definition	Notation	Expected sign	Source
Dependent variable				
Bank stability risk	*Z*-score made up of ROA, capitalization ratio and standard deviation of ROA	*Z*-score		ARB Apex Bank
	Risk-adjusted return on assets	RAROA		ARB Apex Bank
	Risk adjusted equity to assets ratio	RAEA		ARB Apex Bank
Independent variables				
Bank size	Natural logarithm of total Assets	BSIZE	?	ARB Apex Bank
Bank size	Natural logarithm of bank deposits	DEPO	?	ARB Apex Bank
Funding risk	*Z*-score defined as deposits to assets ratio plus equity to assets ratio divided by the standard deviation of deposits to assets ratio	FUNDRISK	+	ARB Apex Bank
Control variables				
Liquidity risk	Cash and due from balances held at other depository institutions to total assets	LRISK	−	ARB Apex Bank
Credit risk	Total loans divided by total Assets	CRISK	−	ARB Apex Bank
Diversification	Total short-term and long-term securities divided by total assets	DIV	+	ARB Apex Bank
Profitability	Return on equity and return on assets	ROE, ROA	+	ARB Apex Bank
Inflation	Quarterly inflation rate	INFL	?	Bank of Ghana
Financial development or structure	Growth in private sector credit	FINDEV	?	Bank of Ghana
Economic growth	Quarterly GDP at current prices	GDP	?	Ghana Statistical Service

Source: Adusei (2015).

appropriate. The second test is the likelihood ratio test or the redundant FE test which assesses the appropriateness of the FE estimation technique. The third test is the Wald test. It examines the joint significance of the explanatory variables in explaining the variations in the dependent variable.

5.2. Data sources

Due to data constraints, 112 out of 137 rural banks in Ghana as at January 2013 have been selected for analysis. The 112 rural banks have requisite data needed for the study. The bank-specific variables have been extracted from the quarterly reports on RCBs covering 2009Q1–2013Q4 compiled by the ARB Apex Bank (the supervisory body of RCBs). Inflation and growth in private sector credit have been obtained from the Bank of Ghana.

The descriptive statistics of the data are reported in Table 4. The total number of observations is 2,200. The mean *Z*-score is 2.29. Compared to the mean *Z*-scores from other parts of the world, it can be argued that RCBs in Ghana are more stable. In their study of bank stability and profitability in advanced and emerging economies, Mirzaei et al. (2013) report 1.91 and 2.06 as mean bank stability *Z*-scores for commercial and non-commercial banks, respectively, in emerging economies and 1.09 and 0.99 for commercial and non-commercial banks, respectively, in advanced economies. In terms of RAROA, whereas Köhler (2015) reports 2.58 for all banks in 15 EU countries between 2002 and 2011, Table 4 shows that the mean RAROA of RCBs is 1.55, suggesting that the returns of RCBs in Ghana are more volatile than the returns of banks in the 15 EU countries. This may be attributed to the risky nature of rural financial intermediation. With respect to RAEA, whereas Köhler (2015) finds 31.24 as the mean score of RAEA for all banks in the 15 EU countries, the mean score for RCBs in Ghana reported in Table 4 is 0.03, suggesting that banks in the 15 EU countries are better capitalized than RCBs in Ghana. Obviously, there is enough justification to suggest that RCBs require recapitalization. The mean size of RCBs in Ghana in natural logarithm terms is 15.62. This contrasts with the

Table 4. Descriptive statistics

Statistic	Z-score	RAROA	RAEA	BSIZE	DIV	ROE (%)	ROA (%)	LRISK	CRISK	FUND-RISK	INFL	FIND-EV	GDP	DEPO
Mean	2.29	1.55	0.03	15.62	0.29	85.43	2.26	16.38	45.12	1.64	11.75	27.41	9.36	15.32
Maximum	69.41	4.95	0.22	18.85	0.86	4,721.77	69.41	2,664.5	4,973.99	6.44	9.47	27.59	10.19	17.75
Minimum	−26.97	−2.76	0.00	12.56	0.00	−663.84	−26.97	−1.66	0.00	0.09	20.7	51.44	8.49	11.76
Std. Dev.	2.85	1.20	0.02	0.93	0.14	141.66	2.85	56.87	142.97	0.73	8.4	9.7	0.60	0.95
Observa-tions	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200	2,200

Notes: *Z*-score is bank stability *Z*-score, RAROA is risk-adjusted return on assets, RAEA is risk-adjusted equity to assets ratio, BSIZE is bank size, DIV is diversification, ROE is return on equity, LRISK is liquidity risk, CRISK is credit risk, FUNDRISK is funding risk, INFL is inflation, FINDEV is financial development, GDP is gross domestic product, and DEPO is deposits.
Source: Adusei (2015).

mean bank size of 14.88 in emerging markets banks reported by Mirzaei et al. (2013). On the face of this evidence, it can be concluded that the average rural bank in Ghana is larger than the average bank studied by Mirzaei et al. (2013). The average funding risk *Z*-score is 1.64 which is satisfactory.

