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# Stress Testing Exposure of Banks to Sectors of the Ghanaian Economy

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## ABSTRACT

The capacity of Ghanaian banks to absorb large but plausible losses resulting from concentration of individual bank loan portfolios in sectors of the Ghanaian economy is investigated. Stress scenarios consist of worsening of banks' impaired loan charges by one, two and three standard deviations of the industry's recent distribution of non-performing loans. Findings reveal that the capital adequacy ratios of many banks would have been negatively impacted, some to the point of becoming insolvent. It is argued that, though these would be micro-prudential breaches, they are of such magnitude as to have economy-wide repercussions. Thus, bank loan portfolios are too concentrated.

## KEYWORDS

Credit risk; loan concentration; stress tests; capital adequacy; Ghana; micro-prudential regulation

## 1. Introduction

Stress tests are methods of subjecting individual bank variables or the entire banking system to exceptional but plausible negative scenarios to determine whether they can withstand the impact of adverse developments. If, in spite of such stress, banks display attributes of remaining legal going concerns and/or the banking system still performs its functions well, confidence in the individual banks and the banking system rises.

Stress tests are carried out to shed more light on key risks that banks face. Credit risk has been most investigated, because bank credit is often the primary funding source for the real economy in many developing economies (Disyatat, 2001). Thus, disruptions in credit supply to enterprises impact output noticeably. Stress test results typically depend on the scenarios or assumptions made. To the Bank of Ghana (2009, p. 5), stress tests are

important in providing forward-looking assessments of risk, overcoming limitations of empirical models and historical data . . . informing setting of bank risk tolerance or system risk tolerance, and facilitating the development of risk mitigation or contingency plans across a range of stressed conditions.

To Bunn, Cunningham, and Drehmann (2005, p. 50), stress tests tend to be useful in complementing other models in assessing vulnerabilities as no single model is likely to capture fully the diverse channels through which shocks may affect a financial system.

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This study proposes another angle from which stress tests of bank loan portfolios may be conducted and uses Ghana as a case study. The approach focuses on possible adverse consequences of concentration of loans made to sectors of the Ghanaian economy. It analyzes the extent to which deterioration in the quality of loans made to the sector of the economy to which each bank's overall loan portfolio is most exposed impairs the chances of the bank's capital remaining above the regulatory minimum. Indeed, the Bank for International Settlements (2009) recommends that banks should regularly maintain and update their stress testing frameworks.

This exercise may be extended to other sub-Saharan African economies, a region whose banking environment is peculiar. For example, alternate financial markets are not well developed; regulations are dated (mostly based on *Basel I*); and regulators are not powerful and have limited capacity to enforce rules. Further, information, the basis of prudential supervision, is often not timely nor very accurate. As a consequence, banks are more opaque. The choice of Ghana is based on the fact that in many respects, she is held up as a star sub-Saharan African reforming economy by both the World Bank and the International Monetary Fund (IMF).

The most recent publicly available information on credit risk stress tests of Ghanaian banks is reported by the International Monetary Fund (IMF, 2014). That report indicates that using end of 2013 data, the central bank of Ghana conducted two credit risk stress tests. One involved a reclassification/migration of 17% of all loans from one risk class to the next higher risk class. The other investigated the failure of each bank's largest borrower. The report concluded that

Only one bank would have negative capital under various stress tests, while about two-thirds of all banks (representing about two-thirds of total assets) would stay above the regulatory minimum capital requirement. Hence, potential recapitalization needs based on estimates of direct impact would likely be small, relative to GDP. (13)

The findings of the current study do not support the IMF (2014) report, for, while it implies that the banking system would be preserved, this study finds that because Ghanaian data suggests increasing dependence of banks on each other, negative shocks felt by some banks are likely to be transmitted to many other banks. For example, transactions in the overnight interbank market grew substantially during the period under investigation from USD 18.2 billion in 2010 to USD 61.2 billion in 2014 (Citifmonline, 2016), suggesting growing involvement of many banks in the interbank market. As such, signs of financial distress among a number of participating banks can result in financial contagion. Financial contagion describes a situation in which liquidity or insolvency risk of one financial institution is transmitted to others. It can result in systemic risk for the financial system and has implications for financial stability.

