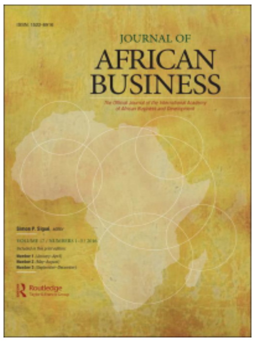

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Bank Deposit Mobilization, Loan Advancement and Financial Stability: The Role of Bank Branches in an Emerging Market

Baah Aye Kusi[a,b,c], Lord Mensah[b] and Elikplimi Agbloyor[b,d]

[a]Department of Banking and Finance, Central University, Miotso, Ghana; [b]Department of Finance, University of Ghana Business School, Accra, Ghana; [c]Department of Integrated Marketing, Ghana Institute of Journalism Integrated Marketing, Accra, Ghana; [d]Stellenbosch University South Africa, Stellenbosch, South Africa

ABSTRACT
This study investigates the relationship between bank branches, financial intermediation, and financial stability in Ghana using 35 banks between 2009 and 2017. Employing a panel two-step dynamic GMM model, a non-linear "inverted U-shaped" relationship is documented between bank branches and financial stability. This implies that initial increases in bank branches promote financial stability but beyond 191 and 173 bank branches, bank branching derails banking stability. The findings further reveal that bank branches enhance the positive effects of deposits on bank stability whilst reducing the negative consequences of bank lending on financial stability. These findings imply that while bank management can rely on bank branches to enhance loans and deposits in promoting banking stability, bank management should also be cautious about the number of bank branches they keep given that beyond a certain threshold it may impede stability.

KEYWORDS
Banks; Deposits; Loans; Stability; Branches

Introduction

The financial intermediation theory suggests that banks are rational economic agents who undertake financial intermediation functions with the aim of maximizing their gains (Ho & Saunders, 1981; Kusi, Agbloyor, Gyeke-Dako, & Asongu, 2020; Kusi, Kriese, Nabieu, & Agbloyor, 2021). That is, the core financial intermediation functions performed by banks include mobilizing deposits and savings from surplus spending units and transforming those deposits and savings into loans and investments for deficit spending units who have viable and profitable economic ventures (Karikari, Gyan, Khan, & Kusi, 2021; Kusi et al., 2020). Interestingly, the performance of these mentioned intermediation functions largely depend on the coverage and reach of banks which is defined by the number of branches a bank has. Arguably, banks have evolved from operating from a single unit or branch to operating from multiple units or branches especially with the revolutionary advancement in technology which enables banks to engage seamlessly with their clients (Asongu, 2015).

CONTACT Elikplimi Agbloyor ekagbloyor@gmail.com Department of Finance, University of Ghana Business School, +233(0)244973939 P.O.BOX LG 78, Legon-Ghana

Interestingly, some empirical studies view bank branches as a geographical diversification mechanism through which banks reduce the risks associated with their financial intermediation functions (mobilizing deposits and granting loans). For instance, Paradi, Rouatt, and Zhu (2011) advanced that deposit mobilization is a strong feature of an efficient bank branch as it helps the bank to diversify its deposits against huge withdrawals by depositors especially during a bank run episode. This therefore reduces withdrawal shocks, inability to settle deposits on demand and the inability of the bank to satisfy loan request it deems profitable. Similarly, Meslier, Morgan, Samolyk, and Tarazi (2016) empirically show that bank branches allow banks to pool and share default risk for both small and large banks in the USA. Other empirical studies have shown that bank branches help banks to reduce risk (Meslier, et al., 2016., 2016), improve value creation or performance (Yildirim & Efthyvoulou, 2018; Meslier et al., 2016; Brighi & Venturelli, 2016), enhance growth potentials (La Plante & Paradi, 2015) and improve efficiency (Ray, 2016; Paradi et al., 2011).

Despite these empirical studies on bank branches, there are some critical questions which the extant empirical literature is yet to provide evidence and answers to especially in the context of Ghana and Africa at large. For instance, (i) what is the effect of bank branches on banking stability?,(ii) are there possible threshold effects of bank branches on banking stability? and (iii) does bank branches complement financial intermediation functions (deposit mobilization and loan advancement) to improve stability? are some critical questions which this study seeks to answer. We argue and link bank branches to banking stability based on prior studies that show that bank branches have risk reducing effects (Meslier et al., 2016) and hence, the risk reducing effect of bank branches should translate into improving banking stability although not empirically established. Moreover, banking stability has become a matter of importance and urgency for policymakers and regulators especially after the 2007–2009 global financial crisis given that worsening banking stability can make or break the world's economy (Crotty, 2009). While we argue that the risk reducing nature of bank branches resides in the law of large numbers (Amini, Cont and Minca, 2012; Sirignano & Giesecke, 2019) which involves pooling and sharing financial intermediation risks across different geographical and bank clients to improve banking stability, we further provide evidence on possible nonlinear threshold effects of bank branches on banking stability. Our argument on nonlinear threshold effect stems from the economies and diseconomies of scale hypotheses (see Beccalli & Rossi, 2020; Boot, 2017) that show that increasing bank branches may not be beneficial beyond a certain threshold due to increased branch set-up and operating costs, bureaucracies, ineffective monitoring, and supervision. Moreover, given that bank branches are established to advance the cause of deposit mobilization and loan advancement, we again contend that the risk-reducing effect of bank branches should modulate the nexus among financial intermediation functions to improve banking stability although such evidence is nonexistent in the empirical literature on bank branches and stability.

In view of the above, this study contributes to the bank branch network and banking stability literature by providing to the best of our knowledge first time evidence on possible threshold effects of bank branches on banking stability and the

Table 1. Yearly Trends in Bank Branches, Loans Advancements and Deposits Mobilization.

