Journal of Economics, Finance and Management Studies

ISSN (print): 2644-0490, ISSN (online): 2644-0504

Volume 6 Issue 2 February 2023

Article DOI: 10.47191/jefms/v6-i2-35, Impact Factor: 6.274

Page No. 911-923

Bank size and bank earnings volatility. A survey of Kenya banking system

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ABSTRACT: Based on the increased interest on bank size in literature, we sought to investigate the effect of large banks on bank earnings volatility in Kenya banking system. Our data cover the period from 2005 to 2020. Included in our analysis is ROA volatility (ROE volatility) and market volatility, as measures of bank earnings volatility at bank level and at market level respectively. In addition, we used bank risk, at individual bank level and at market level, for further analysis in our model. Our findings have shown that bank size positively and significantly affect the bank earnings volatility as measured using ROA volatility, but an inverse and insignificant effect on ROE volatility. We also find that growth in bank size positively and significantly affect their individual risk exposure, but does not increase the market risk. Our findings have policy implications in considering optimal bank size, bank risk and systemic risk.

KEYWORDS: Earnings Volatility, Bank Risk, Bank Size, Concentration, Kenya

I. INTRODUCTION

Over the past years, the banking industry has been changing tremendously owing to the changes in technology and the increase in globalization. More and more, the modern banks have slowly been shifting from their traditional activity of lending to the market-based activities. As a consequence of these shifts, and as a result of embracing technology, banks have increased in size and complexity. Due to the increase in bank size, many scholars and practitioners have raised their concerns that big banks have more exposure to risk. Some literatures have quoted the 'too-big-to-fail' syndrome that may propel large banks to excessive risk incentives, hence exposing large banks to risks. This has raised concerns to what should be the optimal size of a bank. For instance, Haldane (2010) while referring to the too-big-to-fail insurance argue that growth in size increases the interconnectivity between banks, thereby increasing the possibilities of systemic risk. Further, while aware of this, big banks will have more inclinations to become bigger and more complex knowing that they can take riskier activities and be able to maximize shareholder wealth if the returns are favorable, and that they will be covered if the returns are unfavorable. This toobig-to-fail aspect of the banks therefore tends to aggravate the matter further.

Other literature like Beck, Demirguc-Kunt and Levine (2006), have considered the large-sized banks as a challenge in the banking industry due to their effect in increasing bank concentration. The argument is that, only a few of the banks in a market are capable of growing in size, while the rest remain predominantly small in size. As this phenomenon continue, big banks continue to become bigger at a more increasing trend as compared to the growth in size of the smaller banks. This will eventually lead to a few banks controlling a huge market share, thereby leading to a higher bank concentration ratio (Beck, Demirguc-Kunt, & Levine, 2003). Hence, they argue that an increased bank concentration may lead to unhealthy competition, especially in the absence of prudential regulations. As such, big banks lead to bank concentration. This may, in turn, lead to increased competition where banks seek to earn profit by increasing their risk appetite. Consequently, increase in bank size may be a prelude of bank concentration and risk-taking attitude (Rime, 2005; Mirzaei, et al., 2013).

Yet, another strand of literature approaches the problem of bank size from systemic risk approach. Here, the scholars like Laeven, et al. (2014), have argued that increase in bank size tends to create overdependence in the banking industry on one or a few banks. This phenomenon arises because of the interbank activities in the money market. The failure of such large banks creates liquidity risk in the market, creating a ripple effect that can travel to other industries. Moreover, the failures of big-sized banks tend to be more disruptive in the market creating systemic risks as compared to failures of smaller banks (Bord, et al., 2015).

Consequently, there are higher possibilities of systemic risks where the banks are large since their failure cannot be replaced by smaller banks. In addition, the large banks enjoy economies of scale which they use to their advantage to create liquidity even in riskier activities. However, if such banks fail, they may cause financial disruptions in the entire financial system.

Despite these arguments against bank size, other scholars have argued that bank size may have no significant effect on the risk exposure for individual banks nor on the banking industry. For instance, Wheelock and Wilson (2012) have shown that bigger banks increase their efficiency and are more profitable as they enjoy economies of scale, attract highly qualified personnel and have gained experience over time. Again, De Haan and Poghosyan (2012) findings have shown that bigger banks are better in promoting stability of the banking industry as they are easy to monitor and supervise. In addition, Laeven, et al. (2014) found that bank size does not matter in terms of exposure to failure for individual banks. Small banks can equally fail just as big banks. In fact, smaller banks may be exposed to individual failures attributed to corporate governance, poor management, poor risk management policies and credit risk. This implies that the discussion on bank size and bank riskiness is still inconclusive.

This research intends to contribute to this debate by investigating the effect of bank size on bank earnings volatility. The study is conducted by taking a survey of the Kenyan banking industry from 2005 to 2020. The maximum number of commercial banks observed in our sample is 44 banks with some banks having incomplete observation, giving a total of 643 bank years. We argue that bank size matters when considering bank earnings volatility holding that large banks experience earnings volatility more than the small banks. To investigate this, we use earnings volatility measured as standard deviation of Return on Assets (ROA) and regress this against bank size and other bank specific control variables. We also use standard deviation of Return on Equity (ROE) as proxy for earnings volatility for robustness check. Further, in place of individual bank earnings volatility, we use market level volatility using the standard deviation of profit before tax per year. Our findings showed that larger banks experience high level of earnings volatility measured using ROA as compared to smaller banks. Similar results are seen for market level volatility, though the level of impact of large banks is felt more at the market level. However, at the institutional level, ROE volatility is not dependent on bank size.