The next section discusses some theoretical underpinnings of micro and macro stress testing followed by the methodology adopted. Study results are then presented followed by a discussion of findings and then conclusions.

## 2. Prudential regulation

### 2.1 Background

That a stable financial sector plays a vital role in economic growth is well established in the literature. Financial institutions are regulated to reduce the chances of disruptions to the functioning of the financial system. Disruptions may result from excessive exposures to risk, which may undermine economic growth and lead possibly to reduced incomes, reduced employment levels, and possibly social unrest.

As a regulatory measure, the central bank requires banks to report their loan exposures to nine sectors of the economy. [Table 1](#) presents end-of-year distribution of industry loans from 2011 to 2014. It says that Commerce & Finance had the highest share of credit each year, averaging 26.1%. Next, is Services with an average of 25.1%. Thereafter, the average dropped substantially to 10.4% for Electricity, Water & Gas. Mining & Quarrying received the least over the period (3.5%). It is noteworthy that over 51% of total industry loans went to two sectors only, suggesting concentration of loans in these sectors. For the rest of Africa, African Development Bank (2011) suggests that in many African countries, bank loans are concentrated.

[Table 1](#) (Panel B) also reports annual gross interest earned on loans as proportions of gross income for the industry. Interest on loans contributed an average of 45.3% over the period. This is high and is more than any other income stream or activity. This suggests that a big negative shock that affects interest on loans will negatively impact bank profitability, which in turn will reduce amount transferred to income surplus (retained earnings), hence bank capital. Finally, [Table 1](#) also presents industry end-of-year capital adequacy ratios (CARs). The CARs were well above the regulatory minimum of 10%. It is against this background that stress tests of the performance of loans to sectors of the economy to which individual banks are most exposed was conducted.

### 2.2 Micro and macro prudential regulation and systematic risk

Bank regulation may occur at two levels, micro-prudential and macro-prudential. Micro-prudential bank regulation refers to certification of banks, rules about assets that may be held,

**Table 1.** Proportions of Industry Loans Allocated to Economic Sectors, Interest Income and Capital Adequacy Ratios

Sector	2011 %	2012 %	2013 %	2014 %	Average %
<b>PANEL A</b>					
Commerce and Finance	27.2	27.1	25	25.1	26.1
Services	26.9	25.2	26	22.3	25.1
Manufacturing	8.9	11.6	9	8.9	9.10.2
Construction	8.1	8.4	10	9.7	8.6
Electricity, Water & Gas	6.7	10.6	12	12.1	9.5
Miscellaneous	8.1	8.5	7	9.1	7.9
Agriculture, Forest & Fishing	5.7	5.2	4	3.9	4.9
Transport, Storage. & Communication	4.2	4.5	5	6.2	4.6
Mining & Quarrying	4.3	4.1	3	2.7	3.3
<b>TOTAL</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>PANEL B</b>					
Interest earned on Loans	47	39	44	51	45.3
CAR %	17.4	21.1	18.5	22.5	19.7

Source: Bank of Ghana 2014a.

financial instruments that may be traded, or how these may be reported. It is also about how the value and riskiness of bank assets and liabilities may be determined. Micro-prudential regulation is primarily about stability of individual banks and protection of their clients. It is typically about a bank's response to exogenous risks.

Macro-prudential regulation on the other hand, is concerned with regulating economy-wide risks that can accumulate across the banking sector. It is aimed at limiting episodes of significant financial distress that potentially would impact the real economy as a whole. Macro-prudential analysis focuses on threats to financial stability stemming from common shocks affecting all (or a large part of) institutions or spreading of individual problems to the rest of the system.

The benefits of macro-prudential regulation notwithstanding, micro-prudential regulation is the system in place in Ghana and most of sub-Saharan Africa. In fact, Acharya (2013) writes that micro-prudential regulation in emerging markets is still important because traditional banking is funded by dispersed creditors who are more concerned about their bank's health than the health of the entire banking system. Acharya (2013) further argues that, where macro-prudential regulation does not exist (as is the case in many parts of Africa), the best authorities can hope for is to position themselves to extend their micro-prudential regulation to mimic macro-prudential regulation.