6. Results

Table 5 presents the Pearson correlations between pairs of the independent variables. The highest correlation occurs between the two profitability measures: ROE and ROA. Thus, ROE and ROA will not enter one model. ROE is included in the models 5 and 6, whilst ROA is included in model 7. The results of the correlation analysis show that not entering the two profitability measures in one model would mean that the models have passed the multicollinearity test (Bryman & Cramer, 1997).

6.1. Stage one: total assets as proxy for bank size

The empirical results are reported in Tables 6–8. Table 6 reports the results when *Z*-score is used to proxy bank stability. Respectively, Tables 7 and 8 report the results when RAROA and RAEA are used to proxy bank stability. The Hausman tests as well as the redundant FEs tests results reported in Tables 6–8 indicate that the FE model is the optimal estimation technique to use for analysis. In the three tables, the results reject the null hypothesis that the difference between the coefficient of the

Table 5. Pearson correlation matrix

	BSIZE	DEPO	LRISK	CRISK	FUNDRISK	DIV	ROE	ROA	FINDEV	INFL	GDP
BSIZE	1										
DEPO	0.98[a]	1									
LRISK	−0.20	−0.15	1								
CRISK	0.15	0.17	−0.15	1							
FUNDRISK	−0.13	−0.05	0.15	0.09	1						
DIV	0.03	0.06	0.07	−0.43	0.18	1					
ROE	0.46	0.45	−0.08	0.06	−0.27	0.08	1				
ROA	0.17	0.16	−0.04	0.07	0.11	0.12	0.80[b]	1			
FINDEV	0.14	0.14	0.02	0.02	−0.08	−0.13	0.14	0.10	1		
INFL	−0.24	−0.26	0.08	0.02	0.01	−0.03	−0.04	−0.01	0.23	1	
GDP	0.43	0.42	−0.12	0.02	−0.09	−0.08	0.17	0.12	0.39	−0.50	1

Notes: BSIZE is bank size, DEPO is deposits, LRISK is liquidity risk, CRISK is credit risk, FUNDRISK is funding risk, DIV is diversification, ROE is return on equity, ROA is return on assets, INFL is inflation, FINDEV is financial development, and GDP is Gross domestic product.
[a]The correlation between BSIZE (natural logarithm of total assets) and DEPO (natural logarithm of total deposits) is high. Thus, the two do not enter one model.
[b]The correlation between ROE and ROA is high. Thus, the two do not enter one model.
Source: Adusei (2015).

Table 6. Regression results. Dependent variable: *Z*-score

Variable	Full model (2009Q1–2013Q4)			2009Q1–2011Q2			2011Q3–2013Q4		
	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value
BSIZE (−1)	0.2931	4.0392	0.0001***	0.5358	3.8714	0.0001***	0.3774	3.1218	0.0019***
LRISK (−1)	0.0151	0.5794	0.5624	−0.0225	−0.5129	0.6082	0.0172	0.4683	0.6397
CRISK (−1)	−0.0412	−0.9598	0.3373	−0.0448	−0.5881	0.5566	−0.0034	−0.0433	0.9855
FUNDRISK (−1)	0.7298	9.3826	0.0000***	0.3734	2.6598	0.0080***	0.7971	5.4869	0.0000***
DIV (−1)	0.0247	0.7719	0.4403	−0.0057	−0.0780	0.9378	−0.0131	−0.3224	0.7472
ROE (−1)	0.4464	23.0080	0.0000***	0.3207	9.7913	0.0000***	0.3518	12.7647	0.0000***
Constant	−5.8320	−4.9059	0.0000***	−8.7637	−3.9111	0.0001***	−7.0478	−3.4386	0.0006***
	R^2 = 0.71; *N* = 1,899			R^2 = 0.75; *N* = 871			R^2 = 0.74; *N* = 1,028		
	Durbin–Watson stat = 1.8			Durbin–Watson stat = 2			Durbin–Watson stat = 1.8		
	F-statistic = 32.35***			*F*-statistic = 18.52***			*F*-statistic = 20.61***		
	Wald test: $\chi^2(7)$ = 6,360.77***			Wald test: $\chi^2(7)$ = 2,162.97***			Wald test: $\chi^2(7)$ = 4,589.9***		
	Hausman test: $\chi^2(6)$ = 64.79***								
	Likelihood ratio (χ^2) = 1,994.48***								

Notes: *Z*-score is bank stability *Z*-score, BSIZE (−1) is lagged bank size, LRISK is lagged liquidity risk, CRISK (−1) is lagged credit risk, FUNDRISK (−1) is lagged funding risk, DIV (−1) is lagged diversification and ROE (−1) is lagged return on equity.