Year	Branch	Loans	Deposits	Branch Growth	Loan Growth	Deposit Growth
2009	27	54.45	66.04			
2010	29	39.45	69.35	7.407	−27.548	5.012
2011	29	42.16	68.41	0.000	6.869	−1.355
2012	34	42.29	69.1	17.241	0.308	1.009
2013	34	41.44	61.79	0.000	−2.010	−10.579
2014	37	44.11	62.51	8.824	6.443	1.165
2015	39	42.26	67.42	5.405	−4.194	7.855
2016	46	33.9	63.62	17.949	−19.782	−5.636
Average	**34.375**	**42.5075**	**66.03**	**8.118**	**−5.702**	**−0.361**

Computed based on data from Bank of Ghana

modulating effect of bank branches on financial intermediation functions (deposit mobilization and loan advancement) on banking stability in Ghana. The rest of the paper is organized as follows: overview of bank branch network in Ghana, literature review, methodology, empirical results and discussions and conclusions and policy recommendations.

Overview of bank branch network in Ghana

In this section an overview is reported on bank branches, loans advanced and deposits mobilized. The overview spans between 2009 and 2016 for 35 banks. From Table 1 which reports on the above mentioned variables, it is reported that on the average each of the 35 banks have 34 branches over the sample period (2009–2016). Given an average bank branches of 34 branches per bank, average loans advanced and deposits mobilized as a percentage of total assets for the sample period are 42.50% and 66.03% on the average. This is an indication that given the average bank branches of 34 branches, banks are able to mobilize 66.03% of total assets as deposits while advancing on the average 43% of assets as loans.

From Table 1, the lowest and highest average industry bank branches of 27 and 46 branches were reported in 2009 and 2016, respectively. Thus, the number of bank branches have increased steadily as the economy has grown. With respect to bank loans, lowest and highest industry level bank loan advanced are reported in 2016 and 2009, respectively. Thus, the lowest and highest bank loan to total assets are 33.9% and 54.45%. This shows that the lending appetite of banks has reduced. This reduction in lending appetite coincided with an increase in non-performing loans (NPL) in the banking sector. For example, the NPL ratio in 2014 was 11.3%. This had risen to 21.6% in 2017. Indeed, this decline in quality of the loan book of the banking industry is one of the reasons that necessitated the banking sector clean up by the Bank of Ghana between mid 2017 to the end of 2018. Similarly, the highest and lowest deposit to assets were 69.35% in 2010 and 61.79% in 2013 respectively. Interestingly, constantly across all the years, deposits mobilized exceeds loans advanced. In terms of growth, while bank branches increased by 8.12% on the average, loans and deposits declined by 5.70% and 0.36% during the years under study. This is interesting because increasing bank branches should increase both deposit mobilization and loan advancement although the figures in Table 1 shows otherwise.

Literature review

From a theoretical perspective, banks operate on the financial intermediation theory where they aim at profiting from the intermediation activities of mobilizing deposits from surplus spending units and transforming the deposits into loans for deficit spending units who have viable and valuable ventures (Ho & Saunders, 1981; Kusi et al., 2020; Kusi, Kriese et al., 2021). The performance of these intermediation functions by banks are built on the establishment of bank branches which have geographical diversification effects on bank risk and stability (Le, Nguyen, & Tran, 2020). Interestingly, the geographical diversification nature of bank branch establishment is supported by the classical portfolio theory which advance that geographical expansion can lower banking risk (see Goetz, Laeven, & Levine, 2016; Le et al., 2020). Again, establishing bank branches reinforces the law of large numbers concept which banking is built on (Giesecke, Schwenkler, & Sirignano, 2020; Robatto, 2019; Sirignano & Giesecke, 2019). Thus, bank branches help banks to pool and share risk among financial market participants, ensure a well-diversified loan and deposit portfolio and helps mobilize many-small deposits against withdrawals from huge depositors. Thus, bank branches viewed as a geographical diversification tool afford banks the capacity to reduce banking and intermediation risks and translate into improving banking stability although the effect of bank branches on banking stability is scarce and limited in the empirical literature in the context of Ghana and Africa at large. While establishing bank branches can reduce banking risks, it can be argued from the economies and diseconomies of scale concept that some thresholds of bank branches may have beneficial and detrimental effects on banking stability, respectively. The thresholds for which bank branches can be beneficial and detrimental for banking stability is yet to be established especially in the context of Ghana.

In terms of empirical literature, some existent studies view bank branch network as a geographical diversification tool. While majority of bank branch network papers focus on how it affects efficiency (LaPlante & Paradi, 2015; Ray, 2016), liquidity (Gilje, Loutskina, & Strahan, 2016), profitability (Brighi & Venturelli, 2016; Cai, Xu, & Zeng, 2016; Meslier et al., 2016), risk (Meslie et al., 2016; Goetz et al., 2016), value enhancement (Cai et al., 2016; Yildirim & Efthyvoulou, 2018), evidence on how bank branches affect banking stability is less discussed in the empirical literature. Because we ride on the back of the relationship between geographical diversification as represented by bank branches, our discussion focuses on prior studies on geographical diversification and banking risks. Hence, the first part of this empirical review focuses on the relationship between geographical diversification and banking risks while the second part speaks to prior studies on how geographical diversification influences other banking sector variables.