### 2.3 *Stress testing bank loan portfolios*

One approach to stress testing bank solvencies is to conduct financial simulation of the performance of banks' loan portfolios based on some metric. Practitioners find this approach tractable and more easily understood by policymakers (see for example, Buncic and Melecky, 2013).

Alternatively, loan portfolio losses may be benchmarked to changes in some metric, usually, publicly available information, rules of thumb, or shocks mandated or suggested by external bodies such as regulators. Further, historical analysis of loan portfolio performance may be conducted to deduce the level of stress to put on the loan portfolio. Also, some practitioners investigate the impact of factors that theory suggests will drive loan portfolio losses, while others investigate the impact of changes in the risk grade of constituents of bank loan portfolios.

However, researchers now realize that focus on solvency only, or treating solvency and liquidity separately, does not reveal the full picture of exposure of the banking system. This realization led to development of models that integrated solvency and liquidity (and other risks). Another set of models proceed by designing structural macroeconomic models (general equilibrium models or dynamic stochastic general equilibrium models) which explicitly incorporate the financial sector to capture the systemic effects that the financial sector may have on the real economy. (Examples include Demekas, 2015 and Monetary and Capital Markets Department of the IMF, 2012).

Demekas (2015) notes that strides have been made in modelling systematic risk, but they come at the price of analytical and computational complexity, huge data requirements, slow speed and high cost. Also, they rely on bank balance sheet data, which must be available and of acceptable quality. Further, Demekas observes that the biggest headache to implementing macro-prudential stress tests is the different ways by which banks may be interconnected/interdependent. For example, the impact of capital

shortfalls of individual banks is not representative of the vulnerability of the system as a whole. That is, a good appreciation of how contagion might work its way through the banking system is required.

Acemoglu, Ozdaglar, and Tahbaz-Salehi (2015) show that for small magnitudes of negative shocks, the more diversified the interbank liabilities, the less fragile the financial system. However, as the magnitude and/or the number of negative shocks increase beyond a threshold, more diversified (inter-connected) interbank liabilities increase financial contagion, leaving the economy more fragile.

## 2.4 Empirical findings

The most recent central bank credit risk stress study conducted in Ghana that is publicly available has been discussed (IMF, 2014). For South Africa, Havrylychuk (2010), developed a macroeconomic credit risk model for stress testing the banking system. Trial results suggest that macroeconomic shocks have a large impact on credit losses. For Nigeria, Blaauw (2009) observed that banks had not been active in developing effective stress testing programs due to lack of data and the potential complexity of appropriate models.

In the heat of the recent global financial crisis, the US Federal Reserve in 2009 implemented the 2009 Supervisory Capital Assessment Program (SCAP). Later, Bernanke (2013) reported that SCAP provided one of the critical turning points of the crisis. It focused on the impact of common exposures, the effects of possible fire sales of assets, the risk of reduced access to funding in stressed environments, and the importance of considering the impact on a cross-section of banks, as key macro-prudential elements of stress tests. Public disclosure of SCAP results provided economic agents credible information about prospective losses at banks and helped restore confidence in the banking system, he added.

In Europe, the Committee of European Banking Supervisors (2010) reported test results covering 91 banks in 20 European Union countries. Seven banks failed the test and had the stress scenario unfolded, they would have required additional injection of USD 4.73 billion for their Tier one capital to avoid falling below the 6% threshold.

In this paper, a micro prudential approach that estimates the effect of deterioration of loans to the sector of the Ghanaian economy to which each bank was most exposed was conducted. Stressed capital adequacy ratios (CAR) were calculated. The Basel Committee on Banking Supervision (2006) notes that concentration of exposures in credit portfolios is an important aspect of credit risk that arise from two different types of imperfect diversification. One is name concentration, which relates to imperfect diversification of idiosyncratic risk in the portfolio, either because of its small size or because of large exposures to specific individual obligors. The second is sector concentration, which relates to imperfect diversification across systematic components of risk (sectoral factors). This study focuses on the second. The findings are discussed in the context of possible financial contagion stemming from increasing interaction among banks in the Ghanaian interbank market.

## 3. Methodology

Under its prudential regulation guidelines, the Bank of Ghana requires bank loans to be graded into five categories. Loans classified into the two top categories are described as performing, while loans in the lower three categories are described as non-performing.