***Significance at 1% level.

**Significance at 5% level.

Source: Adusei (2015).

fixed and RE models is not significant. This is because the probability of the χ^2 is less than 0.05 (Prob > χ^2 = 0.0000). Thus, the study adopts the FE panel regression model for analysis. The R^2 in all the models ranges between 71 and 88%, the Durbin–Watson statistic is around 2, the *F*-statistic ranges between 16.30 and 68.44 significant at 1% significance level and the Wald test χ^2 values are

Table 7. Panel regression results. Dependent variable: RAROA

Variable	Full model (2009Q1–2013Q4)			2009Q1–2011Q2			2011Q3–2013Q4		
	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value
BSIZE (−1)	0.2780	3.7693	0.0002***	0.5247	3.6432	0.0003***	0.2384	1.9762	0.0484**
LRISK (−1)	0.0201	0.7579	0.4486	−0.0036	−0.0787	0.9373	0.0147	0.4055	0.6852
CRISK (−1)	−0.0436	−0.9988	0.3180	−0.0634	−0.8000	0.4239	0.0212	0.2760	0.7826
FUNDRISK (−1)	0.6689	8.4550	0.0000***	0.2568	1.7510	0.0804	0.5527	3.7839	0.0002***
DIV (−1)	0.0230	0.7073	0.4794	−0.0260	−0.3394	0.7344	0.0077	0.1903	0.8491
ROE (−1)	0.4373	22.0700	0.0000***	0.2872	8.3478	0.0000***	0.3488	12.8001	0.0000***
Constant	−5.9573	−4.9274	0.0000***	−8.8179	−3.7807	0.0002	−5.2031	−2.5457	0.0111***
	R^2 = 0.72; *N* = 1,896			R^2 = 0.73; *N* = 869			R^2 = 0.78; *N* = 1,027		
	Durbin–Watson stat = 1.9			Durbin–Watson stat = 2.06			Durbin–Watson stat = 1.9		
	F-statistic = 34.40***			*F*-statistic = 16.30***			*F*-statistic = 26.48***		
	Wald test: $\chi^2(7)$ = 1,683.27***			Wald test: $\chi^2(7)$ = 405.46***			Wald test: $\chi^2(7)$ = 1,248.68***		
	Hausman test: $\chi^2(6)$ = 25.67***								
	Likelihood ratio (χ^2) = 2,172.32***								

Notes: RAROA is risk-adjusted return on assets, BSIZE (−1) is lagged bank size, LRISK is lagged liquidity risk, CRISK (−1) is lagged credit risk, FUNDRISK (−1) is lagged funding risk, DIV (−1) is lagged diversification and ROE (−1) is lagged return on equity.

***Significance at 1% level.

**Significance at 5% level.

Source: Adusei (2015).

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Table 8. Regression results. Dependent variable: RAEA

Variable	Full model (2009Q1–2013Q4)			2009Q1–2011Q2			2011Q3–2013Q4		
	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value
BSIZE (−1)	0.2891	6.9192	0.0000***	0.2471	3.3282	0.0009***	0.3956	6.0263	0.0000***
LRISK (−1)	−0.0170	−1.1302	0.2585	−0.0570	−2.4109	0.0161	0.0319	1.6161	0.1064
CRISK (−1)	−0.0450	−2.0277	0.0427**	0.0082	0.1995	0.8419	0.0167	0.3979	0.6908
FUNDRISK (−1)	1.3223	33.9867	0.0000***	0.8625	13.0207	0.0000***	0.9589	12.9687	0.0000***
DIV (−1)	−0.0373	−2.0501	0.0405**	−0.0512	−1.2802	0.2009	−0.0041	−0.1870	0.8517
ROA (−1)	0.0010	0.0110	0.9248	−0.0002	−0.0131	0.9896	−0.0166	−1.1253	0.2608
Constant	−8.3570	−12.236	0.0000***	−7.4893	−6.2610	0.0000***	−10.3482	−9.2984	0.0000***
	R^2 = 0.83; *N* = 1,947			R^2 = 0.86; *N* = 898			R^2 = 0.88; *N* = 1,049		
	Durbin–Watson stat = 1.7			Durbin–Watson stat = 1.8			Durbin–Watson stat = 1.8		
	F-statistic = 68.44***			*F*-statistic = 39.82***			*F*-statistic = 53.09***		
	Wald test: $\chi^2(7)$ = 452,660.5***			Wald test: $\chi^2(7)$ = 221,948.4***			Wald test: $\chi^2(7)$ = 333,371.8***		
	Hausman test: $\chi^2(6)$ = 36.51***								
	Likelihood ratio (χ^2) = 3,337.58***								

Notes: RAEA is risk-adjusted equity to assets ratio, BSIZE (−1) is lagged bank size, LRISK is lagged liquidity risk, CRISK (−1) is lagged credit risk, FUNDRISK (−1) is lagged funding risk, DIV (−1) is lagged diversification and ROA (−1) is lagged return on assets.