First, Chu, Deng & Xia (2020) examined the causal effect of geographical diversification on systemic risk using quarterly data on 392 unique bank holding companies between 1986 and 1997. Employing multiple modeling techniques, the results reveal that bank's geographical diversification increases systemic risk measures with change in conditional value at risk and financial integration. Thus, the channel through which geographical diversification affects risk is through asset similarities. Also, Zamore, Beisland, and Mersland (2019) studied the effect of geographical diversification on credit risk in microfinance institutions. Using both static and dynamic models of 657 microfinance institutions across 88 economies covering periods between 1998 and 2015, their results show that the overall effect of geographical diversification is positive on credit risk. The positive effect of geographical diversification is profound for non-shareholder microfinance institutions like cooperatives and NGOs. However, the results show that the increasing effect of geographical diversification on credit risk can be mitigated through group lending methodology. Similarly, Le et al. (2020) examined the effect of geographical loan expansion on banking risk using data on 53 economies between 2005 and 2016. Employing dynamic system generalized method of moments, their results show that global expansion tends to increase bank insolvency and reduce bank adjusted-risk performance. Additionally, the results reveal that loans disbursed to advance markets reduce banking stability while loans disbursed to emerging markets and developing economies have the potential to improve bank solvency and risk-adjusted performance. Additionally, Meslier, Morgan and Samolyk (2016) examined how a bank's geographical diversification within and across states in the US can be beneficial for the bank's risk and return between 1994 and 2008. They show that benefits associated with geographical diversification depends on the size a bank. Specifically, the findings show that for small banks, only intrastate diversification increases risk-adjusted returns and reduces default risk while for large banks interstate diversification are beneficial for reducing default risk. Furthermore, they show that in all cases, there is a U-shape relationship between geographical diversification and risk and return indicating that there is a turning point where the possible agency costs associated with banks getting wide and more geographically diversified outweighs the benefits associated with geographical diversification. Furthermore, Goetz et al. (2016) examined the impact of geographical expansion on banks risk for banks across US metropolitan statistical areas. The findings show that for the average bank holding company, geographical expansion substantially reduces bank risk but does not affect loan quality. These findings are consistent with arguments that geographical expansion lowers bank risk by reducing idiosyncratic local risks.

On the effect of geographical diversification on other banking sector variables, Ray (2016) examined overall cost efficiency and bank branch network for a large public sector bank in India. Employing the branches of the public bank in the city of Calcutta, he presents evidence of over-branching which leads to cost inefficiency. However, he also shows that there are numerous instances, where increasing the number of branches within a market area would be optimal. This finding indicates the effect of bank branching is not straight forward and could be a nonlinear one. Similar papers including La Plante and Paradi (2015) and Paradi et al. (2011) have examined bank branch network and banking efficiency. Moreover, Gilje et al. (2016) investigated how bank branches help integrate US lending markets by facilitating market liquidity. They argue that bank branch network continue to play a key role in financial integration by facilitating liquidity within the financial market and among oil firms, despite the development of securitization markets. Furthermore, Brighi and Venturelli (2016) investigated the effect of functional and geographical diversification on bank performance during 2008 and 2010-financial and sovereign crises, respectively. Employing a bank panel data of 491 banks in Italy between 2006 and 2012, they show that while geographical diversification promotes risk adjusted profitability by enhancing the banks' ability to absorb local systematic risk, geographical distance from headquarters reduces stability and profitability given weak oversight, monitoring and supervision responsibilities resulting from the distance between the headquarters and branches. Other similar studies that show how geographical diversification influence bank performance and value includes Yildirim and Efthyvoulou (2018) and Cai et al. (2016).

From the review, several studies have investigated how bank branches viewed as a geographical diversification tool influence banking sector variables and operations. What is missing or less discussed in the empirical literature especially in the context of Ghana is how bank branches (geographical diversification) influence banking stability although there are theoretical and intuitive underpinnings that suggest that the risk reducing effects of diversification should lead to improved stability. Again, the varying views presented on the effect of bank branches on banking risks coupled with the economies and diseconomies of scale hypotheses raise issues of possible nonlinear threshold effects of bank branches on banking stability. Consequently, we hypothesize that the risk reducing effect of bank branches (geographical diversification) that should promote banking stability is nonlinear. Again, we hypothesize that the risk reducing effect of bank branches complements deposits mobilization and loan administration (financial intermediation activities) of banks to promote banking stability.

Methodology

The study examines the effect of bank branch network on bank stability and its modulating role in the nexus between financial intermediation activities and banking stability in Ghana from 2009 to 2016. The data used for this study is sourced from Bank of Ghana (BoG) and World Development Indicators databases (WDI). The study employs a panel of 35 banks in Ghana in a random effect and two-step Generalized Methods of Moments (GMM) estimation. While the random effect model examines this relationship in a static setting, the GMM examines this relationship in a dynamic setting. However, the GMM results are preferred and relied upon for a number of reasons. First, the GMM estimation procedure is a good fit for models that exhibit high persistence in the dependent variable (Asongu, Le Roux & Nwuchukwu, 2019). Checking for persistence in the dependent variable we observe that our stability model exhibits high correlation above 0.8 threshold required between the dependent variable and its lag which makes the GMM appropriate for our modeling of banking stability. Second, the GMM provides more efficient results when the number of cross sections (in this case banks (N)) is higher than the number of time series (T) which is the case in this study where the number of banks (35) is more than the number of years (9) (Asongu, Le Roux and Nwuchukwu, 2019). Third, Arellano and Bond (1991) and Arellano and Bover (1995) argue that GMM provide more reliable results because of its ability to capture the speed of adjustment. Four, the GMM is easier to implement in dealing with endogeneity since it generates its own instruments consistent with the orthogonality conditions that exist between the error term and the lagged variable and does not require the researcher to identify intuitively and theoretical appropriate and sound instruments which are nearly impossible to identify (Tchamyou, 2020). Five, following Arellano and Bond (1991) and Arellano and Bover (1995), the use of the forward orthogonal GMM technique, minimizes the gaps that are missing observations present in the dataset. Six, the GMM is argued to be more robust in dealing with omitted variable biases, autocorrelation and heteroscedasticity (Windmeijer, 2005).