Banks must make more loss provisions for loans of lower grade. The sum of all loss provisions for the year is charged against the income of the bank (called impairment charge), and total gross loans figure on the balance sheet is reduced by this amount to obtain net loans. Decline in profitability resulting from loan deterioration means that the amount that is available to be transferred from the income statement to the balance sheet as income surplus (retained earnings) is reduced. To the extent that loan deterioration changes both assets and capital of banks, it has the effect of changing capital adequacy ratios.

### 3.1 Computations of stressed CAR

To undertake the micro stress tests reported in this paper, the authors created three progressively worse hypothetical scenarios that result in deterioration in the performance of loans to the sector of the Ghanaian economy to which each bank is most exposed. Stress scenarios consisted of worsening of the quality of a bank's loans by one (*mild stress*), two (*moderate stress*), and three (*extreme but plausible stress*) standard deviations of the mean of the banking industry's historical distribution of *impaired loan charges*. The stress for this year is the largest standard deviation of the three most recent prior annual standard deviations. That is, the standard deviation used for 2012, is the largest of the standard deviations of 2009, 2010, and 2011, and the largest of 2010, 2011, and 2012 is used for 2013, and the largest of 2011, 2012, and 2013 for 2014. In the set out below, the standard deviation that is used is referred to as  $s\%$ .

Investigations are conducted using end of 2012, 2013, and 2014 data. The impact of increased *impaired loan charges* are traced to balance sheets, income statements and capital adequacy ratios (CAR). End-of-year bank returns to the central bank (including financial statements) serve as benchmarks against which stressed scenarios were compared.

Base CARs (0% stress) are reported to the central bank. They are calculated as base Adjusted Capital divided by base Adjusted Assets. Calculations of base Adjusted Capital and base Adjusted Assets are done according to central bank directives, which are generally in consonance with Basel I (Bank of Ghana 2005a, 2005b). Calculations of stressed CARs proceeds as follows.

Suppose that for a bank, the quantum of loans made to the sector with the largest share of loans is  $L$ . Then, additional impaired loans due to the stressed conditions are  $s\%$  of  $L$ ,  $2s\%$  of  $L$ , and  $3s\%$  of  $L$ , for *mild*, *moderate* and *extreme but plausible stress*, respectively. Hence, base Adjusted Assets are reduced by  $s\%$  of  $L$ ,  $2s\%$  of  $L$  and  $3s\%$  of  $L$  respectively to yield stressed Adjusted Assets.

Next, on the income statement, not having information on the contribution of  $L$  to total impaired loans, one proceeds by assuming that reductions in actual reported interest income from loans ( $I$ ) as a result of additional  $s\%$  of  $L$ ,  $2s\%$  of  $L$  and  $3s\%$  of  $L$  impaired loans are,

$$\Delta I_{mild} = s\% \text{ of } \left( \frac{L}{LOANS} \right) I;$$

$$\Delta I_{moderate} = 2s\% \text{ of } \left( \frac{L}{LOANS} \right) I; \text{ and}$$



$$\Delta I_{extreme} = 3s\% \text{ of } \left( \frac{L}{LOANS} \right) I,$$

under *mild*, *moderate*, and *extreme but plausible* stress respectively. *LOANS* is total loans on which benchmark (actual) interest income, *I*, was calculated.  $\Delta I_{mild}$ ,  $\Delta I_{moderate}$  and  $\Delta I_{extreme}$  are then subtracted from reported (no stress) net interest income respectively to yield stressed net incomes.

To the resulting (stressed) net interest income is added income from other sources to obtain operating income, from which is deducted (i) operating expenses, (ii) actual impairment charge for the year, and (iii) the additional *s%* of *L*, *2s%* of *L* and *3s%* of *L* impairment charge just calculated, respectively. The Ghanaian corporate tax rate of 25% is then imposed on the resulting figure to obtain the amount transferred from the income statement to the capital account (equity). Call this *z*.

The actual base Adjusted Capital reported for the year is then reduced by the difference between the actual amount transferred to capital and *z*. The result is called stressed Adjusted Capital. The stressed CARs for *mild*, *moderate* and *extreme* stress scenarios are then calculated respectively as stressed Adjusted Capital divided by stressed Adjusted Assets. This was done for 2012, 2013, and 2014.