***Significance at 1% level.

**Significance at 5% level.

Source: Adusei (2015).

all significant at 1% significance level. The results of these diagnostic tests suggest that the models are reliable and thus the results are also reliable.

The effect of size on bank stability has not been completely and satisfactorily resolved. Laeven et al. (2014) find that large banks, on average, create more individual and systemic risk than smaller banks. Köhler (2015) also reports that bank size has a significant negative impact on bank stability, meaning larger banks are less stable than smaller banks. However, Altaee et al. (2013) find that size has no statistically significant impact on bank stability. In Tables 6–8, a robust positive statistically significant impact of size on the stability of a rural bank is observable, suggesting that increasing size of a rural bank implies its improving stability. Indeed, this result is observed even when the data are split. Theoretically, support has been found for the prediction of the concentration-stability hypothesis which submits that increasing bank size implies improving bank stability (Beck et al., 2013; Boot & Thakor, 2000; Uhde & Heimeshoff, 2009) as well as the prediction of the stewardship theory which predicts that increasing size signals good governance and ultimately good stability. The result contradicts the agency theory's postulation that increasing size should signal higher instability. Empirically, this result contradicts the findings of Köhler (2015), Laeven et al. (2014) and Altaee et al. (2013). The five channels through which banking sectors decrease financial fragility delineated by the concentration-stability hypothesis banking come handy as the possible explanation for this result: (1) larger banks may increase profits, building up high "capital buffers", thus allowing them to be less susceptible to liquidity or macroeconomic shocks; (2) larger banks may improve their charter value, dissuading bank managers from extreme risk-taking behaviour; (3) supervisory bodies find larger, but fewer, banks easier to monitor, thus, there is effective supervision in concentrated banking markets which reduces the risk of system-wide contagion; (4) larger banks tend to be subject to providing credit monitoring services; and (5) larger banks enjoy higher economies of scale and scope, therefore, they have the potential to diversify loan-portfolio risks efficiently and geographically through cross-border activities (Mirzaei et al., 2013).

The results in Tables 6–8 show that under all the three measures of bank stability, there is a strong statistically significant positive effect of funding risk on bank stability, implying that an improvement in the bank funding risk results in a higher bank stability. This confirms the a priori prediction of this study that there should be a positive relationship between funding risk and bank stability. As can be observed, this finding is robust even when the data are split. The implication is that a rural bank that shows consistency in its effective deposit mobilization strategy is more likely to be stable than its counterparts. This accords with the empirical literature that the use of larger customer deposit funding is stability enhancing (Demirgüç-Kunt & Huizinga, 2010; Köhler, 2015; Shleifer & Vishny, 2010).

Profitability as measured by ROE has shown a robust positive statistically relationship with bank stability implying that increasing profitability implies increasing stability. This is understandable because, all things being equal, increasing profits would mean more funds for the bank to meet contingencies. High profitability has been linked to high stability in the banking industry because if profits do not flow out to shareholders as dividends, they become part of equity capital which strengthen the capital base of the banks leading to an improvement in bank stability (Flamini, McDonald, & Schumacher, 2009).

Tables 6–8 show that credit risk has a negative relationship with bank stability. However, this relationship is statistically insignificant, except when RAEA is used to measure bank stability. Thus, some confirmation has been found for the a priori prediction of this study that credit risk should be negatively related to bank stability. The implication is that deteriorating lending standards portend dire consequences for the stability of RCBs.

Tables 6–8 indicate that under all the three measures of bank stability, the coefficient of liquidity risk (LRISK) is statistically insignificant. This suggests that liquidity risk is not a significant predictor of rural bank stability in Ghana.

The effect of diversification (DIV) on bank stability is statistically insignificant in Tables 6 and 7. As can be observed, the coefficient of DIV under the full models in Tables 6 and 7 is positive, but when the data are split, it is either negative or positive. However, in Table 8, where bank stability is measured as RAEA, a weak statistically significant negative coefficient of DIV is observed, suggesting that diversification has a negative effect on bank stability.

