NDIC QUARTERLY

The NDIC Quarterly is a publication of the Nigeria Deposit Insurance Corporation; Enquiries should be addressed to the Editor, NDIC Quarterly, Research Department, Nigeria Deposit Insurance Corporation, P.M.B 284, Abuja, Nigeria. The Views expressed in these articles are those of the authors and do not necessarily represent the official position of the Corporation.

NDIC

QUARTERLY

VOLUME 27 September/December 2015 Nos 3/4

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The banking sector recorded a number of developments during the third and fourth quarters of 2015. Some of the major highlights of these developments included: fraud desk established by the CBN to fight cybercrimes within the Banking Industry and provide solutions toward addressing frauds arising from increased adoption of electronic payments in the country. Also in other to strengthen the regulations guiding the efficient operations of BDCs in Nigeria the CBN issued a Revised Operational Guidelines for Bureaux de Change (BDC). Other major developments in the banking industry during the period include: Circular on the Implementation of the Global Mobile Payments Monitoring & Regulation System (GMPM), Prohibition of Cash Deposit into Domiciliary Accounts by CBN, CBN Circular on the Need for Banks to Build Adequate Loan Loss reserve, CBN Guidelines on the Management of Dormant accounts and other Unclaimed Funds by Banks and Other Financial Institutions in Nigeria,CBN Circular Deadline for Transfer of Federal Government Funds to Treasury Single Account

Financial Condition and Performance of Insured Banks in third and fourth Quarter 2015 **13**

By Research, Policy & International Relations Insurance &Surveillance Departments

During the period under review, the condition and performance of the insured banks showed some positive and negative indices. On the positive side, Total Assets, Shareholders Funds, Recapitalization needs, Total Credits, Total Deposit Base, Liquidity Ratio, and Estimated Insurance Funds, all improved during the quarter; while on the flip side, CAR and Earnings looked down during the period. Despite the mixed performance, the banking industry performed averagely during the period under review.

Measuring Systemic Risk in the Nigerian Banking System **25**

By Research, Policy & International Relations Department

This paper is therefore concerned with the identification of SIBs (Systemically Important Banks) and measurement of their contribution to systemic shortfall. We measure the systemic risk contributions of Nigerian banks based on several approaches advocated by BIS, regulators and academics using regulatory and publicly available market data. The paper also discusses the tools used in management of systemic risk. The paper finds that an advantage of the SRISK (the model proposed by academics) market data-based approach over the Bank for International Settlement (BIS) Indicator approach is that market data is available at a daily frequency and therefore can capture the changing condition of banks at a daily frequency. The BIS Indicator approach can at most be updated at a monthly frequency and can only capture conditions of banks with a month's lag. Financial firms' risks, especially banks' can change very quickly. This implies that the BIS indicator approach needs to be augmented with a model that uses more up-to-date information like the SRISK approach.

Analyzing Financial System Stability By **60**

Research, Policy & International Relations Department

This paper derives default Probabilities of Default and Distance-to-Default from Merton model and applies this to a number of Nigerian financial and non-financial quoted companies. We argue that this model satisfies the macro-prudential approach to financial system stability analysis. On the basis of the Merton model, we constructed a system -wide financial stability measure for Nigeria, which builds on the put options of the banking, insurance, pension sectors, corporate and manufacturing sectors as traded on the floor of the Nigerian Stock Exchange (NSE). The analysis suggests that the Merton model appears to be useful in ranking sectors according to their contribution to financial system stability. The model also provided a means of measuring financial system stability based on individual firms, sectors and the financial system as a whole using several forward-looking measures. The presented measures for financial stability (broken down in probability and distance to default measures) offer a number of insights which may prove useful for policy purposes. First, they contribute to measuring financial system stability, thus facilitating the identification of risks and providing a guideline for policy efforts. This function has been enhanced since the measures were applied to individual firms and sub-sectors as in this paper. This could help to map vulnerabilities more precisely which could form the basis for pre-emptive or corrective action to improve the stability of the system.

REVIEW OF DEVELOPMENTS IN BANKING AND FINANCE IN THIRD AND FOURTH QUARTERS OF 2015.

1.0 INTRODUCTION

The banking sector recorded a number of developments during the third and fourth quarters of 2015. Some of these developments were bye-products of the Central Bank of Nigeria (CBN) Monetary Policy Committee (MPC) meetings.

2.0 CBN Monetary Policy Committee Meetings

The CBN Monetary Policy Committee met three (3) times between July 2015 and December 2015 to review the economic conditions and challenges confronting the Nigeria economy, against the backdrop of slowing global growth and a weakening domestic economic environment, attributable largely to the down turn in oil prices. The first MPC meeting held between July 23rd and 24th, 2015, the second MPC meeting held between September 21st and 22nd, 2015 and the third MPC meeting held between November 23rd and 24th, 2015.

3.0 International Economic Developments

During the period under review, there had been slow-down in improvements to global output evidenced by the less-than-expected growth of 2.9% in the first half of 2015. The development had been largely attributed to the deteriorating global trade, reversal in output growth in the advanced economies and a significant slowdown in growth in the emerging and developing economies.

It was noted that the key impediments to growth in the advanced economies included unfavorable labour market conditions, suppressed foreign demand and weaker than anticipated domestic aggregate demand. Also, growth in the U.S. slowed to 2.1% in the third quarter of 2015 as a result of a drawdown in inventories; deceleration in exports; drag in private consumption, drop in government spending and residential fixed investment. Its 2016 growth rate was projected at 2.6%.

The Bank of England continued its £375 billion ($570 billion) monthly asset purchase program, as there were expectations of decline in economic performance of 0.7% in

the second quarter to about 0.5% in the third quarter due to the decline in foreign demand, potentially dampening the prospects for an interest rate hike.

Japan's recovery remained fragile despite the policy stimulus by the Bank of Japan. The bank's asset purchase programme injects ¥6.7 trillion (US$56.71 billion) monthly into the economy. Growth was estimated at 0.8% in 2015.

Growth in the Emerging Markets and Developing Economies (EMDEs) continued to decrease to 4% in 2015, reflecting the protracted slowdown in China as well as recession in Russia and Brazil. The slowdown among EMDEs had been mainly due to weak import growth in China, low commodity prices, capital flow reversals, rising debt levels and other geopolitical factors. In the emerging and developing markets, the major risk to domestic prices would be the increased pressure on domestic currencies. However, in most emerging markets, the low prices of oil and other commodities had continued to cushion consumer inflation pressures.

4.0 Domestic Economy and Financial Developments

Data from the National Bureau of Statistics (NBS) indicated that real GDP grew by 2.84% in the third quarter and estimated to grow at about 3.4% by December 2015. Both the oil and non-oil sectors contributed to growth in the third quarter of 2015. In the non-oil sector, the key drivers of output growth were Crop Production, Trade and Telecommunications & Information Services, contributing 0.91, 0.79 and 0.40 percentage points, respectively. The continued slump in the oil price continues to have negative consequences on the Nigerian economy and the banking sector in particular.

5.0 Inflation

The headline inflation progressively increased from 9.2% in July 2015 to 9.55% as at December 2015, due largely to food importation as well as other core components. Core Inflation rose to 8.73% in December from 8.8% in July 2015, while food inflation rose from 10.0% in July 2015 to 10.32% in December 2015 (See Table 1 below).

TABLE 1

DATE	HEADLINE INFLATION (%)	FOOD INFLATION (%)	CORE INFLATION (%)
July-2015	9.2	10.0	8.8
Aug-2015	9.3	10.1	9.0
Sept-2015	9.4	10.2	8.9
Oct-2015	9.3	10.2	8.7
Nov-2015	9.37	10.13	8.73
Dec-2015	9.55	10.32	8.73

Source: CBN

6.0 Money Supply

Broad money supply (M2) rose by 5.90% in December 2015, although below the growth benchmark of 15.24% for 2015.

Net domestic credit (NDC) grew by 12.13% in the same period, but remained below the provisional benchmark of 29.30% for 2015. Growth in aggregate credit reflected mainly growth in credit to the Federal Government by 151.56% in December 2015 compared with 145.74% in the corresponding period of 2014.

a) Capital Market

The Nigerian Stock Exchange All Share Index (ASI) declined slightly by 3.11 per cent in December 2015. The market capitalization held steady for the last two quarters of the year. The modest performance of the NSE during quarter two and three of 2015 can be attributed to the temporary rebound of the global oil price.

b) External Reserves

Gross official reserves increased from US$29.85 billion as at 30th September, 2015 to $30.31 billion on 20th November, 2015, however dropped to $29.06 billion as at end of December 2015.