### 3.2 Data sources

The principal sources of data are the published financial statements of all banks. Important additional sources are the capital adequacy returns and industry sectoral distribution of loans filed with the central bank. All data were collected from the Banking Supervision Department of the Bank of Ghana. However, it is generally acknowledged that data quality in the sub-Saharan African environment, including bank data, can be improved further. For stress tests, the importance of quality of data has been emphasized by Demekas (2015) and is noted here.

## 4. Findings

### 4.1 Benchmark industry capital adequacy ratios

The number of banks evaluated annually was 23. However, the faces of the banks changed due to mergers and acquisitions and new entrants. In each of the three years, the base CARs span a wide range and showed healthy annual means and medians relative to the legal minimum of 10%. The annual means ranged between 18% and 21%, while annual medians ranged between 17.5% and 18.6%. However, minimum reported base CARs of one bank fell below the legal minimum in 2012 and again in 2014. Banks with CARs below the legal minimum would have been called upon to inject additional capital.

### 4.2 Stress results

Table 2 reports results for 2012. The applicable standard deviation was 13.4%. Under *mild stress*, the CAR of five banks fell below the legal minimum. These too, would have been called upon to inject additional capital. The same call would have gone out to



**Table 2.** Stress Test Impacts on Bank Capital Adequacy Ratios (CAR), 2012. Scenarios considered were deterioration in actual loan impairment charge to the sector to which each bank is most exposed (last column) by mild, moderate and extreme but plausible stress

BANK	Base CAR %	Mild Stress %	Moderate Stress %	Extreme Stress %	Most Exposed Sector
BANK 1	23.6	22.6	21.0	18.9	Miscellaneous
BANK 2	16.7	14.4	12.0	7.7	C&F
BANK 3	21.1	18.5	16.0	12.2	Services
BANK 4	17.1	15.7	14.4	12.4	Services
BANK 5	35.6	33.0	30.6	25.8	Services
BANK 6	18.6	17.0	15.5	13.1	C&F
BANK 7	31.3	27.9	24.7	18.9	EGW
BANK 8	18.7	17.7	16.8	15.4	EGW
BANK 9	17.9	16.6	15.4	12.5	C&F
BANK 10	24.3	23.4	22.7	20.9	Services
BANK 11	64.1	62.0	61.6	60.0	Miscellaneous
BANK 12	17.1	13.9	8.6	1.3	C&F
BANK 13	11.0	7.5	5.4	1.3	Services
BANK 14	19.5	15.7	13.6	8.5	Construction
BANK 15	7.7	7.6	6.6	4.5	Services
BANK 16	19.7	17.2	15.1	11.3	Services
BANK 17	33.8	32.0	30.3	26.8	C&F
BANK 18	13.4	10.5	8.0	3.4	Services
BANK 19	14.3	12.2	10.3	7.0	C&F
BANK 20	11.1	9.5	8.0	5.3	Construction
BANK 21	11.6	9.6	7.7	4.5	Services
BANK 22	20.5	16.4	12.6	6.0	C&F
BANK 23	15.2	11.8	8.7	2.3	Services
<b>Maximum</b>	64.1	62.0	61.6	60.0	
<b>Mean</b>	21.0	16.5	16.9	13.2	
<b>Median</b>	18.6	14.4	14.4	11.3	
<b>Minimum</b>	7.7	6.9	5.4	1.3	

Notes. Source: Author's computations. Shaded CARs are below regulatory minimum. Legend: C&F = Commerce and Finance; EGW = Electricity, Water and Gas.

shareholders of all eight banks whose CAR fell below the legal minimum under *moderate stress*. Finally, under *extreme but plausible stress*, CARs of 12 out of 23 banks fell below the legal minimum. One of these is BANK 2, one of the biggest banks in the country. Note that even under *extreme stress*, the industry mean CAR was 13.2%. An observer focusing only on the industry mean may have concluded that all was well with the industry. This would obviously have been a wrong conclusion, for, calling upon approximately 50% of the industry to inject fresh capital would have caused turmoil in the economy, contrary to the interpretation in IMF (2014).