6.1.1. Robustness check

As indicated above, the three models of bank stability are re-estimated[6] with the inclusion of three external variables (inflation, financial development and GDP). The purpose is to ascertain the effects of bank size and bank funding risk in the midst of variations in inflation, financial development and GDP. The results are reported in Table 9. As evident in the table, the diagnostic checks support the conclusion that the results are reliable.

Consistent with the above results, the coefficient of bank size (BSIZE) is positive under all the three models. However, under the *Z*-score model, the positive coefficient is statistically insignificant. That notwithstanding, generally, the results show that the effect of the size of a rural bank on its stability is robust even in the midst of variations in inflation, financial development and GDP.

The results in Table 9 show that the coefficient of FUNDRISK is positive under all the three models. This underscores the robustness of the effect of funding risk on rural bank stability. The implication is that funding risk positively explains the variations in rural bank stability irrespective of the variations in inflation, financial development and GDP.

The coefficient of inflation (INFL) is positive and statistically significant under all the three models, suggesting that inflation supports rural bank stability. In effect, an increase in inflation in one quarter results in an improvement in rural bank stability in the next quarter. The implication is that RCBs in Ghana properly anticipate inflation and adjust the prices of their services accordingly. This is in alignment with the postulation of Perry (1992) that inflation should positively affect bank stability when it is anticipated and factored into the pricing process.

Table 9. Results of robustness analysis with inflation, financial development and GDP as additional control variables

	Dependent variables								
	Z-score			RAROA			RAEA		
Variables	**Coefficient**	***t*-value**	***p*-value**	**Coefficient**	***t*-value**	***p*-value**	**Coefficient**	***t*-Value**	***p*-Value**
Constant	−4.7175	−7.6657	0.0000***	−6.8283	−9.8071	0.0000***	−5.1067	−13.1573	0.0000***
BSIZE (−1)	0.0109	0.3275	0.7433	0.1618	3.7554	0.0002***	0.1011	3.4623	0.0005***
LRISK (−1)	0.0215	0.6064	0.5443	0.0472	1.2659	0.2057	−0.0225	−1.5102	0.1312
CRISK (−1)	0.0414	0.7944	0.4270	0.1549	2.7181	0.0066***	−0.0605	−2.4991	0.0125***
FUNDRISK (−1)	0.3722	5.8295	0.0000***	0.2541	3.3042	0.0010***	1.2093	33.3338	0.0000***
DIV (−1)	0.0040	0.1119	0.9109	−0.0283	−0.6964	0.4863	−0.0394	−2.2271	0.0261**
ROE (−1)	0.2652	13.5270	0.0000***	0.2134	10.2689	0.0000***			
INFL (−1)	0.6851	9.0116	0.0000***	0.6848	8.8177	0.0000***	0.1538	5.0661	0.0000***
FINDEV (−1)	−0.0959	−2.5335	0.0114***	−0.0970	−2.5146	0.0120***	−0.0414	−2.7687	0.0057***
ROA (−1)							−0.0067	−0.8068	0.4199
GDP	0.2686	5.9559	0.0000***	0.167021	3.436372	0.0006***	−0.0897	−3.8239	0.0001***
	R^2 = 0.13; *N* = 1,899			R^2 = 0.12; *N* = 1,896			R^2 = 0.43; *N* = 1,947		
	Durbin–Watson stat = 1.9			Durbin–Watson stat = 1.9			Durbin–Watson stat = 1.6		
	F-statistic = 32.02***			*F*-statistic = 27.55***			*F*-statistic = 162.67***		
	Wald test: $\chi^2(10)$ = 1,095.963***			Wald test: $\chi^2(10)$ = 242.981***			Wald test: $\chi^2(10)$ = 8,283.080***		

Notes: *Z*-score is bank stability *Z*-score, RAROA is risk-adjusted return on assets, RAEA is risk-adjusted equity-to-asset ratio, BSIZE (−1) is lagged bank size, LRISK is lagged liquidity risk, CRISK (−1) is lagged credit risk, FUNDRISK (−1) is lagged funding risk, DIV (−1) is lagged diversification and ROE (−1) is lagged return on equity.

***Significance at 1% level.

**Significance at 5% level.

Source: Adusei (2015).

A negative statistically significant relationship between financial development and bank stability under all the three measures of bank stability is evident in Table 9, suggesting that an improvement in financial development in one quarter results in a decline in the stability of a rural bank in the next quarter.

Under the *Z*-score and RAROA models, GDP shows a positive and statistically significant impact on bank stability. On the other hand, under the RAEA model, a negative statistically significant impact of GDP on bank stability is observed. However, since the coefficient of GDP is weak under the RAEA model (approximately −0.09), it can be argued that GDP has generally supported bank stability.