To prevent further depletion of the external reserves, the CBN excluded importers of 43 items from access to foreign exchange. Some of those items include rice, cement, private jets, poultry etc. While these items had not been banned from being imported, they had been refused access to foreign exchange to conserve our external reserves and encourage local production. That policy decision was made on 23rd of June, 2015.

Other decisions by the CBN include limiting the use of Naira debit cards abroad from $150,000/year to $50,000/year with a maximum daily transaction limit of $300.

c) Naira Exchange Rate

The exchange rate at the interbank market opened at ₦197.00/US$ and closed at ₦197.00, with a daily average of ₦196.99/US$ between September 21, October 30 and December 31, 2015. At the BDC segment, the exchange rate opened at ₦223.50/US$ and closed at ₦225.00 in October 2015, with a daily average of ₦224.46/US$, representing a depreciation of ₦1.50k for the period. And later depreciated to ₦258.30/US$ in December 2015.

The wide gap between the official exchange rate and the parallel market rate had raised a number of questions on the appropriateness of the foreign exchange policy of the CBN and had subsequently put a lot of pressure on government to further devalue the currency.

It is worthy of note, that the drop in the external reserve position had a contagion effect on the exchange rate against the dollar. In an effort to combat this pressure and preserve the nation's external reserves, the CBN had on the 18th of February, 2015, shut down the Wholesale and Retail Dutch Auction System foreign exchange windows. The CBN believed FX operators were practicing market arbitrage and the existence of multiple windows had created multiple exchange rate.

7.0 CIRCULARS AND GUIDELINES ISSUED BY CBN

The following are the circulars and guidelines issued by the Central bank of Nigeria (CBN) during the period under review

7.1 CBN Establishes Industry Fraud Desks

The CBN in a circular referenced BPS/DIR/GEN/CIR/02/004 dated June 11, 2015, established the Nigeria Electronic Fraud Forum (NEFF) in continuance of its efforts to fight cybercrimes within the Banking Industry. The Desk would provide solutions toward addressing frauds arising from increased adoption of electronic payments. It would also serve as an effective mechanism for receiving and responding promptly to fraud alerts within the Nigerian Banking Industry.

The banks were directed to implement across all electronic channels, an enterprise fraud monitoring system, which ensures behavioural monitoring, patterns and hold/block controls on transactions suspected to be fraudulent, etc. Banks may subscribe to NIBSS' central anti-fraud solution for this purpose. The policy took effect July 1, 2015.

7.2 CBN Circular On the Implementation of Control of Naira Denominated Card Transactions Consummated Overseas

The CBN released a circular referenced BPSD/DIR/GEN/CIR/02/005 dated July 06, 2015, on the usage of Naira-denominated cards abroad which superseded the earlier circulars referenced TED/FEM/FPC/GEN/01/007 and TED/FEM/FPC/GEN/01/008 which limits individual customer's daily ATM withdrawal overseas with Naira-denominated cards to US$300 (or its equivalent) and total annual expenditure to US$50,000 (or its equivalent), with effect from April 13, 2015. The CBN gave the following directives to DMBs to implement:

1. To submit reports of all Naira-denominated card transactions consummated overseas to NIBSS on daily basis electronically.

2. Naira denominated corporate cards should not be allowed for cross-border payments. Foreign currency denominated cards should be encouraged for corporate entities.
3. Cardholders should be informed that the banking industry has instituted a tracking system on the use of Naira denominated cards abroad.

4. Banks are required to educate their customers on the need to operate within the approved limits, as violators would be sanctioned.

7.3 CBN Circular On The Use of Bank Verification Number (BVN) To All Banks And Licenced Bureau De Change (BDCs)

The CBN in a circular referenced FRP/DIR/CIR/GEN/05/015 dated October 21, 2015, directed all Banks and licenced BDCs to request for BVN for all foreign exchange transactions effective November 1, 2015.

Consequently, customers desiring to purchase foreign exchange through all available channels in Nigeria must provide their BVNs, which should be validated by the CBN Authorized Foreign Exchange Dealer through the Nigerian Interbank Settlement System (NIBBS) platform before the transactions are consummated.

The CBN also stressed that from November 1, 2015, it shall discontinue sale of foreign exchange to the BDCs that had not availed it, the BVNs of all of its depositors.

7.4 CBN Extension of BVN for Nigeria Bank Customers in Diaspora and Other Related Matters

The CBN had in a circular referenced BPS/DIR/GEN/CIR/02/033 dated 2nd November, 2015, extended the BVN enrolment for Nigeria bank customers in Diaspora to 31st January, 2016. This was to enable them complete the registration exercise and the attachment of the BVN to their bank accounts. The CBN had clarified that the registration of BVN is a continuous exercise to enable depositors have access to their funds.

7.5 Revised Operational Guidelines for Bureaux de Change (BDC).

To strengthen the regulations guiding the efficient operations of BDCs, the CBN in November 2015 released a revised guidelines for BDCs. The guidelines took effect 1st January, 2016 with the following amendments:

- The financial requirements had been increased with the minimum paid-up share capital raised to N35 million from N10 million
- Anti-money laundering/combating financing of terrorism policy and manual had been included as a requirement of the feasibility report
- Board/Management requirements had been relaxed with the Managing Director requiring 3 years post-graduation experience as opposed to 5 years in the previous version
- The maximum buying and selling rate spread had been increased from 2% to 3.5%.
- Proper documentation by potential customers had been mandated by the new guidelines including their Bank Verification Number, travelling documents etc.

- BDCs had been prohibited from branch networks
- BDCs had been mandated to display a copy of its license, exchange rates and Anti-money laundering caution notice conspicuously.

The immediate effect of the revised guidelines had been the reduction in the number of BDCs from 3,208 to 2,699 as at 31st December, 2015.

7.6 CBN Circular on the Implementation of the Global Mobile Payments Monitoring & Regulation System (GMPM)

The CBN had implemented a monitoring solution called GMPM at the Nigeria Inter-Bank Settlement System Plc. (NIBSS) for effective surveillance of Mobile Money Operators and their transactions. The system which was fully operational would aid fraud management on mobile money platforms.

This was contained in a circular referenced BPS/DIR/GEN/CIR/02/011 dated November 4, 2015, to all Money Mobile Operators (MMO) who were also instructed to send the daily (on-us) live transaction data only. Failure to comply by November 16, 2015 would attract a sanction of ₦50,000 per week from that day.

7.7 Prohibition of Cash Deposit into Domiciliary Accounts by CBN

The CBN in a circular ref. TED/FEM/FPC/GEN/01/015 dated August 5, 2015, prohibited the acceptance of foreign currency cash deposits by DMBs. That was prompted by the need to prevent money laundering, round tripping and speculation in dollars.

The CBN advised individuals that wished to source foreign currency for eligible and legitimate purposes such as BTA, PTA medical etc. to do so through recognized channels with the use of Form 'A' for "invisible" and Form 'B' for "visible" transactions. Only wire transfers to and from Domiciliary Accounts were permissible.

7.8 CBN Circular on the Need for Banks to Build Adequate Loan Loss reserve

The CBN in a circular referenced BSD/DIR/GEN/LAB/08/052 dated November 11, 2015, mandated banks to immediately increase the general provision on performing

loan to 2% in the prudential review of their credit portfolios in an attempt to ensure that adequate buffers against unexpected loan losses are built up.

This is in line with the provision of section 12.14 of the Prudential Guidelines for Deposit Money Banks 2010 (Regulators Power over adequacy of Provision).

7.9 CBN issues Guidelines on the Management of Dormant accounts and other Unclaimed Funds by Banks and Other Financial Institutions in Nigeria.

The CBN in a circular referenced FPR/DIR/CIR/GEN/05/013 dated October 7, 2015, issued a guideline to all banks and other financial institutions on the management of dormant accounts and other unclaimed funds by banks and other financial institutions in Nigeria.