At the end of 2013, no bank reported a base CAR below the regulatory minimum. Please refer to Table 3. For 2013, the applicable standard deviation was 11.7%. Under *mild stress*, the CAR of one bank fell below the minimum. Under *moderate stress*, the CARs of six banks fell below the regulatory minimum, of which one CAR was negative. Under *extreme but plausible stress*, the CAR of seven banks fell below the minimum. With negative CARs, BANK 18 and BANK 22 would have failed.

At the end of 2014, under *mild stress*, the CARs of four banks fell below the legal minimum. Please see Table 4. At *moderate stress*, the CARs of seven banks fell below the minimum. Finally, under *extreme but plausible stress*, the CARs of 13 banks fell below the regulatory minimum. BANK 2 (a big bank) is again affected. Of the 13, three would have failed because their CARs were negative.

**Table 3.** Stress Test Impacts on Bank Capital Adequacy Ratios (CAR), 2013. Scenarios considered were deterioration in actual loan impairment charge to the sector to which each bank is most exposed (last column) by mild, moderate and extreme but plausible stress.

BANK	Base CAR %	Mild Stress %	Moderate Stress %	Extreme Stress %	Most Exposed Sector
BANK 1	23.6	22.4	20.5	18.6	Services
BANK 2	23.2	19.5	15.8	11.7	C&F
BANK 3	16.4	14.5	12.4	10.1	Services
BANK 4	13.1	12.1	10.8	9.5	EGW
BANK 5	35.0	33.8	31.9	30.0	C&F
BANK 6	19.2	18.1	16.6	15.0	Services
BANK 7	47.1	47.5	46.5	45.5	EGW
BANK 8	17.1	15.6	13.5	11.4	C&F
BANK 9	27.3	26.4	25.3	24.2	C&F
BANK 10	15.8	14.3	12.2	10.0	C&F
BANK 11	35.1	33.9	33.0	32.1	C&F
BANK 12	20.3	18.3	15.2	12.0	C&F
BANK 13	14.2	10.7	8.4	6.0	Services
BANK 14	22.5	19.3	16.6	13.8	Services
BANK 15	17.5	14.7	13.2	12.7	C&F
BANK 16	18.9	16.8	14.4	11.9	C&F
BANK 17	28.1	25.9	23.5	20.9	C&F
BANK 18	12.2	6.5	-0.1	-7.8	Services
BANK 19	12.7	10.9	8.7	6.4	C&F
BANK 20	15.8	14.3	12.2	10.0	Construction
BANK 21	12.8	10.8	8.6	6.3	Services
BANK 22	15.2	10.2	4.6	-1.9	Services
BANK 23	13.8	11.8	9.7	7.6	Services
<b>Maximum</b>	47.1	47.5	46.5	45.5	
<b>Mean</b>	20.7	18.6	16.3	13.7	
<b>Median</b>	17.5	15.6	13.5	11.7	
<b>Minimum</b>	12.2	6.5	-0.1	-7.8	

Notes. Source: Author's computations. Shaded CARs are below regulatory minimum. Legend: C&F = Commerce and Finance sector; EGW = Electricity, Water and Gas. Bank 27 is a new entrant.

### 4.3 Discussion

The claim that there is the potential of banking sector contagion is illustrated in Table 5. The Table depicts a general upward trend in interbank overnight transactions. Starting 2010 with USD 18.2 billion, these transactions increased steadily to USD 61.2 billion in 2014, a huge growth of 240% in four years. Data sources do not provide details of the number of participating banks, but it is reasonable to hypothesize that more banks participated from year to year. The banks that would have been required by regulators to inject additional capital to meet minimum capital adequacy obligations are likely to also have been active participants in the interbank market. If called upon to meet capital adequacy requirements, affected banks may have opted to achieve this by trying to quickly sell assets. Such actions by so many banks, especially under extreme stress, would have driven down the value of assets, leading potentially to banking sector contagion. Such banking sector distress would probably have affected other sectors of the economy. Disyatat (2001) emphasized the importance of bank loans to the real economy in developing countries. Thus, the Ghanaian banking system suffers from sector concentration, (Basel Committee on Banking Supervision, 2006). Whether inter-bank liabilities have crossed the threshold of making the Ghanaian financial system more fragile in the sense of Acemoglu et al. (2015) is yet to be investigated.