In providing evidence on how bank branches influence banking stability, equations 1 and 2 presents the baseline effect of bank branches on banking stability while equations 3 and 4 present the nonlinear threshold effect of bank branches on banking stability. Equations 5 and 6 report on the modulating effect of bank branches on the relationship between deposits and stability and loans and banking stability. Our banking stability model is broadly explained by bank level factors (lag of the dependent variable, bank branches and its square term, interaction between deposits and bank branches, interaction between loans and bank branches, efficiency, size, capitalization, nonperforming loans, loans and deposits), macroeconomic level factors (gross domestic product per capita, inflation and employment) and an error term ($\boldsymbol{\varepsilon_{it}}$) (comprising of bank specific errors, time specific errors and idiosyncratic error). The dynamic models for this study are expressed as follows:

Bank stability models

Baseline effect of bank branch on banking stability

$$LNZSCORE_{it} = \beta_1 LNZSCORE_{it-1} + \beta_2 BRANCH_{it} + \beta_3 EFFICIENCY_{it} + \beta_4 SIZE_{it} + \beta_6 CAPITALRATIO_{it} + \beta_6 NPLRATIO_{it} + \beta_7 LOANRATIO_{it} + \beta_8 GDPPC_t + \beta_9 INFLATION_t + \beta_{10} UNEMPLOYMENT_t + \varepsilon_{\mathbf{it}} \quad (1)$$

$$LNZSCORE_{it} = \beta_1 LNZSCORE_{it-1} + \beta_2 BRANCH_{it} + \beta_3 EFFICIENCY_{it} + \beta_4 SIZE_{it} + \beta_6 CAPITALRATIO_{it} + \beta_6 NPLRATIO_{it} + \beta_7 DEPOSITRATIO_{it} + \beta_8 GDPPC_t + \beta_9 INFLATION_t + \beta_{10} UNEMPLOYMENT_t + \varepsilon_{\mathbf{it}} \quad (2)$$

Non-linear effect of bank branch on banking stability

$$LNZSCORE_{it} = \beta_1 LNZSCORE_{it-1} + \beta_2 BRANCH_{it} + \beta_3 SQBRANCH_{it} + \beta_4 EFFICIENCY_{it} + \beta_5 SIZE_{it} + \beta_6 CAPITALRATIO_{it} + \beta_7 NPLRATIO_{it} + \beta_8 LOANRATIO_{it} + \beta_9 GDPPC_t + \beta_{10} INFLATION_t + \beta_{11} UNEMPLOYMENT_t + \varepsilon_{\mathbf{it}} \quad (3)$$

$$LNZSCORE_{it} = \beta_1 LNZSCORE_{it-1} + \beta_2 BRANCH_{it} + \beta_3 SQBRANCH_{it} + \beta_4 EFFICIENCY_{it} + \beta_5 SIZE_{it} + \beta_6 CAPITALRATIO_{it} + \beta_7 NPLRATIO_{it} + \beta_8 DEPOSITRATIO_{it} + \beta_9 GDPPC_t + \beta_{10} INFLATION_t + \beta_{11} UNEMPLOYMENT_t + \varepsilon_{\mathbf{it}} \quad (4)$$

Modulating effect of bank branch through loans and deposits on banking stability

$$LNZSCORE_{it} = \beta_1 LNZSCORE_{it-1} + \beta_2 BRANCH_{it} + \beta_3 [BRANCH * LOANRATIO]_{it} + \beta_4 EFFICIENCY_{it} + \beta_5 SIZE_{it} + \beta_6 CAPITALRATIO_{it} + \beta_7 NPLRATIO_{it} + \beta_8 LOANRATIO_{it} + \beta_9 GDPPC_t + \beta_{10} INFLATION_t + \beta_{11} UNEMPLOYMENT_t + \varepsilon_{\mathbf{it}} \quad (5)$$

$$LNZSCORE_{it} = \beta_1 LNZSCORE_{it-1} + \beta_2 BRANCH_{it} + \beta_3 [BRANCH * DEPOSITRATIO]_{it} + \beta_4 EFFICIENCY_{it} + \beta_5 SIZE_{it} + \beta_6 CAPITALRATIO_{it} + \beta_7 NPLRATIO_{it} + \beta_8 DEPOSITRATIO_{it} + \beta_9 GDPPC_t + \beta_{10} INFLATION_t + \beta_{11} UNEMPLOYMENT_t + \varepsilon_{\mathbf{it}} \quad (6)$$

In respect of the modulation models, where bank branches moderate the relationship between deposit and loans on banking stability, the study follows the arguments in Brambor, Clark, and Golder (2006) and test for the joint significance of the interactive term and constitutive terms. For example, in equations 7 and 8, the hypothesis that the effect of bank branches modulates the relationship between bank stability and loans and bank stability and deposits are examined and described below. *λ_3 and γ_3 are the coefficients of the interactive terms of bank branches and deposits and bank branches and loans, respectively. λ_8 and γ_8* are coefficients of bank deposits and loans, respectively. In terms of examining the nonlinear threshold effect of bank branches on banking stability, the approach of Lind and Mehlum (2010) where the partial derivative of Equation 3 and 4 are taken with respect to bank branches to arrive at Equations 9 and 10, respectively. Equations 9 and 10 shows the threshold point of bank branches by dividing the linear coefficient of bank branches by the nonlinear coefficient of bank branches.

Marginal effects

$$\partial LNZSCORE_{it/} \partial DEPOSITRATIO_{it} = \lambda_3 BRANCH_{it} + \lambda_8 \quad (7)$$

$$\partial LNZSCORE_{it/} \partial LOANRATIO_{it} = \gamma_3 BRANCH_{it} + \gamma_8 \quad (8)$$

Threshold effects

$$\partial LNZSCORE_{it/} \partial BRANCH_{it} = -\frac{\lambda_2}{2\lambda_3} \quad (9)$$

$$\partial LNZSCORE_{it/} \partial BRANCH_{it} = -\frac{\gamma_2}{2\gamma_3} \quad (10)$$

Variable definition and justification

Bank stability

Bank stability is the dependent variable measured using natural log of z-score. It is computed as capital adequacy ratio plus return on assets all divided by standard deviation of return on assets (Beck, De Jonghe, & Schepens, 2013; Fernández, González, & Suárez, 2016; Ozil, 2018). The value of z-score provides an indication of how far a bank is away from insolvency or bank failure. Intuitively, Boyd and Runkle (1993) advance that the resulting z-score is interpreted as the number of deviations by which the return of a bank would have to fall from the mean to erode the equity of a bank; hence measuring how stable a bank is from distress. The measure is such that higher values indicate more stability while low values indicate lower stability. Following studies (Beck et al., 2013; Fernandez et al., 2016; Ozil, 2018), the z-score values are logged to control for scalar biases and skewness.