8.0 CBN Circular Deadline for Transfer of Federal Government Funds to Treasury Single Account

The CBN released a circular referenced BSD/DIR/GEN/LAB/08/048 dated September 7, 2015, on the Deadline for Transfer of federal Government Funds to Treasury Single Account. The CBN directed all banks to ensure that all balances and receipts due to the Government or its agencies to be paid into the Treasury Single Account (TSA) maintained with the Central Bank of Nigeria on or before September 15, 2015 or face sanctions.

8.1 Skye Bank Appoints Four Executive Directors

The appointment of four (4) New Executive Directors (EDs) was announced by the Board of Directors of Skye Bank Plc. The New EDs are: Mr. Bayo Sanni, Executive Director, Lagos Commercial Banking; Mr. Idris Yakubu, Executive Director, Abuja and Northern Region; Mrs. Markie Idowu, Executive Director, Technology and Service Delivery Channels; and Mrs. Abimbola Izu, Executive Director, Corporate services. This took effect July 2015.

FINANCIAL CONDITION AND PERFORMANCE OF INSURED BANKS IN THIRD AND FOURTH QUARTERS OF 2015 BY

RESEARCH POLICY & INTERNATIONAL RELATIONS AND INSURANCE AND SURVELLANCE DEPARTMENTS

1.0 INTRODUCTION

The last two quarters of 2015 witnessed a decline of economic activities in the domestic economy. This is mainly as a result of the decline in crude oil globally. Nigeria being a country that is mainly dependent on oil for revenue was therefore affected resulting in revenue shortfalls and also decline in the banking industry's profitability.

Despite the above, the Nigerian banking industry witnessed a mixed performance as some of the relevant financial indices of the Banking industry appreciated while others decreased.

During the last two quarters of 2015, total assets of the banking sector increased by 0.74% from ₦26.764 trillion as at 30th September 2015 to ₦26.962 trillion as at 31st December 2015. This increment was mainly as a result of the increase in balances with banks and Central Bank, Net Loans and Advances/Leases to customers, property plants and equipment, and investment securities.

During the periods under review, Loans and Advances to customers which have the highest contribution of the total asset increased to ₦12.114 trillion in December 2015 from ₦11.917 trillion in September 2015 .Balances with Banks and the Central Bank increased slightly by 0.81% from ₦5.631 trillion in September 2015 to ₦5.676 trillion in December 2015. Also, investment securities: available for sale increased by 14.58% from ₦2.495 trillion in September 2015 to ₦ 2.859 trillion in December 2015. Similarly, investment securities: held to maturity increased by 7.46% from ₦ 2.137 trillion to ₦2.296 trillion in December 2015.

Asset quality of the banking industry declined slightly during the two quarters under review as the ratio of impaired credits to total credit deteriorated by 2.51% from 4.75% in September 2015 to 4.87% in December 2015.

The industry experienced a significant decline in profitability as profit-before-tax showed 24.95% decrease from N151, 662 billion as at September 2015 to N113, 827 billion as at December 215.

The Capital Adequacy Ratio reduced slightly as the Capital to Risk-Weighted Asset Ratio declined by 0.07% from 17.73% in September 2015 to 17.66% in December 2015 .However, during the two quarters under review, two (2) Deposit Money Banks out of twenty three (23) failed to meet the minimum prudential Capital Adequacy Ratio of 10%.

The banking industry liquidity ratio recorded some improvement from 53.30% in September 2015 to 54.52% in December 2015.

Apart from this introduction, the rest of this paper comprises of three sections. Section two presents the Structure of Assets and Liabilities; Section three assesses the financial condition of insured banks, while Section four concludes.

2.0 STRUCTURE OF ASSETS AND LIABILITIES

During the periods under review, the Total Assets of the industry increased by 0.74% from ₦26.764 trillion as at 30th September 2015 to ₦26.962 trillion as at 31st December 2015. The structure of industry total assets and liabilities at the end of the third and fourth quarters of 2015 are presented in Table 1 and Charts 1A and 1B.

TABLE 1

Structure of Banks' Assets and Liabilities for third and fourth quarters of 2015

Assets (%)	**December 2015**	**September 2015**	**Liabilities (%)**	**December 2015**	**September 2015**
Balances with banks and central bank	21.05	21.04	Deposits from customers	64.77	65.09
Loans and advances to customers	44.93	44.53	Deposits from banks	2.41	3.34
Investmentsecurities: available for sale	10.61	9.33	Shareholders fund	12.90	12.70
Property plant and equipment	3.02	2.89	Borrowings	8.02	6.44
Financial asset held for trading	1.96	2.47	Debt instrument	2.60	2.90
Other Assets	3.62	4.48	Other liabilities	9.24	9.46
Assets pledged as collateral	1.58	1.75	Financial liabilities held for trading	0.06	0.07
Investment in subsidiaries and associates	1.15	1.18	-	-	-
Others	12.08	12.33	-	-	-
Total	**100.00**	**100.00**	**Total**	**100.00**	**100.00**

Source: ISD, NDIC

NOTE: TOTAL ASSETS (N Trillion) December 2015 = ₦26.962 & September 2015 =₦26.764

Chart 1A: Structure of Banks' Assets for the 3rd and 4th Quarters of 2015

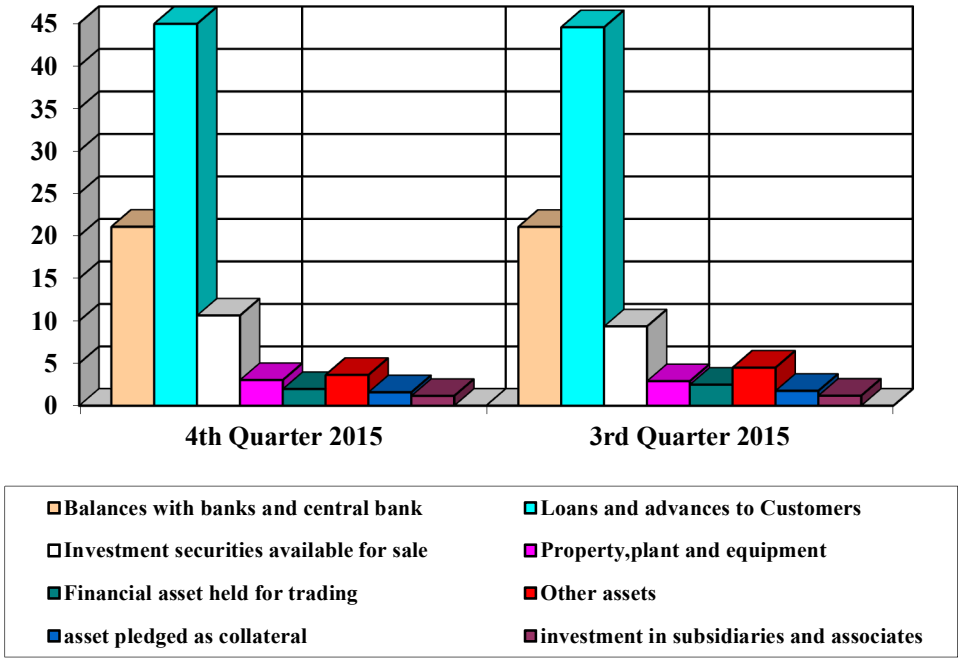
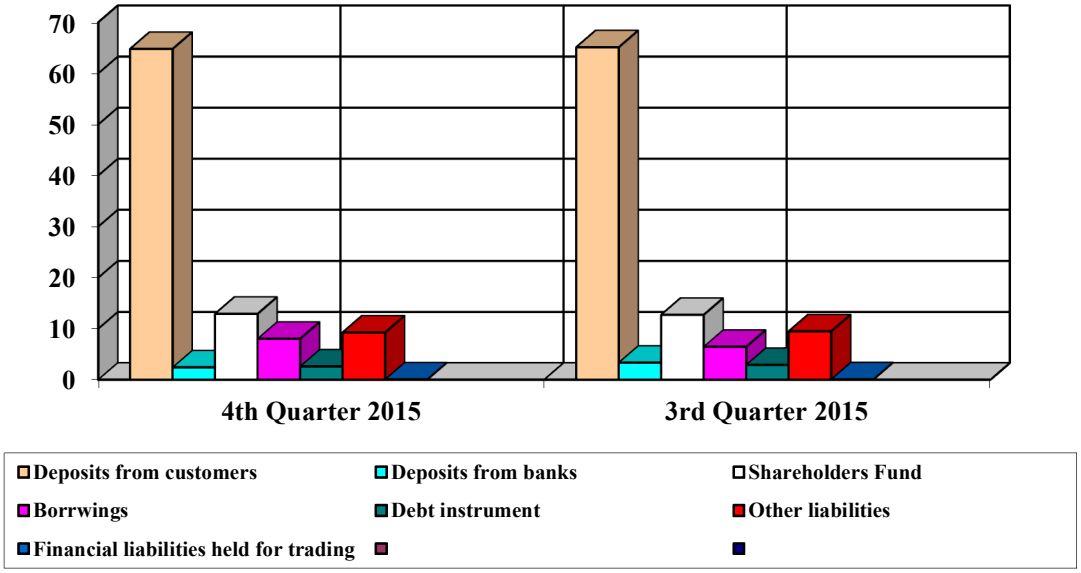