**Table 4.** Stress Test Impacts on Bank Capital Adequacy Ratios (CAR), 2014. Scenarios considered were deterioration in actual loan impairment charge to the sector to which each bank is most exposed (last column) by mild, moderate and extreme but plausible stress.

BANK	Base CAR %	Mild Stress %	Moderate Stress %	Extreme Stress %	Most Exposed Sector
BANK 1	18.2	17.1	14.8	10.0	Miscellaneous
BANK 2	17.5	14.1	10.8	3.3	C&F
BANK 3	14.1	12.2	10.0	2.6	Services
BANK 4	18.2	16.9	14.9	10.0	Services
BANK 5	31.1	29.5	27.5	24.0	Construction
BANK 6	15.0	13.9	12.4	8.5	C&F
BANK 7	27.9	26.8	24.3	17.5	EGW
BANK 8	16.2	14.5	12.8	8.6	TSC
BANK 9	20.2	19.5	18.0	13.0	EGW
BANK 10	12.0	11.0	9.6	5.6	C&F
BANK 11	20.9	18.9	17.8	15.4	C&F
BANK 12	24.8	22.8	20.0	13.9	Services
BANK 13	10.8	7.0	4.6	-0.1	Agriculture
BANK 14	21.7	18.9	17.5	14.5	Services
BANK 15	9.2	7.1	4.8	0.5	EGW
BANK 16	22.1	21.0	19.5	15.7	Services
BANK 17	14.8	10.6	5.8	-2.4	EGW
BANK 18	11.9	8.2	4.0	-2.2	Services
BANK 19	11.0	9.2	7.0	2.0	Services
BANK 20	15.1	12.9	11.6	8.2	Construction
BANK 21	12.0	10.0	7.9	4.1	Miscellaneous
BANK 22	20.5	16.0	10.8	2.4	C&F
BANK 23	28.5	27.0	25.4	21.3	EGW
<b>Maximum</b>	31.1	29.5	27.5	24.0	
<b>Mean</b>	18.0	15.9	13.6	8.5	
<b>Median</b>	17.5	14.5	12.4	8.5	
<b>Minimum</b>	9.2	7.0	4.0	-2.4	

Notes. Source: Author's computations. Shaded CARs are below regulatory minimum. Legend: C&F = Commerce and Finance sector; EGW = Electricity, Water and Gas; TSC = Transport, Storage. & Communication. Original Bank 12 and Bank 18 no more exist.

**Table 5.** Quantum of Overnight Transactions on the Ghanaian Interbank Market

Year	Transactions
Year	Billions of United States Dollars
2010	18.2
2011	25.9
2012	32.2
2013	37.3
2014	61.2

Source. Citifmonline 2016.

Another observation is that, each year, more banks with loans concentrated in Commerce and Finance and Services breached the regulatory minimum than banks with loans concentrated in other sectors. Also, it is noted that the impact of stress on the industry differed from year to year. Yet another observation is that, some banks were more likely to suffer from stress than others, BANK 2, BANK 13, and BANK 15 say.

It is logical to hypothesize that if bank loans were less concentrated, results of the stress tests carried out here would have been less severe. However, Bank of Ghana (2010, 2014) indicate that banks deliberately tighten credit to certain sectors of the economy citing poor credit history, low cash flows, inadequate security, weak

management, weak financials, lack of appropriate documentation and weaknesses in the entire process of asset administration as challenges they face in lending. The insight provided by this study to bank managers is that the risks still exist.

## 5. Conclusion and policy implications

Findings of this study suggest that many bank loan portfolios are sufficiently exposed to shocks that may strike Commerce and Finance and Services sectors, or other sectors of the Ghanaian economy. Should stressed scenarios unfold, many banks will be negatively affected resulting in possible contagion of the entire banking system. Also, some banks are more prone to suffer under stress than others.

Bank managers, supervisors, and other managers of the Ghanaian economy should take note of this. Surely, further diversification of bank loan portfolios should help reduce the impact of sector specific non-performing loans.

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