Branches

Bank branches is measured as the number of branches a bank has for each year. Increased bank branch may be seen as a geographical diversification strategy which boost deposit mobilization and loan diversification to promote financial stability (see Cai et al., 2016; Goetz, Laeven and Ross Levine, 2016; Yildirim & Efthyvoulou, 2018). However, following Meslier, Morgan and Samolyk (2016) extreme increase in bank branches may deteriorate the stability of banks. Hence, a non-linear relationship is expected between bank financial stability and bank branches.

Deposits

Deposits measures the ability of banks to mobilize savings from surplus spending units. It is measured as total deposits to total assets. It is expected that deposits which strengthen the financial positions of banks given that banks that are able to mobilize more deposits may have greater liquidity to honor deposits on demand and grant more loans (Paradi et al., 2011). Similarly, mobilizing more deposits solidifies and strengthens the law of large numbers on which banks operate and reinforce their stability (Amini, Cont and Minca, 2012; Sirignano & Giesecke, 2019).

Loans

Bank loans are measured as total loans and advances to total assets (Cai & Zhang, 2017) and measures the ability of a bank to advance more credit assistance to deficit spending units. Advancing more loans increases the risk portfolio of banks and hence reduce the financial stability of banks in two ways. First, advancing loans represents converting deposits into loans. This weakens the ability of banks to honor deposits on demand and hence reduces stability. Second, advancing loans leads to higher possibility of exposure to credit risk as not all the loans may be recovered. Hence, loans are expected to increase the credit risk portfolio and subsequently reduce the bank’s financial stability.

Efficiency

Efficiency is expected to boost bank financial stability. That is, efficient banks have lower wastage, risks and costs and therefore are expected to be more stable (see Mensah, Andoh, Kuttu, & Kusi, 2019; Saka, Aboagye, & Gemegah, 2012). Efficiency is computed using the data envelopment anaylsis (DEA) approach. The expection is that bank efficiency should reinforce banking stability.

Size

Bank size is measured as the natural log of bank total assets. Following the economies and diseconomies of scale and scope literature (see Beccalli & Rossi, 2020; Boot, 2017), the effect of bank size on financial stability could be positive or negative. That is, while the economies of scale and scope suggests that there are efficiency gains associated with size which promote stability, diseconomies of scale and scope suggests that wastage and duplication of functions and resources, bureaucracies, poor supervision and monitoring associated with size may lead to more unstable banks. Hence, both positive and negative nexus between size and stability may be realized.

Capital ratio

Bank capital ratio measures the ability of banks to absorb banking risks and losses; hence leading to improved banking stability. It is against this background that most bank regulators rely on capitalization and recapitalization as tools for strengthening banking stability (see Aboagye & Ahenkora, 2018; Beccalli, Frantz, & Lenoci, 2018; Homar & van Wijnbergen, 2017). That is, increase in capital adequacy induces equity-holders to be more vigilant and scrutinize bank managers to ensure the stability of the bank. Hence, a positive nexus is expected between capital and bank stability.

Non-performing loans

Non-performing is measured as nonperforming loans to gross loans and advances. It indicates the credit losses or undesirable losses originating from the lending function of banks. Following prior studies (Castro, 2012; Chaibi & Ftiti, 2015; Kusi, Dzeha, Gyan, & Turkson, 2021) credit risk is arguably the largest risk that banks face due to the fact that they are set up to lend to the private sector; hence a negative nexus is expected between credit risk and bank stability.

Gross domestic product per capita

Gross domestic product per capita is a macroeconomic indicator which denotes improvement in the economic conditions and standard of living of citizenry (Jimenez, Lopez, & Saurina, 2009; Ozili, 2018). Thus, improvement in gross domestic product per capita implies improved ability to settle loan obligations by bank clients leading to decline in credit losses and risks. This improves the stability of banks and a positive relationship between gross domestic product per capita and bank stability is expected.

Inflation

Inflation is measured with consumer price index and indicates unanticipated fluctuations or changes in consumer prices. Following existent literature, unanticipated inflation (which usually occurs when inflation is high) weakens the ability of bank clients to pay their loans which leads to worsening financial position of banks (see Castro, 2012; Ozili, 2018). From the bank perspective, unanticipated inflation reduces the monetary value or purchasing power of loans when the banks receive or recover their loans. This reduces the value of their capital over time and exposes banks to financial instability. Hence, a negative relationship is predicted between inflation and bank stability.

Unemployment

Unemployment is an indication of unemployed employable population as a percentage of total employable population. Following Ozili (2018) and Ozili (2018) a negative relationship is expected between unemployment and bank stability. That is, unemployment heightens bank credit defaults and losses leading possibly to weakened or reduced banking stability. Table 2 summarizes the measurements, sources and expected signs of all the variables employed in this study.

Empirical results and discussions

Table 3 presents the summary statistics of the variables employed in this study. Using the minimum and maximum values of the variables, outliers which have the possibility to influence the consistency, efficiency and biasedness of coefficients were not observed. Similarly, the pairwise correlation (see Table 4) is used to detect

TABLE 2. Summary of Variables Employed.