We also included a risk measure as indicator of bank volatility. Z-score measure, which is a common measure of risk was used, both at institutional level and market level. We argued that large banks are exposed to risk as they engage in riskier banking activities which may eventually be transmitted to the market. Our findings however showed that even though size matters both at institutional level and market level, the size has different impact on bank risk. At the institutional level, bank size increases the riskiness of the bank (with a positive and significant sign), while at the market level, large banks reduce the market risk (with a negative and significant effect). This implied that even though large banks may be exposed to higher risks, their risk exposure is not necessarily transferred to the market. In fact, the market risk reduces with the growth of bank size.

Further, we investigated whether bank categorization (by size) has significant effect on bank volatility at the market level. We categorized banks as small, medium and large based on their total assets. This helped to investigate the interaction between different banks categories with the market. Our argument is that when a given bank category operates as a unit, it would easily transmit this to the market. For instance, if many small banks within a banking system are exposed to risk, and they operate as a unit, this may be transmitted to the market and cause systemic failures (De Haan & Poghosyan, 2012). Consistent with this argument, our findings showed that bank category positively and significantly affect market volatility. However, the effect is negative in case of market risk. Our paper contributes to the body of knowledge particularly by focusing on the effect of bank size on bank earnings volatility in a developing country. Our findings have a significant bearing on the discussions about the policy interventions for bank failures, bank size and bank performance.

The rest of the paper is organized as follows: section 2 provides selected literature review, on bank size, bank performance, earnings volatility and risk exposure. It also outlines how our paper is related or deviates from previous studies. Section 3 develops the model starting by describing our study variables and sources of data. It also sets out the important computations and the model preliminary tests. Section 4 presents the main empirical results and discussions. Section 5 provides a conclusion and recommendations.

II. LITERATURE REVIEW

Some literatures have analysed how bank size affects earnings volatility. Fayman (2009) study shows that the profitability of large banks differs significantly from that of small banks owing to the operating activities of these banks. He attributes the difference to the fact that large banks engage more in non-interest activities. George (2015) explains that bigger banks operate differently from smaller banks. They take advantage of their size and experience to transform deposit to loans more efficiently than smaller banks. Further, larger banks borrow more in the interbank market than do the smaller banks, and are more leveraged. These and other characteristics of large banks improve their performance, smoothening their returns.

Our paper is closely related to the study by De Haan and Poghosyan (2012). In their study, the authors examined the effect of bank size on bank earnings volatility while also controlling for the level of concentration. They used quarterly data for noninvestment banks in US for 2004-2009. However, the authors found that bank size reduces earnings volatility, which decreases with market concentration. These findings therefore show that larger banks experience low earnings volatility. In addition, banking concentration brings stability to the banking industry.

Moutsianas and Kosmidou (2016) have investigated whether bank size matters when it comes to bank earnings volatility in UK. The authors made a comparative analysis of commercial banks and investment banks, and find that a nonlinear relationship exists between bank size and earnings volatility. Similarly, et al., (2017) find that larger banks provide stability in the banking industry. The authors investigated whether bigger Islamic banks are needed to improve bank stability using a sample of 45 Islamic banks from 13 different countries. They further show that banking regulations including capital tightening tend to improve the size-stability relationship implying that large banks are a benefit to the stability issues.

Okpe and Madugba (2017) investigated the effect of bank size on the relationship between corporate governance and financial performance. While acknowledging the complexity in large banks, the authors find that large banks enjoy economies of scale and have technical efficiency which help in the corporate governance-performance relationship. The main findings indicated that bank size impact positively and significantly on the relationship between corporate governance and financial performance for commercial banks in Nigeria.

Pais and Stork (2013) studied the effect of bank size on systemic risk. The authors point that banks are vulnerable to contagion effect. This effect increase as the banks become more integrated and interdependent. Their findings showed that bank size has limited effect on univariate risk, but higher significant effect on the systemic risk. A similar study by Laeven, et al. (2014) investigated the effect of bank size on systemic risk. The authors first provide descriptions of the characteristics of large banks using graphical presentations. They argue that large banks engage less in the traditional lending activities as they opt for market-based investments. This reduces their risk exposure associated to loan and advances. However, they found that large banks are riskier and create systemic risk especially when their funding is less stable. They create systemic risk, not individually, but when they engage in the market-based activities. Further, the authors found that large banks are more destructive when they fail, than the failure of small banks. Banking regulations which mainly focus on institutional risk may be insufficient in dealing with the large banks' effect on the system. These findings show that large banks impact greatly the market risk.

Bord, et al. (2015) showed that large banks transmitted shocks to unaffected areas during the 2007/08 global financial crisis. This suggest that large banks are high transmitters of shocks and can easily lead to systemic risks. Adusei (2015) investigated the impact of bank size and funding risk on bank stability in Ghana. While controlling for various bank specific characteristics, the author finds that increase in bank size tends to increase the bank stability, supporting the push for restriction in bank size in order to promote healthy and stable banking systems.

Adusei (2015) further explains his findings based on the arguments for concentration-stability hypothesis. It is argued that large banks contribute to stability through six different channels: i) larger banks through increased profit build higher capital buffers; ii) larger banks may result to credit rationing and restrict managers from excessive risk taking; iii) few and larger banks are easy to monitor and supervise; iv) larger banks enjoy economies of scale; v) larger banks have higher capacity for credit screening; and vi) large banks have more opportunities for diversifications, hence reducing their reliance on risk lending activities.