Chart 1A: Structure of Banks' Liabilities for the 3rd and 4th Quarters of 2015



The largest proportion of total assets during the periods under review was Loans and Advances to customers which its components accounted for 44.93% and 44.53% of the total assets of the Nigerian banking industry as at December and September 2015. In the second position was balances with banks and Central Bank which stood at 21.05% and 21.04% in the same period. While Investment Securities available for

sale followed suit with 10.61% and 9.33% respectively. For the other components of the industry's total assets; Loans and advances to banks was 1.77% as at December 31st 2015 and 2.23% as at September 30th 2015. While financial assets held for trading was 1.96% and 2.47% during the two quarters under review, also investment in subsidiaries and associates was 1.15% and 1.18%. And property, plant and equipment had a 0.13% increment from 2.89% in September to 3.02% in December 2015
On the Liabilities side of the Balance Sheet, deposits from customers has the highest percentage of the banking industry total liability with 64.77% and 65.09% during the period under review.

There was a marginal increase in shareholders fund from 12.70% in September to 12.90% in December 2015. Other liabilities accounted for 9.24% in December and 9.46% in September 2015. Borrowings were 8.02% in December and 6.44% in September 2015. While deposits from banks contributed 3.34% of the total liabilities in September 2015 and 2.41% in December 2015 respectively.

ASSESMENT OF THE FINANCIAL CONDITION OF INSURED BANKS

3.1 Asset Quality

The Banking Industry Total risk assets or total Credit marginally increased by 1.89%, rising from ₦13.082 trillion in September, 2015 to ₦13.329 trillion as at December 2015.

The quality of Assets of the Banking Industry which is measured by the proportion of Impaired Credits to Total credits however deteriorated during the period under review. Volume of non-performing credits increased by ₦27.57 or 4.44%, from ₦621.343 billion as at September to ₦ 648.913 billion at December 2015. Its ratio to Total Credit which stood at 4.87% in December 2015 was still less than the statutory maximum threshold of 5%.The Ratio of impaired credit to shareholders' fund decreased from 13.28% in September to 12.79% in December 2015. Also, during the two quarters under review, the ratio of provision for impaired credit to impaired credit also decreased from 3.95% in September to 3.78% in December 2015.

Table 2 and Chart 2 present the indicators of insured banks Asset Quality for the third and fourth quarters of 2015.

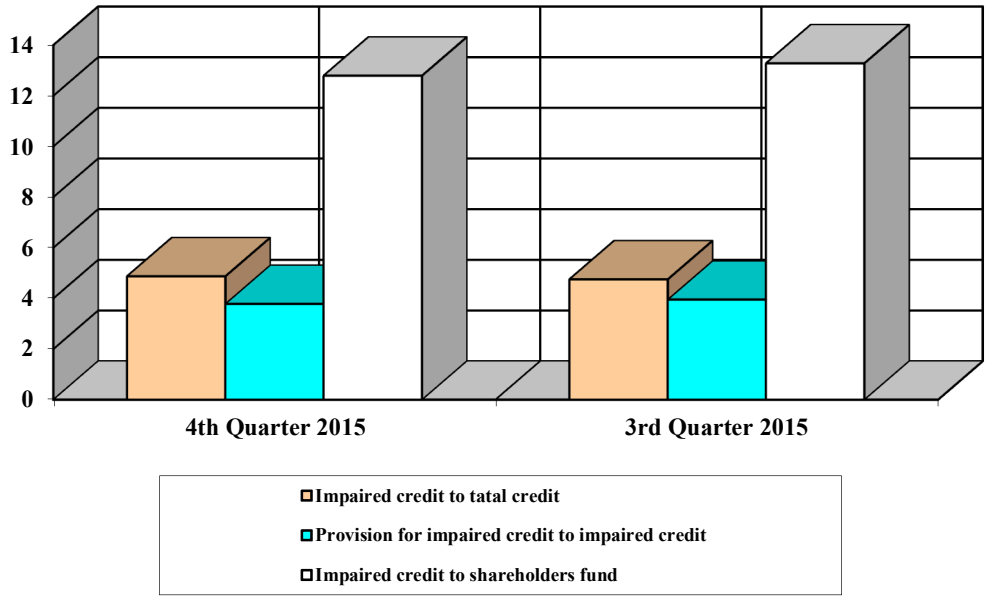
TABLE 2

INDICATORS OF INSURED BANKS' ASSET QUALITY FOR THE 3rd AND 4th QUARTERS OF 2015

Asset Quality Indicator (%)	Industry	
	December 2015	September 2015
Impaired credit to total credit	4.87	4.75
Provision for impaired credit to impaired credit	3.78	3.95
Impaired credit to shareholders fund	12.79	13.28

Source: Banks Returns

Chart 2: Indicators of Insured Banks' Asset Quality for 3rd and 4rd Quarters of 2015



3.2 Earnings and Profitability

The industry recorded a decline in profitability between the third and fourth quarters of 2015. Profit-Before-Tax stood at N113.827 billion as at the end of the fourth quarter, showing a 24.95% decrease from the N151.662 billion recorded at the end of the third quarter of 2015. Interest Income declined by 2.29% from N623.738 billion reported for the quarter ended September 2015 to N609.429 billion for the quarter ended December 2015, Recoveries dropped by 35.57% from September figure of N4.561 billion to a figure of N2.939 billion as at December 2015. Operating expenses on the other hand increased by 8.48%, from the figure of ₦375.085 billion in September to ₦406.891 billion in December, 2015. also, Non-Interest Income appreciated by 11.49%, from ₦145.376 billion in September to ₦162.076 billion in December 2015, while interest expenses declined by 3.96% from ₦349.091 billion in September to ₦239.216 billion in December, 2015.These and other indices are depicted in Table 3 and Chart 3.

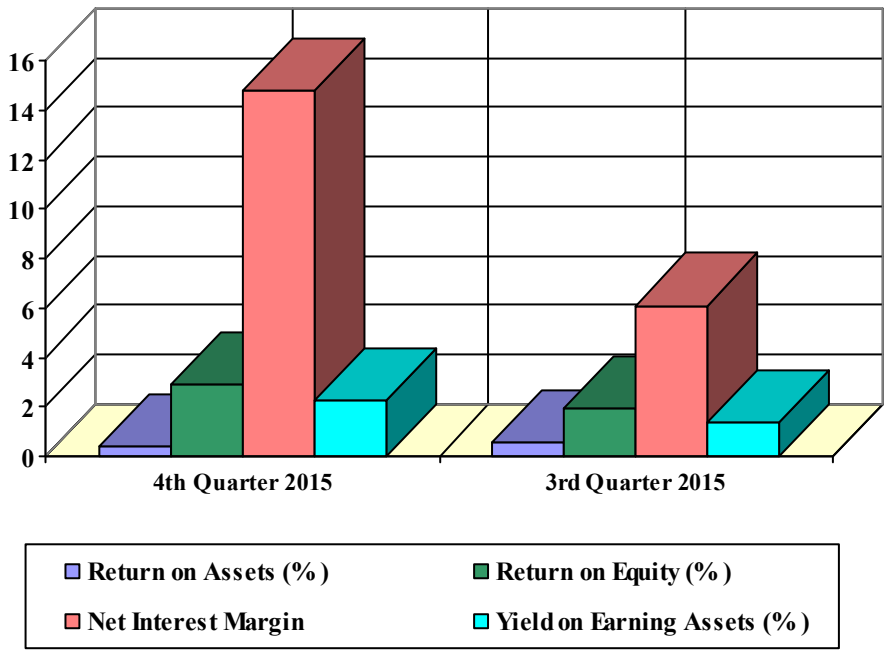
TABLE 3

INSURED BANKS' EARNINGS AND PROFITABILITY INDICATORS FOR THE 3rd AND 4th QUARTERS OF 2015

Earnings/Profitability Indicator	Industry	
	December 2015	September 2015
Return on Assets (%)	0.38	0.55
Return on Equity (%)	2.90	1.91
Net Interest Margin	14.79	6.09
Yield on Earning Assets (%)	2.24	1.35
Profit Before Tax (N' billion)	113.827	151.662
Interest Income (N' billion)	609.428	623.737
Operating Expenses (N' billion)	406.891	375.084
Non-Interest Income (N' billion)	162.076	145.375