Variables	Measurement	Source	Expected Sign
BANK STABILITY(ZSCORE)	capital ratio + return on assets/standard deviations of return on assets	Author's computation	
BRANCHES	number bank branches	Ghana Banking Survey Reports	-/+
DEPOSITRATIO	total customer deposits/total assets	Author's computation	+
LOANSRATIO	gross loans/ total assets	Author's computation	-
EFFICIENCY	Data envelopment analysis approach	Author's computation	-/+
SIZE	natural log of total assets	Author's computation	-/+
CAPITALRATIO	total equity/total assets	Author's computation	+
NPLRATIO	non-performing/total loans and advances	Author's computation	-
GDPPC	sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products/total population	WDI	+
INFLATION	changes consumer price index	WDI	-
UNEMPLOYMENT	share of the labor force that is without work but available for and seeking employment	WDI	-

multicollinearity and setting multicollinearity threshold to 0.8 (following Grewal, Cote & Baumgartner, 2004), no evidence of multicollinearity observed with the exception of the relationship between loans and deposits. Hence, these two variables are employed in separate models.

In Tables 5–7, the main results of this study are reported. Each Table contains four regression models of which the first two are random effect models (models 1 and 2; 5 and 6 and 9 and 10) and the other two are GMM models (models 3 and 4; 7 and 8 and 11 and 12), respectively. Specifically, while Table 5 reports on the baseline effect of bank branch network on bank stability, Table 6 reports on the non-linear effect of bank branch network on banking stability. Furthermore, Table 7 reports on the modulating effects of bank branch network between loans and deposits on banking stability. The discussion of the result is done relying on the GMM models given that they provide more reliable and efficient results as discussed earlier. Hence, the preferred models are the two-step GMM models.

From the results, a positive significant linear and nonlinear relationships are reported between bank branches and stability in Tables 5,6, respectively. While results in Table 5 reports a significant linear positive between bank branches and banking stability, results in Table 6 reports a non-linear relationship between bank branches and banking stability. The linear relationship between bank branching and stability reported in Table 5 implies that an increase in bank branching improves banking stability. However, further analysis in Table 6 reports a non-linear "inverted U-Shape" relationship between bank branching and stability. The non-linear results imply that increasing bank branches will promote stability of banks but beyond a certain threshold bank branches may impede banking stability. The non-linear effect of bank branching is consistent with prior studies (see Meslier, Morgan and Samolyk, 2016; Ray, 2016). Indeed, the results suggests an optimal level of bank branches beyond which increasing bank branches might be detrimental for the stability of banks in Ghana. Specifically, we find that beyond 191 and 173 bank branches under the deposits and loans models respectively (see Model 7 and 8), the propelling effect of bank branches begins to reduce banking stability. This finding is consistent with the economies and diseconomies of scale (see Beccalli & Rossi, 2020; Boot, 2017) which suggest that as bank branches increase, branch set-up and operating costs, bureaucracies, ineffective monitoring, and supervision also increase leading to reduction in banking stability.

Table 3. Descriptive Statistics.

Variable	Obs	Mean	Std.Dev.	Min	Max	VIF	SWILK
ZSCORE	325	8.149	1.929	−12.746	12.854		10.11***
BRANCHES	328	32.021	37.802	1	298	1.316	10.32***
EFFICIENCY	328	.777	.754	0	1	1.025	11.72***
SIZE	328	20.181	1.801	12.595	22.981	3.212	8.34***
CAPITALRATIO	328	0.124	0.0313	.005	.9096	2.277	12.37***
NPLRATIO	328	0.1355	0.0426	0.064	0.2159	1.256	3.56***
LOANRATIO	328	0.4075	0.2273	0.006	0.9965	9.201	12.38***
DEPOSITRATIO	328	0.6899	0.1733	0	0.8966	8.627	12.37***
GDPPC	328	0.0687	0.029	0.0372	0.1405	2.170	7.58***
INFLATION	328	0.1337	0.0363	0.0713	0.1925	1.880	5.33***
UNEMPLOYMENT	328	0.0350	0.0117	0.0215	0.0532	1.466	7.85***

Table 4. Pairwise Correlations.

Variables	−1	−2	−3	−4	−5	−6	−7	−8	−9	−10	−11
(1) ZSCORE	1										
(2) BRANCHES	−0.078	1									
(3) EFFICIENCY	0.033	−0.104*	1								
(4) SIZE	−0.624*	0.394*	−0.047	1							
(5) CAPITALRATIO	0.619*	−0.026	0.009	−0.488*	1						
(6) NPLRATIO	−0.265*	0.161*	−0.084	0.297*	−0.086	1					
(7) LOANRATIO	0.591*	−0.067	0.028	−0.655*	0.739*	−0.059	1				
(8) DEPOSITSRATIO	0.602*	−0.064	0.016	−0.665*	0.702*	−0.048	0.936*	1			
(9) GDPPC	−0.106*	−0.028	−0.052	−0.111*	−0.022	0.081	0.027	0.035	1		
(10) INFLATION	−0.124*	0.048	0.033	0.063	−0.065	0.119*	−0.02	−0.015	−0.639*	1	
(11) UNEMPLOYMENT	0.076	−0.167*	0.051	−0.350*	0.007	−0.139*	0.028	0.036	0.380*	−0.167*	1

* shows significance at the .1 level

Table 5. Effect of Bank Branches on Bank Financial Stability.