A similar study by Ali and Puah (2018) investigated whether bank size affects banks' stability and whether funding risk has any effect on banking stability in Pakistan. The findings showed that bank size negatively affects stability, suggesting that large banks increase volatility in the banking industry. A study in Kenya by Mwangi (2018) showed that bank size positively affects the financial performance of commercial banks. Baituti and Ngaba (2022) have shown that bank size has no significant effect on non-performing loans. Goetz (2018) investigated the effect of banking competition on bank stability, arguing that competition increase bank efficiency, improves the bank performance and consequently increase bank stability. These findings imply that having large or small banks may not matters, as long as there is effective competition among the existing banks. This would lead to market correction for any individual bank's failures, thereby improving banking stability.

III. METHODOLOGY

III-A. Data Description and Sources

The study used analytical research design. We used this design to critically review the effect of bank size on the earnings volatility of commercial banks. Both descriptive statistics and inferential statistics were used. The main variable in this study is bank size which is measured using the natural logarithm of total assets for bank *i* at time *t*. We argue that bank size affect bank earnings volatility. Hence the dependent variable is earnings volatility measured as the standard deviation of Return on Asset (ROA) for each bank. We also develop the same equation but using Return on Equity, (ROE) for each bank. These measure the earnings

volatility for individual banks for the time period covered in this study. The earnings volatility for individual bank is computed (following De Haan & Poghosyan, 2012 approach) as follows:

$$Earnings\ Volatility = \sqrt{\frac{1}{T}\left(\sum_{t=1}^{T}\left(ROA_{i,t} - \frac{1}{T}\sum_{t=1}^{T} ROA_{i,t}\right)^2\right)} \quad (1)$$

where *i* and *t* are subscripts denoting the ROA of bank *i* at time *t* in years and T is the total number of bank years in our sample. We use the same equation (1) to compute earnings volatility but using ROE in place of ROA.

To include robust analysis on the effect of bank size on earnings volatility, we further analyse the effect of bank size on the earnings volatility at the market level. Therefore, we compute the standard deviation of the average profit before tax for all banks at a particular year *t*. The market volatility is computed as given in equation (2) below:

$$Market\ Volatility = \sqrt{\frac{1}{N}\left(\sum_{n=1}^{N}\left(PBT_{i,t} - \frac{1}{N}\sum_{n=1}^{N} PBT_{i,t}\right)^2\right)} \quad (2)$$

where *i* and *t* are subscripts denoting the profit before tax (PBT) of bank *i* at time *t* in years and N is the total number of banks in our sample.

Further, we use the z-score measure which is a common measure of risk (following Anginer and Demirguc-Kunt, 2018) as proxy for volatility as an alternative model specification. We include risk measurement in our analysis in order to capture any negative movements in earnings. This is because earnings volatility in itself would include positive and/or negative changes in ROA and ROE, of which it would only tell us about instability in earnings. For this purpose, we compute the z-score as given in the following equation, which gives the z-score for bank *i* at time *t*.

$$z - score = \frac{\left(ROA + \frac{Equity}{Asset}\right)}{\sigma ROA} \quad (3)$$

where σROA is the standard deviation of ROA.

Further, we test whether bank size has an effect on the banking industry as a whole, in which case we use a z-score computed using equation (3) but at the market level. These two analyses helped us to capture the effect of bank size on the riskiness of the banks. Included in our model are bank specific control variables such as deposit to asset ratio, loan to asset ratio and bank leverage (given as the ratio of asset to equity).

For the purpose of these analyses, the data were obtained from the Annual Financial Stability Report prepared by the Central Bank of Kenya for all commercial banks from 2005-2020. The study covered a period of 16 years. Those commercial banks that do not have data for at least eight years were dropped from the analysis. In total, our sample included a maximum of 44 commercial banks and 643 bank years since some banks did not have full data for all the years (see Table A1 and Table A2 in the Appendix).

III-B. Preliminary Tests

This section performs some necessary preliminary tests to ensure the data fits for purpose of analysis. These include normality test, multicollinearity test and heteroskedasticity test. Figure 1 shows the histogram distribution of the residues used to check for outliers. The results show that there were no visible outliers in the data.

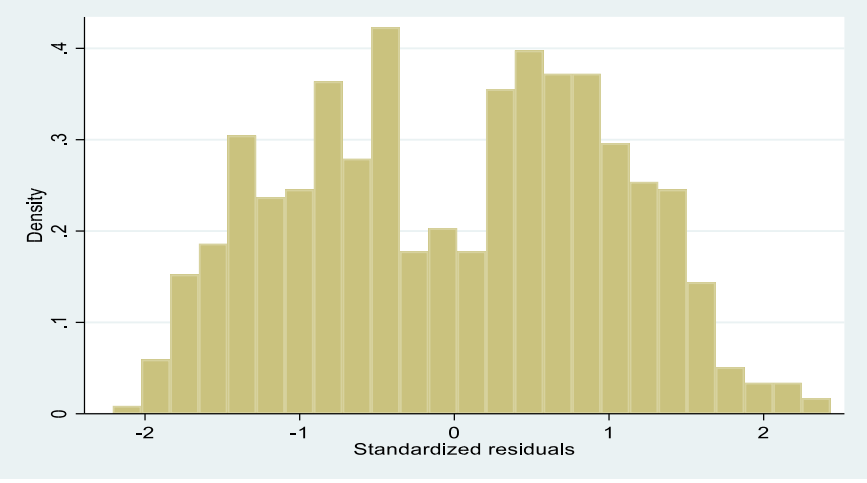


Figure 1: Histogram for normality test using standardized residuals

We also tested for multicollinearity using Variance Inflation Factor (VIF). According to Akinwande, *et al.* (2015), if VIF is greater than 10, then the data is considered to have violated the assumption that the independent variables should not be corelated among themselves, that is, no multicollinearity in the data set. Similarly, a value of 1/VIF that is less than 0.1 shows presence of multicollinearity. As shown in Table 1, the VIF results revealed no problems of multicollinearity in the data.