Generally, the other control variables have maintained their effects on bank stability, suggesting that the results in Tables 6–8 are robust.

6.2. Stage two: deposits (DEPO) as proxy for bank size

To further explore the impact of bank size and funding risk on bank stability, bank size is proxied with bank deposits. The results of the regression estimations using deposits as proxy for bank size are reported in Tables 10 and 11. The Hausman tests as well as the redundant FE tests results reported in Table 10 show that the FE model is the optimal estimation technique to use for analysis. Thus, the FE panel regression model is used for estimation. The R^2 in all the models ranges between 71 and 87%, the Durbin–Watson statistic is around 2, the *F*-statistic ranges between 32.02 and 90.95 significant at 1% significance level and the Wald test χ^2 values are all significant at 1% significance level. The results of these diagnostic tests suggest that the results are reliable. This same conclusion can be made about the results reported in Table 11. In Table 11, R^2 ranges from 11 to 43%, the *F*-statistic

Table 10. Regression results with deposits (DEPO) as proxy for bank size without macroeconomic variables

Variable	Dependent variables								
	Z-score			RAROA			RAEA		
	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value
DEPO (−1)	0.1269	1.8415	0.0657*	0.1144	1.6339	0.1025*	0.0031	0.0778	0.9380
LRISK (−1)	0.0076	0.2870	0.7741	0.0131	0.4900	0.6242	−0.0193	−1.2600	0.2078
CRISK (−1)	−0.0645	−1.5122	0.1307	−0.0659	−1.5201	0.1287	−0.0750	−3.0395	0.0024***
FUNDRISK (−1)	0.6373	8.6515	0.0000***	0.5798	7.7437	0.0000***	1.2036	32.8820	0.0000
DIV (−1)	0.0148	0.4497	0.6530	0.0142	0.4266	0.6697	−0.0344	−1.8126	0.0701*
ROE (−1)	0.4452	22.8106	0.0000***	0.4362	21.8946	0.0000***	–	–	–
ROA (−1)							0.0016	0.1413	0.8876
Constant	−3.0538	−2.8195	0.0049***	−3.2276	−2.9321	0.0034***	−4.1296	−6.5740	0.0000***
	R^2 = 0.71; *N* = 1,899			R^2 = 0.72; *N* = 1,896			R^2 = 0.87; *N* = 1,947		
	Durbin–Watson stat = 1.8			Durbin–Watson stat = 1.9			Durbin–Watson stat = 1.8		
	F-statistic = 32.02***			*F*-statistic = 34.09***			*F*-statistic = 90.95***		
	Wald test: $\chi^2(7)$ = 6,301.814***			Wald test: $\chi^2(7)$ = 1,660.89***			Wald test: $\chi^2(7)$ = 440,969.7***		
	Hausman test: $\chi^2(6)$ = 76.683***			Hausman test: $\chi^2(6)$ = 28.46***			Hausman test: $\chi^2(6)$ = 80.35***		
	Likelihood ratio (χ^2) = 1,972.67 ***			Likelihood ratio (χ^2) = 2,164.92 ***			Likelihood ratio (χ^2) = 3,230.43 ***		

Notes: *Z*-score is bank stability *Z*-score, RAROA is risk-adjusted return on assets, RAEA is risk-adjusted equity-to-asset ratio, BSIZE (−1) is lagged bank size, LRISK is lagged liquidity risk, CRISK (−1) is lagged credit risk, FUNDRISK (−1) is lagged funding risk, DIV (−1) is lagged diversification and ROE (−1) is lagged return on equity.

***Significance at 1% level.

*Significance at 10% level.

Source: Adusei (2015).

ranges between 0.33 and 160. 60 significant at 1%, the Durbin–Watson statistic is around 2 and Wald test χ^2 values are all significant at 1% significance level.

In Table 10, DEPO has a positive coefficient under all the three measures of bank stability except that under RAEA, the coefficient is statistically insignificant. The positive statistically significant coefficient of DEPO is observed in Table 11 under the RAROA measure of bank stability. However, under the *Z*-score and RAEA measures of bank stability, the results in Table 11 show that the inclusion of inflation, financial development and GDP makes the coefficient of DEPO negative. However, this is statistically insignificant. That notwithstanding, generally, these results underscore the fact that the effect of size on rural bank stability is positive.

Tables 10 and 11 indicate that the coefficient of FUNDRISK is positive and statistically significant under all measures of bank stability. The obvious implication is that there is a robust positive relationship between the funding risk of a rural bank and its stability.

In line with the results in Table 9 when bank size is measured as natural logarithm of total assets, inflation, financial development and GDP have maintained their effects on bank stability. Thus, these results establish the robustness of the results in Table 9.