	(1)	(2)	(3)	(4)
	RANDOM EFFECT MODELS (REM)		GENERALIZED METHOD OF MOMENTS (GMM)	
VARIABLES	Deposit	Loan	Deposit	Loan
L.LNZSCORE			0.102***	0.157***
			(0.0354)	(0.0311)
BRANCHES	0.00221*	0.00304*	0.00341***	0.00348**
	(0.00133)	(0.00166)	(0.00118)	(0.00136)
DEPOSITSRATIO	0.00502***		0.00502***	
	(0.00103)		(0.000861)	
LOANRATIO		0.00246		0.00522***
		(0.00234)		(0.000980)
EFFICIENCY	0.0175	0.00997	0.0326	0.0217
	(0.0256)	(0.0242)	(0.0254)	(0.0343)
SIZE	−0.379***	−0.524***	−0.255***	−0.310***
	(0.0754)	(0.115)	(0.0767)	(0.0749)
CAPITALRATIO	0.0102***	0.0147*	0.0157***	0.0121***
	(0.00335)	(0.00776)	(0.00208)	(0.00425)
NPLRATIO	0.00447	−0.0205	0.0124	0.0253
	(0.0310)	(0.0338)	(0.0140)	(0.0152)
GDPPC	−0.00137	0.117	−0.0222	−0.0327*
	(0.159)	(0.180)	(0.0150)	(0.0170)
INFLATION	−0.0120	0.0801	−0.0267*	−0.0369**
	(0.106)	(0.124)	(0.0144)	(0.0161)
UNEMPLOYMENT	−0.263	0.371	−0.126***	−0.145***
	(0.960)	(0.993)	(0.0411)	(0.0383)
CONSTANT			−1.915	−0.201
			(1.824)	(1.718)
Observations	237	237	224	224
Banks	35	35	33	33
Year Effect	Yes	Yes	No	No
Instruments			22	22
F-Prob.			447.34***	1845.43***
AR(1)			−3.45***	−3.47***
AR(2)			0.89	0.89
Sargan			5.78	7.78
Hansen			11.01	9.95

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

Further analysis in Table 7 show that bank branches could serve as complementary tool for enhancing the nexus between both loans and deposits on bank stability. Thus, the results (see Table 7) show that at an average bank branches of 32, the positive effect of deposits is enhanced while the negative effect of loans on banking stability is weakened. These findings confirm prior studies that show that the diversification nature of bank branches, given the ability of bank branches to pool and share banking risk among banking participants, induce a more diversified deposit and loan portfolio to enhance banking stability (see Cai et al., 2016; Goetz, Laeven and Ross Levine, 2016; Yildirim & Efthyvoulou, 2018).

In the quest to enhance our understanding of the enhancing effect of bank branches on the relationship between bank loans and deposits on stability, we vary the number of bank branches to provide evidence of how increasing or decreasing bank branches modulates the relationship from bank loans and deposits to banking stability (see Appendix 1 and 2). Interestingly, it is observed that varying level of bank branches avert the negative effect of loans on the stability of banks

Table 6. Non-Linear Effect of Bank Branches on Bank Financial Stability.

	(5)	(6)	(7)	(8)
	RANDOM EFFECT MODELS (REM)		GENERALIZE METHOD OF MOMENTS (GMM)	
VARIABLES	Deposit	Loan	Deposit	Loan
L.LNZSCORE			0.111***	0.170***
			(0.0345)	(0.0343)
BRANCHES	0.00624**	0.00985**	0.00802***	0.00971**
	(0.00268)	(0.00392)	(0.00272)	(0.00360)
C.BRANCHES#C.BRANCHES	−1.61e-05*	−2.75e-05**	−2.14e-05**	−2.78e-05**
	(8.65e-06)	(1.38e-05)	(9.27e-06)	(1.21e-05)
DEPOSITRATIO	0.00467***		0.00466***	
	(0.000985)		(0.000840)	
LOANRATIO		0.00203		0.00504***
		(0.00224)		(0.000926)
EFFICIENCY	0.0253	0.0243	0.0390*	0.0351
	(0.0238)	(0.0197)	(0.0222)	(0.0229)
SIZE	−0.417***	−0.572***	−0.289***	−0.347***
	(0.0771)	(0.119)	(0.0774)	(0.0777)
CAPITALRATIO	0.00982***	0.0140**	0.0156***	0.0112***
	(0.00326)	(0.00698)	(0.00188)	(0.00387)
NPLRATIO	−0.0010	−0.0270	0.0176	0.0287*
	(0.0317)	(0.0347)	(0.0142)	(0.0151)
GDPPC	0.0197	0.140	−0.0221	−0.0290*
	(0.160)	(0.180)	(0.0143)	(0.0153)
INFLATION	0.00352	0.0966	−0.0291*	−0.0384**
	(0.107)	(0.123)	(0.0147)	(0.0156)
UNEMPLOYMENT	−0.0710	0.627	−0.137***	−0.157***
	(0.965)	(1.018)	(0.0411)	(0.0396)
CONSTANT			−1.264	0.490
			(1.858)	(1.757)
Observations	237	237	224	224
banks	35	35	33	33
Year Effect	Yes	Yes	No	No
Instruments			23	23
F-Prob.			533.96***	1621.27***
AR(1)			−3.41***	−3.40***
AR(2)			0.93	1.03
Sargan			6.10	8.81
Hansen			10.23	9.41
Inflection Point	**156**	**176**	**191**	**173**

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

while at the same time deepening the positive effect bank deposits have on banking stability. These findings suggests that bank branches enhance the geographical diversification capacity of a bank to enhance banking stability by lowering the financial intermediation risks associated with bank loans and deposits. Typically, establishing bank branches improves the ability of banks to mobilize many-small deposits which enhances banking stability by reducing the risk of withdrawal by one huge depositor or saver. With respect to loans, establishing bank branches affords banks the opportunity to pool and share default risk across different clients at different geographical locations. These results are consistent with prior studies that argue in favor of geographical diversification effect of bank branches (Meslier et al., 2016; Paradi et al., 2011).

Table 7. Conditional Effect of Loan and Deposits through Bank Branches on Bank Financial Stability.