Table 1. Variance Inflation Factor test for Multicollinearity

Variable	VIF	1/VIF
market volatility	4.845	.206
zscore2	4.743	.211
ROE volatility	1.309	.764
log assets	1.309	.764
loan assets	1.264	.791
dep asset	1.148	.871
concentration	1.119	.894
zscore1	1.094	.914
leverage	1.01	.99
Mean VIF	**1.982**	**.**

Another important assumption for OLS analysis is the assumption of equal variance, that is homoskedasticity. To test for this assumption, LM white test for heteroskedasticity was used. In this test the hypotheses are stated as follows:

H_0: The error variances are constant (homoskedasticity)

H_1: The error variances are not constant (heteroskedasticity)

Table 2: LM white test for heteroskedasticity

White's test for Ho: homoskedasticity against Ha: unrestricted heteroskedastic chi2(20) = 29.50	df	p
Prob > chi2 = 0.0784		
Cameron & Trivedi's decomposition of IM-test chi2		
29.500	20	0.078
11.250	5	0.047
2.530	1	0.112
43.270	26	0.018

The chi-square p-value (p=0.0784) for the LM test for heteroskedasticity was greater than 5% threshold therefore the H_0 could not be rejecting. This implied that the alternative hypothesis which states that there is heteroskedasticity was rejected. The da ta was therefore found to have homoskedasticity, appropriately satisfying the OLS assumption of homoskedasticity.

III-C. Model Specification

In this study, we use two different models for robustness test. The baseline model is specified in equation (4) while the alt ernative model is specified in equation (5) as follows:

$$Earnings\ volatility = \beta_0 + \beta_1(Bank\ Size) + \beta_2(Concentration) + \gamma_1 X + \epsilon \qquad (4)$$

$$z\text{–}score = \beta_0 + \beta_1(Bank\ Size) + \beta_2(Concentration) + \gamma_1 X + \epsilon \qquad (5)$$

where earnings volatility and z-score are the dependent variables as defined in equations (1), (2) and (3); bank size is the proxy for bank size computed as the natural log of total asset for bank *i* at time *t* in years while concentration is the proxy for bank concentration computed using Herfindahl Hirschman Index (HHI). According to HHI, banking concentration is computed as the summation of the squares of market share of each bank at a given year. In this study, we followed CBK computation of market share, which is a weighted average based on the total net assets (weight=0.33), total deposits(weight=0.33), total shareholders'

fund(weight=0.33), number of deposit accounts(weight=0.005) and number of loan accounts(weight=0.005). *X* is a vector of bank specific control variables.

We applied Hausman test to determine whether to use fixed effect (FE) model or random effect (RE) model under the following hypotheses:

H_0: Random effect model is the appropriate model to use

H_1: Fixed effect model is the appropriate model to use

Table 3: Hausman test for model selection between fe and re

Statistics	Coef.
Chi-square test value	20.998
P-value	0.0003

Since the p-value is far less than 5%, the null hypothesis was rejected. Hence, in this study, we used fixed effect model which allowed us to control for bank specific and year specific dynamics, as appropriate to the analysis.

IV. FINDINGS

IV-A. Descriptive Statistics and Graph Presentations

Table 4: Summary statistics

Variables	mean	sd	p50	min	max	skewness	kurtosis	N
ROA volatility	1.177	1.249	0.805	0.00319	6.238	2.398	9.332	649
ROE volatility	13.28	14.37	10.28	2.694	112.5	5.667	38.91	649
Market volatility	1.873	0.261	1.749	1.579	2.425	0.965	2.710	649
z-score1	2.827	8.527	0.230	-3.999	66.20	4.291	22.52	649
z-score2	4.730	3.109	4.934	0.0550	10.05	-0.0650	1.716	649
Bank size	10.14	1.407	9.868	7.103	13.54	0.309	2.181	649
Leverage	3.653	96.83	6.634	-2,430	173.2	-24.75	622.5	643
Deposit/asset	0.734	0.118	0.761	0.00114	0.989	-1.779	8.147	643
Loan/assets	0.737	1.826	0.333	0	19.90	6.592	53.75	643
Market share	0.0245	0.0331	0.00823	-0.000107	0.173	2.020	6.730	638
Concentration	0.0675	0.00544	0.0671	0.0582	0.0808	0.558	3.212	649
Number of banks	**44**	**44**	**44**	**44**	**44**	**44**	**44**	**44**

Table 4 displays the descriptive statistics for the variables used in this study. All the data (apart from the computed ones) were obtained from Central Bank of Kenya website on Banking Supervision and Banking Sector annual reports for the years 2005-2020. ROA volatility, ROE volatility and Market volatility are proxies for earnings volatility and are computed using equations (1) and (2) respectively. z-score1 is used as proxy for bank risk and is computed using equation (3) while its variant z-score2 is bank risk at the market level. Bank size was used as proxy for the main variable, size of bank, and was computed using natural logarithm of total assets for each bank at time *t.* Leverage is the ratio of total assets to total equity; deposit/assets is the ratio of total deposits to total assets; loan/assets is the ratio of total loans to total assets; market share is a weighted average computed following CBK computation and concentration is the proxy for bank concentration computed following HHI formula.