7. Discussion of key findings

The demise of one bank has serious pervasive ramifications for the financial system in particular as well as the economy in general. The news that a bank has become extinct triggers bank panic which could send the other banks in the industry tumbling. In the long run, customer confidence is lost resulting in low deposits and low investment. The cumulative effect is that economic growth is

Table 11. Regression results with deposits as proxy for bank size including macroeconomic variables as control variables

Variables	Dependent variables								
	Z-score			RAROA			RAEA		
	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value	Coefficient	*t*-Value	*p*-Value
Constant	−4.2656	−7.2099	0.0000***	−6.2654	−9.3327	0.0000***	−3.5036	−9.5829	0.0000***
DEPO (−1)	−0.0360	−1.1601	0.2461	0.1151	2.7560	0.0059***	−0.0452	−1.5956	0.1107
LRISK (−1)	0.0189	0.5352	0.5926	0.0390	1.0461	0.2956	−0.0213	−1.4037	0.1606
CRISK (−1)	0.0489	0.9452	0.3447	0.1504	2.6289	0.0086***	−0.0678	−2.7845	0.0054***
FUNDRISK (−1)	0.3802	6.1285	0.0000***	0.2265	2.9611	0.0031***	1.1498	32.8000	0.0000***
DIV (−1)	0.0152	0.4240	0.6716	−0.0348	−0.8478	0.3967	−0.0333	−1.8299	0.0674*
ROE (−1)	0.2769	14.2012	0.0000***	0.2180	10.4797	0.0000***			
INFL (−1)	0.6753	8.8563	0.0000***	0.6836	8.7618	0.0000***	0.1226	3.9534	0.0001***
FINDEV (−1)	−0.0953	−2.5150	0.0120***	−0.0988	−2.5574	0.0106***	−0.0379	−2.5017	0.0124***
ROA (−1)							−0.0053	−0.6344	0.5259
GDP	0.2939	6.5754	0.0000***	0.1919	3.9618	0.0001***	−0.0056	−0.2380	0.8119
	R^2 = 0.14; *N* = 1,899			R^2 = 0.11; *N* = 1,896			R^2 = 0.43; *N* = 1,947		
	Durbin–Watson stat = 1.9			Durbin–Watson stat = 1.9			Durbin–Watson stat = 1.6		
	F-statistic = 33.00***			*F*-statistic = 26.75***			*F*-statistic = 160.60***		
	Wald test: $\chi^2(10)$ = 1,187.70***			Wald test: $\chi^2(10)$ = 316.98***			Wald test: $\chi^2(10)$ = 8,492.70***		

Notes: *Z*-score is bank stability *Z*-score, RAROA is risk-adjusted return on assets, RAEA is risk-adjusted equity-to-asset ratio, BSIZE (−1) is lagged bank size, LRISK is lagged liquidity risk, CRISK (−1) is lagged credit risk, FUNDRISK (−1) is lagged funding risk, DIV (−1) is lagged diversification and ROE (−1) is lagged return on equity.

***Significance at 1% level.

**Significance at 5% level.

*Significance at 10% level.

Source: Adusei (2015).

stunted and the far-reaching implications are obvious. It is for this reason that after the 2007/2008 global financial crisis, the ongoing intellectual and policy debate has been whether or not policy-makers should constrain bank size as a way of circumventing the recurrence of the crisis. As noted in the introduction to this paper, regulators in the US (under the Dodd Act, 2010) and in the European Union [as in recommendations by the Liikanen (2012) implemented into EC law as well the recommendations by the Vickers Report (2011) implemented into UK law] are making frantic efforts at constraining bank size by demanding more capital and liquidity in line with Basel III requirements as well as restricting banks' involvement in riskier areas of activity. These interventions have been occasioned by the evidence that loose deregulation of the financial sector that fostered increasing bank size was largely responsible for the global financial crisis. The question that arises from the finding that size improves bank stability is, is the call for bank size moderation applicable to RCBs? To the extent that increasing bank size supports stability of RCBs, it is the contention of this paper that any attempt to put some hurdles on the growth trajectory of RCBs in the name of size control may not augur well for them. They should be given the necessary impetus to scale up their operations within the confines of prudential banking standards. They should be allowed to grow insofar as the growth is supported with adequate capitalization and liquidity.