Source: Banks Returns

Chart 3: Insured Banks' Earnings and Profitability for the 3rd and 4th Quarters of 2015



As can be seen from the above chart and table, return on Assets (ROA) decreased significantly by 31.06% between the third and fourth quarters of 2015. Return on Equity (ROE) however increased to 2.90% in December 2015 from 1.91% in September 2015.

3.3 Liquidity Profile

The industry liquidity position remained positive and stable during the period under review. The average liquidity ratio increased by 4.9 percentage points from 53.30% in September to 58.18% in December 2015 .which is well above the required 30% minimum requirement. The net credit to deposit ratio fell marginally by 1.24 percentage points from 75% to 73.76. While interbank takings to deposits ratio also decreased from 430.99% to 464.31% in the two quarters under review. One bank failed to meet the required liquidity ratio of 30% during the period under review. These are shown in the chart 4 and table 4 below.

Chart 4: Indicators of Insured Banks' Liquidity Profile for the 3rd and 4th Quarters of 2015

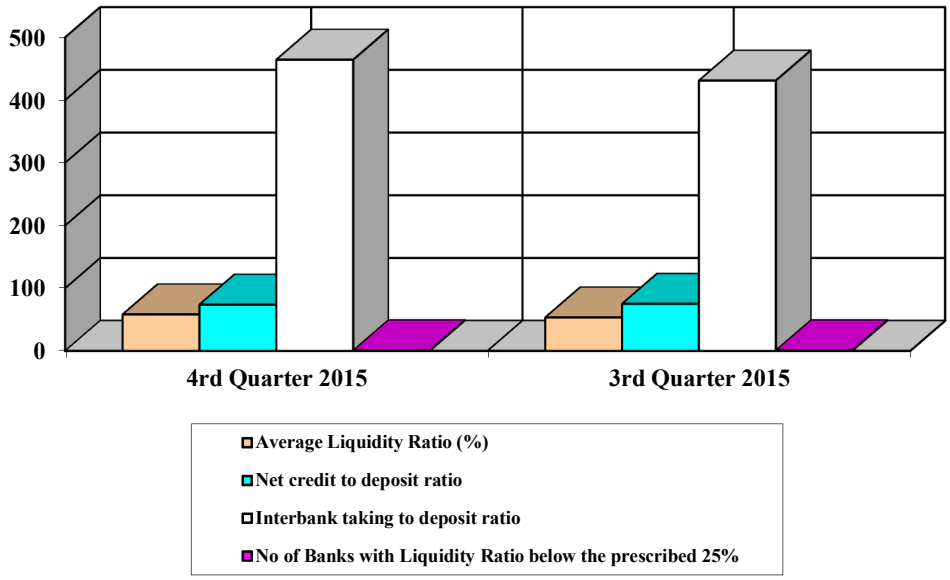


TABLE 4

INDICATORS OF INSURED BANKS' LIQUIDTY PROFILE FOR THE 3rd AND 4th QUARTERS OF 2015

Liquidity	Period	
	December 2015	September 2015
Average Liquidity Ratio (%)	58.18	53.30
Net credit to Deposit Ratio (%)	73.76	75.00
Inter-bank taking to Deposit Ratio (%)	464.31	430.99
No of Banks with Liquidity Ratio below the prescribed 30%	1	1

3.4 Capital Adequacy

In the periods under review, the capital adequacy position of the industry was strong. However, The Banking Industry Capital to Risk Weighted Assets Ratio (CAR) marginally deteriorated from 17.73% as at 30th September 2015 to 17.66% at the close of the period under review. Also, 2 banks did meet the prudential 10% capital adequacy threshold during the two quarters under review. These and other capital adequacy indicators are depicted in Table 5 and chat 5 below:

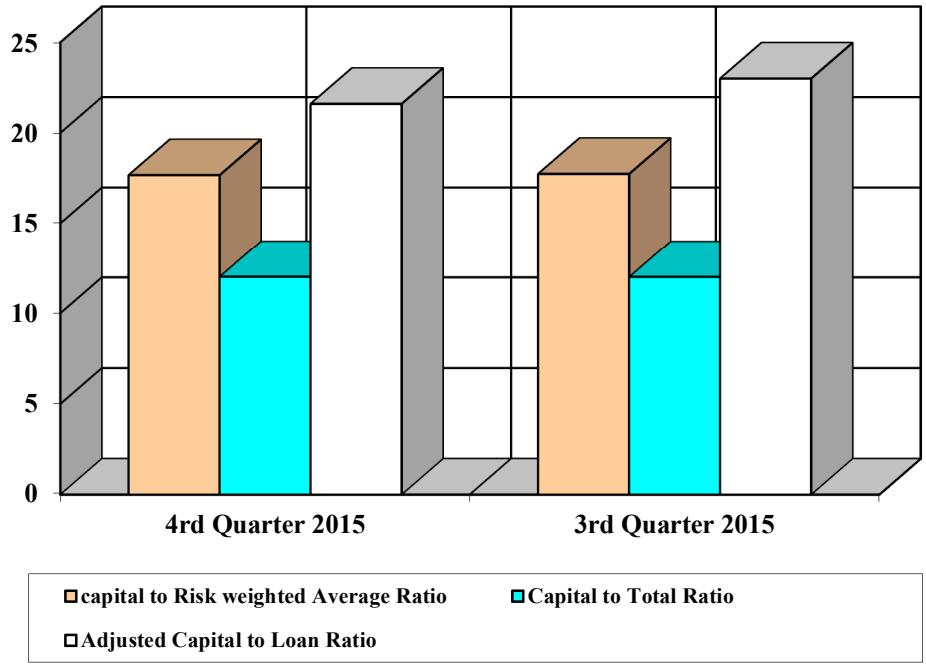
TABLE 5

INDICATORS OF INSURED BANKS' CAPITAL ADEQUACY POSITION FOR THE 3rd AND 4th QUARTERS OF 2015

Capital Adequacy Indicator	Period	
	December 2015	September 2015
Capital to Risk weighted Average Ratio (%)	17.66	17.73
Capital to Total Asset Ratio (%)	12.01	12.00
Adjusted Capital Ratio (%)	21.60	23.00

Source: Banks Returns

Chart 5: Insured Bank's Capital Adequacy for the 3rd and 4th Quarters of 2015



4 CONCLUSION

From the above it can be seen that the condition and performance of the insured banks as at September and December 2015 showed some positive and negative indices. On the positive side, Total Assets, Shareholders Funds, Recapitalization needs, Total Credits, Total Deposit Base, Liquidity Ratio, and Estimated Insurance Funds, all improved during the quarter; while on the flip side, CAR and Earnings looked down during the period.

Measuring and Managing Systemic Risk in the Nigerian Banking System: By Research Department

Executive Summary

Backdrop and objectives: The failure of systemically important financial institutions, or SIFIs, (also referred to as too big to fail financial institutions or large complex financial firms) generate large, undesirable externalities that include disruption of the stability of the financial system and its ability to provide credit and other essential financial services to individuals and businesses. When this happens, not only is the financial sector disrupted, but its troubles cascade over into the real economy.

A financial institution can be regarded as systemically important due to the financial functions it provides to the economy. Some systemically important functions are payment operations, deposits to ensure access to liquidity for payment transactions and loans and credits to non-financial firms. All other functions carried out by SIFIs that might have systemic importance can also be considered.