Table 4 shows that the variables for this study fairy had normal distribution. However, some outliers were identified where skewness was larger than 3 or less than -3. For these observations, the kurtosis was larger than the minimum 10 for normal distribution. These observations were investigated and dropped from our analysis. Similarly, the observation with negative market share was investigated and dropped from our analysis. Observations with negative leverage causing high skewness were also dropped from the analysis.

Further, we presented our arguments on the characteristics of large banks using graphical presentation. The four largest banks in Kenya by their market share include Kenya Commercial Bank (KCB), Equity Bank, Absa Bank and Standard Chartered Bank. Figure 2 shows the growth in total assets (in Million Kenya shillings (Ksh) for the four largest banks in Kenya over the study period. As shown in the diagram, these banks have increased in their total assets at an increasing rate. This compares with Figure 3 which shows the relative increase in bank size.

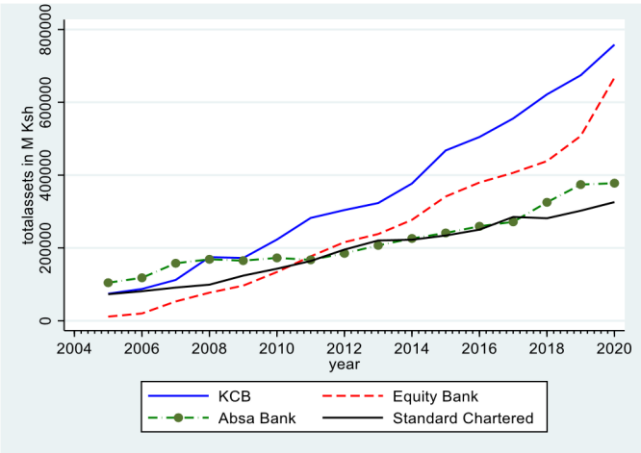


Figure 2: Growth of four largest banks by asset

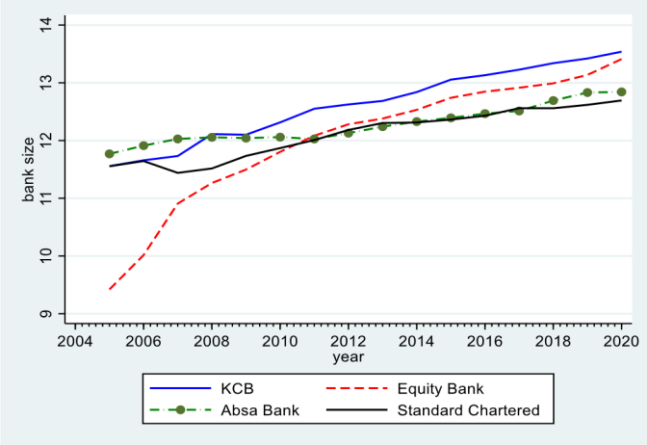


Figure 3: Increase in bank size for four largest banks

As these banks increase at an increasing trend, their specific activities do not increase at the same rate. Figure 4 shows the trend of lending activities for the four banks while Figure 5 shows their changes in total deposit over the study period. As evidenced by these trends, lending activity of the largest banks does not increase at same rate as the increase in bank size. However, deposit activity seems to depict similar trends as that of bank total assets. Apart from KCB which shows a sharp increasing trend in loan growth over time, the other three banks have relatively low growth rate of their loan portfolio as compared to their asset growth in Figure 1.

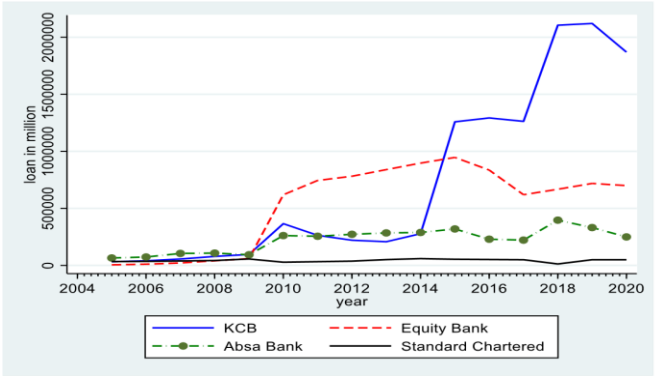


Figure 4: Growth of four largest banks by loan size

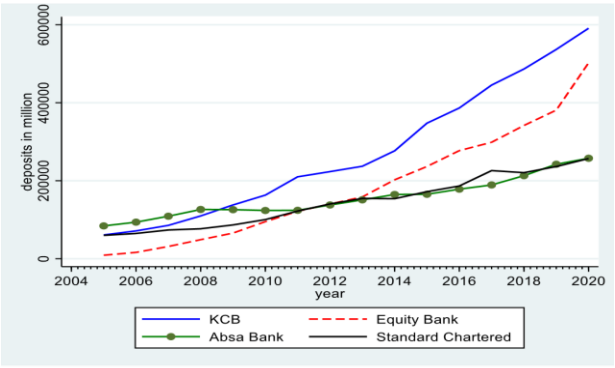


Figure 5: Growth of four largest banks by deposit size

Moreover, Figure 6 shows that large banks engage in more lending activities as their size increase. While the findings by Laeven, *et al.* (2014) in their study showed that large banks engage less in lending activities, our findings showed a different trend as the largest commercial banks in Kenya lend more. They also increased their reliance on deposit as source of funding (Figure 7), though at a lower rate as compared to the loan rate in Figure 6. Laeven, *et al.* (2014) argued that large commercial banks engage more in non-traditional banking activity, that is, they engage more in market-based activities than lending activity.