The study has shown that funding risk supports bank stability. Thus, RCBs that are able to map out effective strategies for mobilizing more deposits are likely to improve their stability. However, the task of mobilizing more deposits has always been daunting for RCBs because of their demarcated geographical areas of operation. RCBs offer financial intermediary services to the rural communities where abject poverty is endemic. This has made deposit mobilization challenging for them. One activity that could help the deposit mobilization drive is agriculture. Part of the rationale for introducing the RCBs was the facilitation of cocoa purchase in the rural cocoa growing areas through the special Akuafo cheque system. Unfortunately, owing to high illiteracy levels in the rural communities, most cocoa farmers are reluctant to receive payment for their cocoa yield through the system. Beyond the issue of illiteracy, administrative processes of RCBs also undermine the smooth operation of the Akuafo Cheque system. Cocoa farmers have expressed misgivings about the processes they go through when they accept Akuafo cheques. Their main complaint has been that there are rigmarole procedures at the banking halls of RCBs when they turn up to cash their cheques. So to avoid the drudgery involved in cashing their cheques, they prefer taking cash at the point of sale to receiving cheques. The General Manager of one of the RCBs indicates that lack of confidence in the special Akuafo cheque system coupled with increasing poverty in the rural communities has compelled almost all RCBs to open branches[7] in the urban areas. The concern of many market watchers and analysts is that the expansion of RCBs into the urban communities defeats the purpose for introducing the rural banking system as a special development banking model to promote rural financial intermediation. Is it plausible, on the basis of the current finding, to suggest that to ensure the sustainability of RCBs, regulators should officially allow them to spread their operations beyond their current rural domain? The answer is not farfetched. Judging from the fact that not much economic activity takes place in the rural communities for which reason income levels of rural dwellers are low, the current rural banking model that restricts them to only rural areas is yearning for review. To avoid instability in the rural banking industry and its accompanying problems, it is the contention of this paper that the rural banking regulation should be amended to allow RCBs into the urban communities for more deposit mobilization to improve their stability. However, the extent to which a rural bank can expand should be clearly defined to avoid the horrors of over expansion. The decision to allow RCBs into the urban centres should come with the caveat that a percentage of their loan portfolio should go into agriculture. Indeed, allowing RCBs to move into the urban areas with some restrictions will help rural communities because deposits mobilized in the urban centres could be offered as loans to rural dwellers that will go a long way to reduce rural poverty as well as boost agriculture which is the mainstay of the Ghanaian economy.

8. Conclusion and policy implications

The purpose of this study is to examine the impact of bank size and bank funding risk on bank stability with quarterly data (2009Q1–2013Q4) from the rural banking industry in Ghana. Panel ordinary least squares regression technique with FE has been used for analysis. The study uses diversification, credit risk, liquidity risk, profitability, inflation, financial development and GDP as control variables. The data provide robust evidence that both bank size and bank funding risk positively impact bank stability.

One policy implication of this study is that thought of constraining bank size as a way of safeguarding the financial system that has been gathering increasing momentum since the 2007/2008 global financial crisis may not be in the best interest of RCBs in Ghana. This is because the study has shown that increasing bank size leads to increasing stability. It is, therefore, submitted that, within the parameters of prudential banking standards, RCBs should be encouraged to scale up their operations.

To the extent that funding risk supports bank stability, it is recommended that RCBs should intensify their deposit-mobilization efforts to improve their stability. It is the position of this study that since customer deposits are stability-supporting and income levels of rural communities are low, RCBs should be allowed to expand into the urban areas where income levels are relatively higher. Doing this will ensure the stability of the RCBs and ultimately insulate the entire financial system from any ills that emanate from bank collapse. Opening agencies in strategic locations as well as introducing innovative banking techniques such as bank on wheels strategy[8] that will enable RCBs penetrate into hinterlands to reach out to the unbanked should be explored.

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Notes

1. In this paper, rural banks and RCBs are used interchangeably.
2. This has been revised. The Bank of Ghana in a recent notice dated 3rd July, 2015 has stated that the minimum paid-up capital requirement for obtaining a Rural/Community banking licence is GH¢1,000,000.00 (One Million Ghana Cedis). The transitional arrangements are as follows: All licensed RCBs are to raise their minimum paid-up capital to GH¢300,000.00 (Three Hundred Thousand Ghana Cedis) by 31st December 2015, GH¢500,000.00 (Five Hundred Thousand Ghana Cedis) by 31st December 2016 and GH¢1,000,000.00 (One Million Ghana Cedis) by 31st December 2017.
3. US$1 = GH¢ 4.
4. The funding risk *Z*-score has been developed by Adusei (2015).
5. However, the REs model is used for estimation when inflation, financial development and GDP are included in the models.
6. The re-estimation is done using the REs estimation technique.
7. The branches have been camouflaged as agencies to circumvent the law that established the RCBs.
8. Bank on wheels strategy is a new banking technique where banks try to reach out to the unbanked through the use of special purpose vehicles.

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