Institutional perspective of systemic importance refers to firms who due to the services they perform to the economy cannot be easily substituted by other companies within a short time period. In Nigerian context, the financial sector is dominated by banks and constitutes the majority of the financial system. This therefore limits the measurement and management of systemic risk to only the banking sector.

It is the task of national supervisory and regulatory agencies as well as standard setting agencies like Bank for International Settlement (BIS) and International Association of Deposit Insurers (IADI) to identify risks to financial stability due to the activities of big financial firms and respond appropriately. Consequently, the issue of SIFIs is of great importance to Nigeria. The Central Bank of Nigeria (CBN) and Nigeria Deposit Insurance Corporation (NDIC) as the banking sector regulators are charged with the responsibility of developing framework for regulating Syemically Important Banks or SIBs. The goal of this initiative is in line with Basel III and other global initiatives where each jurisdiction designs a policy framework

for the identification and regulation of their domestic SIFIs (in addition to global, if any)so as to limit the economic impact of crisis in the financial system and promote financial stability.

Identification of SIBs (Systemically Important Banks) and accurate measurement of systemic shortfall is of significant benefit to regulators because by identifying SIFIs or SIBs posing big threats to financial stability, measures and targets can help in targeting increased supervisory standards. For example, by indicating that the potential for financial instability is rising (i.e., providing early warning signals), metrics can signal to policymakers a need to tighten so-called macroprudential policies.

However, the task of measuring systemic risk is difficult because there is no agreed definition of such an important risk by the key participants. This is because it is difficult to manage what cannot be measured. And before we can measure systemic risk, we need to define or characterize it. Policymakers, regulators, academics and practitioners have given different definitions to systemic risk.

This paper is therefore concerned with the identification of SIBs and measurement of their contribution to systemic shortfall. We measure the systemic risk contributions of Nigerian banks based on several approaches advocated by BIS, regulators and academics. The paper also discusses the tools used in management of systemic risk.

Identification of SIBs/SIFI: There are several methods of categorizing SIFIs/SIBs. In this paper, we consider the categorisation of systemic risk measures based on Benoit et al (2012); supervisory approach that relies on data supplied to regulators by the banks and based on BIS (BIS Indicator approach) and approach that relies on market data such as stock returns and market capitalisation(SRISK approach).

The *Basel indicator-based measurement* approach considers the following factors in the classification of SIFIs/SIBs: Size, Interconnectedness, Substitutability and Complexity. We obtained Total Assets, Net-Interbank Transactions, Total Credits and Total Deposits, branch network and number of foreign subsidiaries from eFASS in order to determine the Nigerian SIBs. In the CBN and NDIC SIB Framework, size

and substitutability factors were assigned weight of 30% each, while complexity and interconnectedness were weighted 25% and 15%, respectively. The determinants within complexity were assigned 12.5% each whereas determinants under substitutability were each assigned 15% weight.

The *market data-based systemic expected shortfall and systemic risk (SRISK)* measures systemic risk as the amount by which a bank is undercapitalized in a systemic event in which the entire financial system is undercapitalized. This concept is appealing as it uses market data that are readily available to regulators and market participants, at a daily frequency. A financial firm will be unable to function when the value of its equity falls to a sufficiently small fraction of its outstanding liabilities. In good times, such a firm will likely be acquired, may be able to raise new capital or may face an orderly bankruptcy. If this capital shortage occurs at a time when the financial sector is already financially constrained, then the government faces the question of whether to rescue the firm with taxpayer money as other avenues are no longer available. Consequently a firm is systemically risky if it is likely to face a capital shortage just when the financial sector itself is weak.

Observations:

- The recent financial crisis has shown that no single Financial Safety Net participant can resolve systemic crisis alone. All the members should participate and collaborate to manage systemic risk. The near-financial crisis of 2009 that involved the collaboration of CBN and NDIC in special examination of all the universal banks, establishment of bridge-banks by NDIC and capital injection of N620 billion involved the coorperation of most FSN players in the country.
- The necessary tools to prevent a systemic crisis by deposit insurers include the information-sharing framework with other FSN players, appropriate level of coverage, public awareness, early detection of risk and timely intervention. Public awareness is essential in preventing bank runs in crisis times by enhancing public confidence in the deposit insurance system. Equally important is early detection of risk and timely intervention when a bank (s) is deemed to be in a problem. The CBN created the Financial Policy and Regulation Department (FPRD) with the key responsibility of macroprudential regulation

and supervision in Nigeria. The NDIC carries out several public key awareness campaigns, improved its payout process, extended scope and level of coverage and has strengthened its early warning signals to identify weak banks early and intervene appropriately. Both CBN and NDIC carry out routine stresstesting of the economy to identify systemic vulnerabilities and act accordingly.

- As it is already established, size is not the only criterion to determine systemic importance. We observe that banks identified as systemically important change in terms of weight or degree of importance from one month to the next and also different methods rank the systemic importance of the banks differently.

- A major advantage of the market-based approach and its appealing feature of calculating systemic risk surcharge is that it makes it possible to understand systemic risk in terms of an individual bank and the broader context of banking subsectors. This implies that it is possible to compute the systemic risk surcharges of a regional banking sector against another region, etc.
- The necessary tools to prevent a systemic crisis by deposit insurers include the information-sharing framework with other FSN players, appropriate level of coverage, public awareness, early detection of risk and timely intervention. Public awareness is essential in preventing bank runs in crisis times by enhancing public confidence in the deposit insurance system. Equally important is early detection of risk and timely intervention when a bank (s) is deemed to be in a problem. The CBN created the Financial Policy and Regulation Department (FPRD) with the key responsibility of macroprudential regulation and supervision in Nigeria. The NDIC carries out several public key awareness campaigns, improved its payout process, extended scope and level of coverage and has strengthened its early warning signals to identify weak banks early and intervene appropriately. Both CBN and NDIC carry out routine stresstesting of the economy to identify systemic vulnerabilities and act accordingly.

- The new market-based systemic risk measures have demonstrated that CBN and NDIC should develop SIB regulatory framework that includes market data

and perspective instead of eFASS-based bank returns or supervisory view alone.

Findings

- An advantage of the SRISK market data-based approach over the BIS Indicator approach is that market data is available at a daily frequency and therefore can capture the changing condition of banks at a daily frequency. The BIS Indicator approach can at most be updated at a monthly frequency and can only capture conditions of banks with a month's lag. Financial firms' risks, especially banks' can change very quickly. This implies that the BIS indicator approach needs to be augmented with a model that usesmore up-to-date information like the SRISK approach.

- Applying SRISK market data-based and BIS Indicator approaches to the Nigerian DMBs unambiguously establishes the six banks as systemically important: Bank 1, Bank 2, Bank 3, Bank 4, Bank 5 and Bank 6. Most banks in Nigeria currently hold capital levels in excess of amounts required to be well capitalized. The exception, according to SRISK approach is Bank 7, Bank 8, Bank 9 and Bank 10 that should raise additional equity capital.

- The recent financial crisis has shown that no single FSN participant can resolve systemic crisis alone. All the members should participate and collaborate to manage systemic risk. The near-financial crisis of 2009 that involved the collaboration of CBN and NDIC in special examination of all the universal banks, establishment of bridge-banks by NDIC and capital injection of N620 billion involved the cooperation of most FSN players in the country.
- All banks identified as systemically important have to be subjected to higher capital and other regulatory requirements than those that are non-SIBs. This is due to the burden they can place on the financial system and the economy when they fail. The CBN/NDIC SIB Framework has recommended higher capital requirement SIBs.

- Bank 1, Bank 3, Bank 4, Bank 2, Bank 6 and Bank 5 have featured as SIBs under the two approaches within the first 8 highest ranked banks, each month from December 2012 to September 2013 using both SRISK and BIS Indicator approaches. This shows that these 6 banks should be designated as SIBs without any other due consideration. However, Bank 11 has also featured within the first 8 highest banks, at different months, inconsistently, under either SRISK or BIS Indicator approaches, but not together at the same time. Bank 12 also consistently features as SIB under SRISK approach but hovers around 9-12th position under BIS Indicator approach. Bank 7 and Bank 13 on the other hand, are categorised as SIB under BIS Indicator approach but are rated around 9-13 SIBs under SRISK approach. Bank 14 and Bank 15 are rated within 10-12 range under the two approaches. Therefore, Bank 14, Bank 15, Bank 12 and Bank 11 should be on SIB watch list (to be created by CBN/NDIC) because the failure of any one of them could also have ramifications beyond other non-SIBs and they can also easily fall into the category of SIBs.