However, our results show different trends, possibly owing to the level of development of market-based activities.

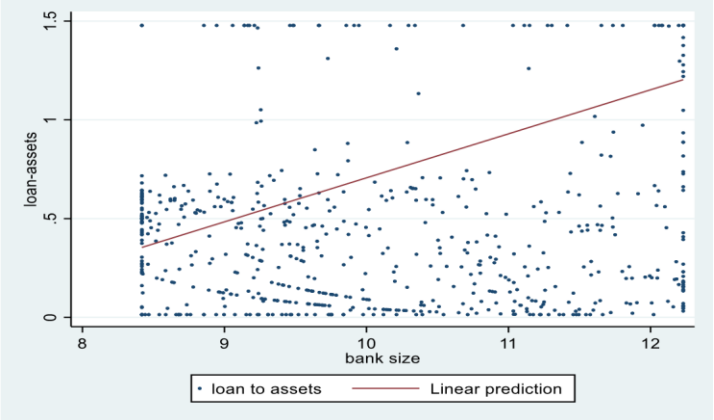


Figure 6: Large banks engage in more lending activities

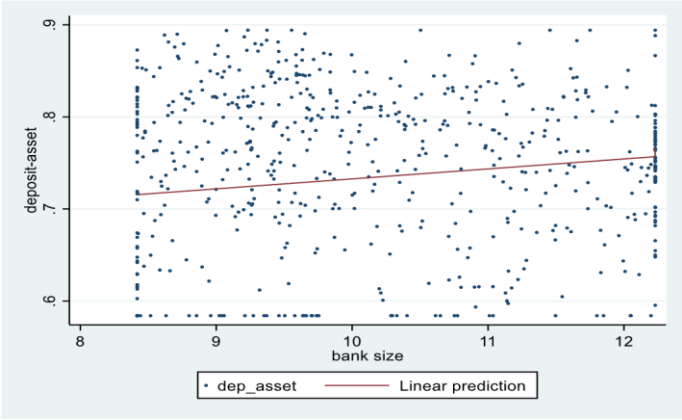
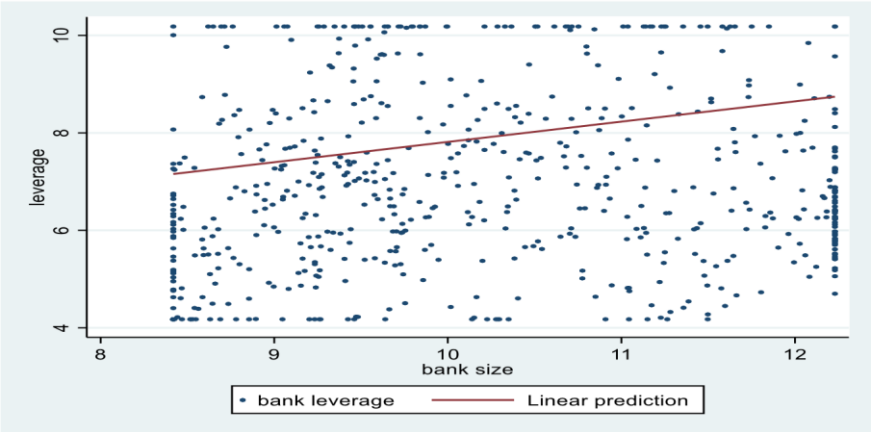


Figure 7: Large banks have more funding from deposit

Further, large banks hold less capital than small banks. Figure 8 shows the leverage ratio (computed as the ratio of total assets to total equity), evidencing that large banks have higher leverage ratio than smaller banks. This implies that large banks have relatively lower capital compared to their asset base.

Figure 8: Large banks have higher leverage



IV-B. Baseline Specification

Our main model shown in equation (4) has earnings volatility as the dependent variable. For robustness check, we use three measures of earnings volatility, namely, ROA volatility, ROE volatility and market level volatility.

Table 5: Baseline Specification

	(1)	(2)	(3)
Variables	**ROA volatility**	**ROE volatility**	**Market volatility**
Bank size	0.106***	-0.142	0.349***
	(2.737)	(-0.327)	(27.01)
Concentration			13.25***
			(8.070)
Deposit/asset	-1.870***	-37.00***	0.0852
	(-4.517)	(-7.927)	(0.995)
Loan/assets	0.0650**	1.980***	0.00438
	(2.473)	(6.676)	(0.946)
Leverage	-0.00515	-0.0376	0.000414
	(-1.011)	(-0.654)	(0.370)
Constant	1.623***	41.23***	-2.850***
	(3.461)	(7.796)	(-11.79)
Observations	637	637	637
R-squared	0.056	0.166	0.625

Table 5 reports the baseline model. The dependent variable is earning volatility, measured using ROA volatility, ROE volatility and market volatility. All variables and computations of the variables are defined in the legend of Table 4. Regressions in column (1) and (2) include year fixed effect while in column (3) include bank fixed effects. The tstatistics are reported in parenthesis; ***, ** and * denote significance at 1%, 5% and 10% respectively.