	(9)	(10)	(11)	(12)
	RANDOM EFFECT MODELS (REM)		GENERALIZE METHOD OF MOMENTS (GMM)	
VARIABLES	Deposit	Loan	Deposit	Loan
L.LNZSCORE			0.100*	0.0716*
			(0.0537)	(0.0383)
BRANCHES	0.00208	0.00233*	0.00278**	0.00303***
	(0.00136)	(0.00137)	(0.00102)	(0.000905)
DEPOSITRATIO	6.17e-05		0.00132	
	(0.000783)		(0.000881)	
C.BRANCHES#C.DEPOSITSRATIO	0.000133***		0.000105***	
	(1.29e-05)		(1.73e-05)	
LOANRATIO		−0.00763**		−0.00268
		(0.00319)		(0.00331)
C.BRANCHES#C.LOANRATIO		0.000413***		0.000292**
		(9.41e-05)		(0.000115)
EFFICIENCY	0.0170	0.0136	0.0272	0.0286
	(0.0255)	(0.0249)	(0.0199)	(0.0272)
SIZE	−0.378***	−0.432***	−0.273***	−0.293***
	(0.0746)	(0.0701)	(0.0590)	(0.0765)
CAPITALRATIO	0.0191***	0.0261***	0.0211***	0.0221***
	(0.00179)	(0.00701)	(0.00208)	(0.00526)
NPLRATIO	0.00564	−0.00187	0.00999	0.0114
	(0.0311)	(0.0312)	(0.0116)	(0.0126)
GDPPC	−0.00619	0.0414	−0.0251*	−0.0180
	(0.159)	(0.160)	(0.0131)	(0.0171)
INFLATION	−0.0108	0.0274	−0.0303**	−0.0230
	(0.107)	(0.107)	(0.0131)	(0.0148)
UNEMPLOYMENT	−0.283	−0.0988	−0.122***	−0.129***
	(0.955)	(0.940)	(0.0291)	(0.0443)
CONSTANT			−1.438	−1.383
			(1.525)	(1.750)
Observations	237	237	224	224
banks	35	35	33	33
Year Effect	Yes	Yes	No	No
Instruments			19	25
F-Prob.			6697.16***	1359.34***
AR(1)			−3.35***	−3.32***
AR(2)			0.32	−0.40
Sargan			3.01	9.23
Hansen			2.73	12.55
Net Effect	0.0042***	0.0056***	0.0047***	0.0067***

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

Considering the control variables, we find a consistent nexus across all the results reported in Tables 5–7. Specifically, bank size, gross domestic product per capita, inflation and unemployment reduced banking stability across all the models while bank capital adequacy promoted banking stability. These findings and results are consistent with prior studies. The results are largely consistent across the twelve (12) models estimated.

Robustness checks and diagnostics

To enhance reliability, efficiency and accuracy of the results, the study employs a number of econometric techniques. The study screens for outliers, multicollinearity, acceptability of variables and normality of variables using the appropriate techniques. Issues of model appropriateness is dealt with using Breusch-Pagan/Cook-Weisberg test for heteroscedasticity

(Appendix 3), autocorrelation (Appendix 4) and Hausman (Appendix 5) while the GMM estimations are employed to control for autocorrelation, heteroscedasticity, omitted variable biases and endogeneities. As expected, the twelve models estimated show consistent and reliability across all the models estimated. Hence, there is evidence of consistency, reliability and accuracy given the R-Squared, F-probability, F-statistics, instruments, Hansen test, and Arellano-Bond tests (1 & 2) results reported. Given all the results of the robustness tests employed, the results are reliable, consistent and efficient and fit for generalization for banks in the Ghanaian banking sector.

Conclusions, policy implications and recommendations

This study set out to investigate the modulating and non-linear role bank branches play in ensuring banking stability through financial intermediation activities (bank loans and deposits) in Ghana using thirty-five banks between 2009 and 2017. Employing a panel two-step dynamic GMM and robust random effect estimation models with year and technological controls, findings are reported on the interrelationship among bank branches, financial intermediation activities (loans and deposits) and banking stability in Ghana.

From the findings, it is observed that bank branches has a non-linear "inverted U-Shape" relationship with banking stability implying that initial increases in bank branches promote banking stability but beyond a threshold of 191 and 173 bank branches, banking stability begins to decline. Again, while loans and deposits have adverse and propelling effects on banking stability respectively, we show that at an average level of bank branches (32) the adverse effect of loans on stability improved to a positive marginal effect while the propelling effect of deposits is deepened. Moreover, when the level of bank branches is varied, we observed a persistent positive marginal effect of loans and deposits on baking stability. These findings show that bank branches can serve as a geographical diversification tool that reduces the financial intermediation risks of loans to improve banking stability.

These findings have policy implications and recommendations for bank managers, policymakers, and academic researchers. First, although increasing bank branches results into enhancing banking stability, managers of banks must be cautious about increasing bank branches since beyond a certain threshold, bank branches may derail or dampen banking stability. Also, policymakers in designing and developing banking stability policies must keenly consider bank branches given its dampening effect on banking stability beyond some threshold. Finally, researchers are encouraged to investigate these interrelations using a larger dataset since this study covers only banks in Ghana.

Disclosure statement

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Appendix 1

Delta-method						
depositsratio	dy/dx	Std.Err.	z	P > z	[95%Conf.	Interval]
_at						
1	0.002	0.001	3.410	0.001	0.001	0.004
2	0.004	0.001	5.870	0.000	0.002	0.005
3	0.005	0.000	10.380	0.000	0.004	0.006
4	0.009	0.001	12.880	0.000	0.008	0.011

Appendix 2

Delta-method						
loanratio	dy/dx	Std.Err.	z	P > z	[95%Conf.	Interval]
_at						
1	0.001	0.002	0.240	0.807	−0.004	0.005
2	0.003	0.001	2.640	0.008	0.001	0.006
3	0.008	0.001	5.280	0.000	0.005	0.010
4	0.019	0.006	3.420	0.001	0.008	0.030

Appendix 3: Breusch-Pagan / Cook-Weisberg test for heteroskedasticity

	Coef.
Chi-square test value	18.931
P-value	.168

Ho: Constant variance
chi2(1) = 82.43
Prob > chi2 = 0.0000

Appendix 4: Wooldridge test for autocorrelation in panel data

H0: no first order autocorrelation
F(1, 29) = 1.762
Prob> F = 0.1948

Appendix 5: Hausman (1978) specification test