Recommendations

- The Corporation should assess its status in terms of systemic risk management as well as examine the legal framework for the resolution of this risk. International Association of Deposit Insurers (IADI, 2012) stated that a coordinated financial safety net (FSN) and legal framework are essential for promoting financial stability. The Association also stated that governments, central banks or deposit insurers are the leading agencies in systemic crisis management.
- The Corporation, in collaboration with CBN and other FSN players, should establish a legal framework for systemic risk management. Effective systemic risk management requires that a crisis response mechanism should be specified in advance, and a speedy resolution of failed financial institutions should be carried out under the mechanism.
- The Corporation shares failure resolution responsibility with CBN. While, resolution of SIB can be quite tedious and demanding, international best practice requires the SIBs to submit resolution plans to resolution authorities at a predefined

frequency, usually yearly. The NDIC/CBN SIB Framework requires all Nigerian banks designated as SIBs to develop and submit resolution and winding-down plan ("Living Will") annually to CBN. The Corporation should also be a recipient of the SIBs' annual Living Wills given its responsibility in failure resolution. Guidance should be issued to the identified SIBs on how to submit their respective plans including their strategy for rapid and orderly resolution in the event of failure of the bank.

- The Corporation should equally examine and if necessary strengthen its resolution processes for large complex financial institutions or SIBs. The Corporation should develop a resolution mechanism to safely wind down failing, systemically important banks in line with recent global financial reforms.
- Payment of funds for resolving systemic crisis can be ex ante or ex post fund. The recent financial crisis has led to the formation of ex-ante and ex-post fund for systemic crisis management under various names such as the resolution fund and bank levy. In Nigeria, the financial stability fund is established for the systemic risk management as an ex-ante fund in line with global best practice. However, the contribution of each bank to the financial stability fund should be based on individual bank's systemic risk capital surcharge. Systemic risk surcharge of each bank should be used in computing the bank's contribution to bail-out cost in crisis situations.

1.0 Introduction

It is the task of national supervisory and regulatory agencies as well as standard setting agencies like BIS and AIDI to identify risks to financial stability due to the activities of big financial firms and respond appropriately. To reliably accomplish these tasks, systemic risk has to be accurately measured and regulated. Measuring and regulating systemic risk is important because of the externalities associated with the failure of an institution, that is, the costs due to deposit insurance, bailout costs and a loss of intermediation to the

real sector. The recent financial crisis has therefore focused widespread attention on systemic risk in the global financial system.

Moreover, policymakers want to know when problems in financial institutions and markets more broadly are likely to become "systemic." Being able to identify systemic events at an early stage enhances policymakers' ability to take necessary (and perhaps exceptional) steps to contain the crisis. Similarly, being able to detect when those pressures may be easing would help to determine when to initiate exit strategies. In addition, increased focus on systemic risk is considered to be a key aspect of macroprudential policy and surveillance with a view towards enhancing the resilience of the financial sector. The ability to identify policies that are not performing and having unintended consequences quickly is one of the most effective ways of improving regulation, and measurement is the starting point. Systemic risk measures can facilitate the monitoring and regulation of the overall level of risk to the system. In addition, prevention is better than management when it comes to systemic crises.

However, the task of measuring systemic risk is difficult because there is no agreed definition of such an important risk by the key participants. This is because it is difficult to manage what cannot be measured. And before we can measure systemic risk, we need to define or characterize it. Policymakers, regulators, academics and practitioners have given different definitions to systemic risk.

In addition, the first component of systemic risk management is the assessment of systemic risk by identifying the systemically important institutions, based on accepted criteria. The second component is the management of systemic risk through imposition of specific regulatory policies and systemic capital surcharge, if applicable.

Systemic risk has been defined as the probability that a series of correlated defaults among financial institutions, occurring over a short time span, will trigger a withdrawal of liquidity and widespread loss of confidence in the financial system as a whole (Billio et al, 2010).The European Central Bank (ECB,

2010) view systemic risk as a risk of financial instability so widespread that it impairs the functioning of a financial system to the point where economic growth and welfare suffer materially. Acharya et al, 2010 define this risk in terms of correlated exposures, Mishkin(2007) focussed on information disruptions, Moussa (2011) defined this risk with respect to contagion and in terms of negative externalities by (Financial Stability Board, 2009). Systemic risk occurs if and only if there is an aggregate shortage of capital in the financial sector such that a reduction in lending by the failure of one bank cannot be offset by other financial institutions (Acharya and Steffen, 2012). However, systemic risk can simply be defined as any broad-based breakdown in the financial system

This could be due to the complexity of the financial system and the sheer variety of products that are traded. The financial system is very big and complicated comprising various market and participant characteristics, legal and institutional constraints, and exogenous factors driving the system at any given time. This leads to the simple conclusion that there is no perfect methodology that precisely measures the systemic risk contribution of individual financial institutions. The various definitions suggest that more than one risk measure will be needed to capture the complex nature of the financial system. Relying on a single approach runs a risk of errors, and therefore, various approaches need to be considered when implementing policy geared at managing systemic risk.

This paper is concerned with the identification of SIFIs and measurement of their contribution to systemic shortfall. We measure the systemic risk contributions of Nigerian banks based on several approaches advocated by BIS, regulators and academics. Specifically, we identify and analyse systemically important Nigerian banks during the 2007 to 2009 financial crisis using the systemic expected shortfall (SES) introduced by Acharya et al. (2010), marginal expected shortfall (MES)introduced by Acharya et al. (2010) and BIS Indicator Approach (BCBS 2011 & 2012). A major goal of this paper is to provide a

comprehensive comparison of the above systemic risk measures by considering the Nigerian Deposit Money Banks (DMBs) over the period 2009-2013. For a concise summary of systemic risk measures, the reader should consult Bisias et al (2012).

We seek to answer the following questions: How much capital should have been raised by banks in crisis situations to cover their expected capital shortfall? Do the different risk measures identify the same SIFI or SIB? And if not, what are the reasons? We use the various methods not only to identify systemic institutions but also to rank the banks according to their systemic risk contribution and to construct future risk rankings.

Our empirical analysis reveals that applying SRISK market data-based and BIS Indicator approaches to the Nigerian DMBs unambiguously establishes the six banks as systemically important: Bank1, Bank 2, Bank 3, Bank 4, Bank 5 and Bank 6. We also find that most banks in Nigeria currently hold capital levels in excess of amounts required to be well capitalized. The exception, according to SRISK approach is Bank 7, Bank 8, Bank 9 and Bank 10 that should raise additional equity capital.

In Section 2 we look at the definition of systemically important financial institutions (SIFIs) and the categorisation of their key characteristics. In Section 3 we focus on the methods that can be used to identify SIFIs and apply some of them to the Nigerian banking sector. Section 4 focuses primarily on the data used in identifying SIBs as well as the empirical analysis of the proposed approaches. Section 5 discusses tools used to manage systemic risk and SIBs in Nigeria. The final section concludes and offers recommendations.

2.0 Definition and categorisation of SIFIs

Billio et al (2010) view systemic risk as "any set of circumstances that threatens the stability of or public confidence in the financial system". A systemic crisis is

defined as an episode of stress in the banking sector followed by significant policy intervention. IMF and BIS defined systemic risk as the risk of a disruption to financial services that is caused by an impairment of all or parts of the financial system; and has the potential to have serious negative consequences for the real economy. Blancher et al (2013) define systemic risk as s risk that originates within, or spreads through, the financial sector (for instance due to insufficient solvency), with the potential for severe adverse effects on financial intermediation and real output[1].

Categorisation of Systemic Risk Measures

Acharya et al. (2010) categorise the recent approaches of measuring systemic risk, mostly related to the financial crisis of 2007-2009, into two categories, one based on a structural approach using contingent claims analysis of the financial institution's assets and the other on a reduced form approach focusing on the tail behaviour of financial institutions' asset returns. These two approaches treat systemic risk in a portfolio context in which the portfolio is the financial sector, and individual assets are the financial institutions. The key variable in these two approaches is the comovement between financial firms when the system as a whole is distressed.