Our findings showed that bank size positively and significantly affect the bank earnings volatility as measured using ROA volatility. This implies that as the commercial banks grow in size, their return on assets tends to be more volatile as compared to smaller banks. However, a negative and insignificant effect was found between bank size and ROE volatility, meaning that bank size has no significant influence on ROE instability. Further, we found that bank size increases the banking market volatility. This effect is evidenced to be stronger at market level than at individual bank level, since the t-statistics (t=27.01) at market level is

bigger than t-statistics (t=2.860) at institutional level. To this, we conclude that bank size greatly affects the market level earning volatility. As the bank size increase, the market experience more volatile earnings. In addition, growth of large banks increases banking concentration, which we found has a strong and positive effect on market volatility.

IV-C. Alternative Specification

The alternative specification includes measures of bank risk using z-score. The computation of z-score is defined in equation (5).

Table 6: Alternative specification

	(1)	(2)
Variables	**z-score1**	**z-score2**
Bank size	0.346**	-3.740***
	(2.198)	(-22.47)
Concentration	-17.21	-101.0***
	(-0.860)	(-4.771)
Deposit/asset	-0.823	0.873
	(-0.788)	(0.791)
Loan/assets	-0.00580	-0.0544
	(-0.103)	(-0.911)
Leverage	-0.0248*	-0.0180
	(-1.818)	(-1.250)
Constant	-0.0778	52.25***
	(-0.0264)	(16.77)
Observations	637	637
R-squared	0.940	0.563

Table 6 reports the alternative model. The dependent variable is z-score a common measure of bank risk. All variables and computations of the variables are defined in the legend of Table 4. Both regressions include bank fixed effects. Column (1) relates to institutional risk while column (2) relates to market risk. The t-statistics are reported in parenthesis; ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Our analysis of bank risk importantly helps to capture the effect of bank size on risk exposure of the individual banks and the market. At institutional level, we argued that large banks are more exposed to risk, as they tend to lend more, take more risky investments while believing in 'too big to fail'. This risk appetite could spill over to the market and affect the overall market risk as well as the earnings volatility at the market risk. Our findings showed that growth in bank size positively and significantly affect their risk exposure. However, the presence of large banks does not increase the overall bank risk at the market level. In contrast, a negative and significant effect was found in our analysis. This would mean that large banks do not necessarily affect the market risk, though at the institutional level, their risk exposure becomes pronounced. Furthermore, we also found that increase in banking concentration, as a result of presence of large banks, negatively and significantly affect banking risk at the market level. This means that as concentration increases, the banking risk significantly reduces. While this finding negates our earlier prediction, it supports the concentration-stability hypothesis.

IV-D. Bank Size Interactions with Market Operations

We also analyse the interactions between bank category with the market operations. To perform this analysis, we divided our observations into three categories (small, medium and large-sized banks) based on the total assets of bank *i* at time *t.* We also based our bank categorization depending on the proportion that small, medium and large banks each have respectively as per the CBK bank ranking. Therefore, banks with total assets less than 25 billion Kenya shillings were categorized as *small* banks, banks with total asset greater than 80 billion Kenya shilling were categorized as *large* banks, while *medium* sized banks were the banks with total assets greater than 25 billion Kenya shilling but less than 80 billion Kenya shillings. This helped us to analyse the effect of small, medium and large banks on the market volatility and market risk.

Table 7: Bank category effects on market volatility

	Dependent variable: Market Volatility		
Variables	**Small Banks**	**Medium Banks**	**Large Bank**
Bank size	0.370***	0.363***	0.502***
	(15.84)	(8.147)	(16.53)
Concentration	10.70***	17.14***	16.12***
	(4.987)	(4.825)	(4.356)
Deposit/asset	-0.130	0.257	0.495*
	(-1.224)	(1.050)	(1.765)
Loan/assets	0.0118	-0.104**	0.00180
	(1.404)	(-2.562)	(0.274)
Leverage	-0.00543	0.00103	-0.00673
	(-1.477)	(0.955)	(-0.661)
Constant	-2.819***	-2.608***	-5.202***
	(-7.110)	(-4.357)	(-11.11)
Observations	350	142	145
R-squared	0.605	0.795	0.765

Table 7 reports the effect of bank category on market volatility. The dependent variable is market volatility. The columns re present our bank categories *small*, *medium* and *large* respectively. All variables and computations of the variables are defined in the legend of Table 4. All regressions include bank fixed effects. The t-statistics are reported in parenthesis; ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Our findings reported in Table 7 show that bank category play a significant and positive role on the market volatility as proxied by standard deviation of profit before tax as defined in equation (2). The banking system in Kenya is predominated by many small banks and few large banks. But the effect of the few large banks plays a greater positive and significant effect (t=16.53) on the overall market volatility. This is an indication that the contribution of the few large banks in the industry have a stronger combined effect compared to the many small banks in the industry. Further our analyses have shown that the size of small banks also contribute significantly to the market volatility. However, it is also noted from our study that medium banks contribute less the market volatility. We therefore conclude that the effect of bank size does not depend largely on whether a

market has many small banks or it has few dominant and large banks. Whatever the market characteristic, bank size will affect positively the market volatility. This is in line with the argument that the combined effect of many small banks in an industry could also contribute to systemic volatility.

Table 8: Bank category effect on market risk

	Dependent Variable: z-score2 (Market Risk)		
Variables	**Small Banks**	**Medium Banks**	**Large Bank**
Bank size	-4.194***	-4.543***	-5.245***
	(-12.59)	(-7.640)	(-15.06)
Concentration	-71.67**	-158.9***	-198.9***
	(-2.344)	(-3.350)	(-4.689)
Deposit/asset	3.007**	1.846	-0.106
	(1.983)	(0.565)	(-0.0329)
Loan/assets	-0.124	0.258	-0.00577
	(-1.036)	(0.477)	(-0.0765)

Leverage	0.0849	-0.0301**	0.144
	(1.621)	(-2.084)	(1.228)
Constant	53.05***	55.44***	77.59***
	(9.392)	(6.933)	(14.45)
Observations	350	142	145
R-squared	0.524	0.727	0.726

Table 8 reports the effect of bank category on market level risk. The dependent variable is z-score2 measure of bank risk at the market level. The columns represent our bank categories *small*, *medium* and *large* respectively. All variables and computations of the variables are defined in the legend of Table 4. All regressions include bank fixed effects. The t-statistics are reported in parenthesis; ***, ** and * denotes significance at 1%, 5% and 10% respectively.

Table 8 shows our findings on the interactions between our bank categorization with the banking market risk. Market risk is defined and computed in equation (3). Our findings have shown that the effect of bank size on for all categories of banks have a negative and significant effect on market risk. This implies that increasing bank size would significantly reduce market risk. However, the growth of large banks tends to greatly reduce the market risk (t=-15.06) as compared to the effect of small banks (t=-12.59).

V. CONCLUSION AND RECOMMENDATIONS

The global financial crises triggered the forgotten debate about large banks and the "too-big-to fail" syndrome. On this interest, this paper sought to investigate the effect of large banks on bank earnings volatility. Included in our analysis is ROA volatility (ROE volatility) and market volatility, as measures of bank earnings volatility at bank level and at market level respectively. In addition, we used bank risk, at individual bank level and at market level, to offer further analysis in our model. Our graphical presentations showed that large banks in Kenya have been growing at an increasing rate, and that these banks have different organizational characteristics compared to smaller banks. Further, our findings have shown that bank size positively and significantly affect the bank earnings volatility as measured using ROA volatility.

However, a negative and insignificant effect was found between bank size and ROE volatility. We also found that growth in bank size positively and significantly affect their individual risk exposure. However, the presence of large banks does not increase the overall bank risk at the market level. Furthermore, we also found that increase in banking concentration, as a result of presence of large banks, negatively and significantly affect banking risk at the market level. Our results suggest that policy makers have nothing to worry about the large banks in Kenya, at least, as channel for systemic risk. But their concern should be on the institutional risk exposure of the large banks. Tightening regulatory and supervisory framework would improve the individual bank risk management, especially in line with Basel III accord.

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Appendices Table A1: Bank distribution

Bank	No. of observations	Min. year	Max. year	No. of years
ABC Bank	16	2005	2020	16
Absa Bank	16	2005	2020	16
Access Bank	16	2005	2020	16
Bank of Africa	16	2005	2020	16
Bank of Baroda	16	2005	2020	16
Bank of India	16	2005	2020	16
CBA	16	2005	2020	16
CFC Stanbic Bank	16	2005	2020	16
Charterhouse Bank Ltd	8	2005	2013	8
Chase Bank Ltd	10	2005	2014	10
Citibank Bank	16	2005	2020	16
Consolidated Bank	16	2005	2020	16
Coop Bank	16	2005	2020	16
Credit Bank	16	2005	2020	16
Development Bank	16	2005	2020	16
Diamond Trust	15	2005	2020	15
Dubai Bank Ltd	10	2005	2014	10
Ecobank	16	2005	2020	16
Equity Bank	16	2005	2020	16
Family Bank	15	2006	2020	15
First Community	13	2008	2020	13
GTBank	16	2005	2020	16
Giro Bank	12	2005	2016	12
Guardian Bank	16	2005	2020	16
Gulf Bank	13	2008	2020	13

Habib AG Zurich Bank	16	2005	2020	16
Habib Bank	12	2005	2016	12
Housing Finance	12	2006	2020	12
I&M Bank	16	2005	2020	16
Imperial Bank Ltd	10	2005	2014	10
KCB	16	2005	2020	16
Kingdom Bank	11	2010	2020	11
M-Oriental Commercial Bank	16	2005	2020	16
Middle East Bank	16	2005	2020	16
NIC	14	2005	2018	14
National Bank	16	2005	2020	16
Paramount Bank	16	2005	2020	16
Prime Bank	16	2005	2020	16
SBM Bank	15	2005	2020	15
Sidian Bank Ltd	16	2005	2020	16
Spire Bank	13	2005	2017	13
Standard Chartered	16	2005	2020	16
UBA Bank	12	2009	2020	12
Victoria Commercial Bank	16	2005	2020	16
Total	**643**			

This table reports the frequency distribution of banks in our sample. Min. (Max.) year is the first (last) that a bank is included in the sample.

Table A2: Number of Banks per Year

Year	No. of banks observed
2005	38
2006	40
2007	40
2008	42
2009	42
2010	44
2011	43
2012	44
2013	44
2014	43
2015	40
2016	39
2017	38
2018	38
2019	37
2020	37

This table reports the total number of banks observed in each year for our sample