Bisias et al (2012) categorise systemic risk measures into Microprudential Measures-Securities and Commodities, Microprudential Measures-Banking and Housing, Microprudential Measures-Insurance and Pensions, Microprudential Measures-General Applications, Macroprudential Measures and Macroprudential Regulation based on whether the measure is micro or macro-prudential in nature. The authors further classify systemic risk measures according to the by event/decision time horizon of the risk. This could be Ex Ante Measures-Early Warning, Ex Ante Measures-Counterfactual Simulation and Stress Tests, Contemporaneous Measures-Fragility, Contemporaneous Measures-Crisis Monitoring, Ex Post Measures-Forensic Analysis and Ex Post Measures-Orderly

[1] The objective of macroprudential policy is to limit system-wide financial risk

Resolution. In addition, Bisias et al (2012) categorise systemic risk measures by research method as follows: Probability Distribution Measures, Contingent-Claims and Default Measures, Illiquidity Measures, Network Analysis Measures and Macroeconomic Measures.

In this paper, we consider the categorisation of systemic risk measures based on Benoit et al (2012). The authors categorisation divide the measures into supervisory approach that relies on data supplied to regulators by the bank or firm (BCBS 2011 & 2012) and approach that relies on market data such as stock returns and option prices (Acharya et al. (2010) and Huang et al (2009)).

Properties associated with systemic risk

General properties that are usually associated with systemic risk include:

- Negative externalities. Financial economists have long believed that the failure of certain large, interconnected financial institutions could have spillover effects on the financial system as a whole. Since the costs of failure do not fall exclusively on the failing institution, there is an incentive for firms to take excessive risk and to invest less in risk management than is socially optimal.
- Breakdown of key parts of the financial system (e.g., the collapse of the asset-backed commercial paper market in 2008–2009).
- Large multiplier on shocks. In the 2008 crisis $2 trillion subprime loss generated a $20 trillion hit to the household balance sheet.
- Shared belief in an erroneous risk measurement, and herd behavior following such beliefs (e.g., housing prices will only go up).
- Asset price bubbles. Such bubbles are not well defined and extremely hard to detect inreal time. Important facets to consider include:

Why should policy makers and regulators be interested in systemic risk?

In the wake of the global financial crisis, there has been increased focus on systemic risk as a key aspect of macroprudential policy and surveillance with a view towards enhancing the resilience of the financial sector.

Alexander (2010) provide four distinct policy applications of systemic risk measures:

(a) by identifying individual institutions (SIFIs or systemically important banks (SIBs) posing big threats to financial stability, measures and targets can help in targeting increased supervisory standards;

(b) by identifying specific structural aspects of the financial system that are particularly vulnerable, measures and targets can help policymakers identify where regulations need to be changed;

(c) by identifying potential shocks to the financial system posing big threats to stability metrics may help guide policy to address those threats; and

(d) by indicating that the potential for financial instability is rising (i.e., providing early warning signals),metrics can signal to policymakers a need to tighten so-called macroprudential policies

3.0 Methods used to identify SIFIs

BIS Indicator-based measurement approach

Systemic risk is a risk of disruption to financial services that is caused by an impairment of all or parts of the financial system, and has the potential to have serious negative consequences for the real economy. Fundamental to the definition is the notion of negative externalities from a disruption or failure in a financial institution, market or instrument. All types of financial intermediaries, markets and infrastructure can potentially be systemically important to some degree.

Three key criteria that are helpful in identifying the systemic importance of markets and institutions are:

- Size

The volume of financial services provided by the individual component (banks in this case) of the financial system.

- substitutability

  The extent to which other banks can provide the same services in the event of a failure. The systemic impact of a bank's distress or failure is expected to be negatively related to its degree of substitutability as both a market participant and client service provider.

- interconnectedness

  Its linkages with other components of the system. Financial distress at one institution can materially raise the likelihood of distress at other institutions given the network of contractual obligations in which these firms operate. A bank's systemic impact is likely to be positively related to its interconnectedness with other financial institutions.

- Complexity

  The systemic impact of a bank's distress or failure is expected to be positively related to its overall complexity – that is, its business, structural and operational complexity. The more complex a bank is, the greater are the costs and time needed to resolve the bank.

BETA

The beta (β) of a stock or portfolio is a number describing the correlated volatility of an asset in relation to the volatility of the benchmark that the asset is being compared to. This benchmark is generally the overall financial market and is often estimated via the use of representative indices. Beta measures systematic risk based on how returns co-move with the overall market.

A high beta implies a stock price grows dramatically when the market is up, and falls dramatically when the market goes down. Small values of beta mean the stock's return is relatively unaffected by the swings in the overall market's return.

- A beta of 1.0 implies that the security's returns have the same volatility as the market's returns and their correlation is +1.0, or that the relative volatility is 2.0 and the correlation is +0.5, or that the relative volatility is 5.0 and the correlation is +0.2. It is certain that the volatility of the security's returns is at least as great asthe volatility of the market's returns, and that the correlation of returns between the security and the market is positive.
- A beta higher than 1.0 means that the security's returns have been more volatile than the market's returns, and that the correlation of returns is positive. The value of beta gives a lower limit to the relative volatility of the security's returns compared to the market's returns.
- A beta lower than 1.0 implies that the security's returns are less volatile than the market's returns, or that the security's returns and the market's returns have a low correlation.
- A beta of 0 means that the correlation of returns of the security and the market is 0.0; i.e., they tend to move independently.
- A negative beta means that the security's returns tend to move opposite the market's returns; i.e., their correlation of returns is negative.

Marginal Expected Shortfall

A firm's marginal expected shortfall (MES) is defined as the average return of its equity during the 5% worst days for the overall market return. Marginal expected shortfall (MES) and leverage metrics are used as early warning indicators of Systemic Expected Shortfall (SES).MES corresponds to the partial derivatives of the system Expected Shortfall (ES) with respect to the weight of firm *i* in the economy.

$$MES_{it}(C) = E_{t-1}(r_{it} | r_{mt} < C)$$

Where *i* is any firm, *t* is the period of time and *C* is any given threshold.

Similarly, the long-run marginal expected shortfall (LRMES) is given as

$$LR \approx 1\text{-}\exp(18 \text{ X } MES)$$

Systemic Expected Shortfall and Systemic Risk (SRISK)

Acharya et al (2010) measure systemic risk as the amount by which a bank is undercapitalized in a systemic event in which the entire financial system is undercapitalized, and they call this concept the systemic expected shortfall (SES). This concept is appealing as it uses market data that are readily available to regulators and market participants.

The Systemic Risk Analysis applied in this paper is based on the SES framework of Acharya et al (2010). A financial firm will be unable to function when the value of its equity falls to a sufficiently small fraction of its outstanding liabilities. In good times, such a firm will likely be acquired, may be able to raise new capital or may face an orderly bankruptcy. If this capital shortage occurs at a time when the financial sector is already financially constrained, then the government faces the question of whether to rescue the firm with taxpayer money as other avenues are no longer available. Consequently a firm is systemically risky if it is likely to face a capital shortage just when the financial sector itself is weak.

This calculation takes three steps. First we estimate the daily drop in equity value of a firm that would be expected if the aggregate market falls more than 5%. This is called Marginal Expected Shortfall or MES. The measure incorporates the volatility of the firm and its correlation with the market, as well as its performance in extremes. In a second step this is extrapolated to a financial crisis which involves a much greater fall over a much greater time period. Finally, equity losses expected in a crisis are combined with current market value of equity and book value of debt to determine how much capital would be needed in a crisis in order to maintain an 8% capital ratio to asset value.

The Systemic Risk Contribution, SRISK%, is the percentage of financial sector capital shortfall that would be experienced by this firm in the event of a crisis.

Firms with a high percentage of capital shortfall in a crisis are not only the biggest losers in a crisis but also are the firms that create or extend the crisis. This SRISK% is the Systemic Risk Ranking of the Nigerian Banking sector.

$$\text{SRISK} = k\,[D + (1- \text{LRMES})\,E\}- (1- \text{LRMES})\,E,$$

Where k is a prudential standard ratio of equity to assets = 8%, D is the quarterly book value of total liabilities and E is the daily market capitalisation or market value of equity

4.0 The Data and Descriptive Statistics

The sample used in this paper can be grouped into two categories. The first sample comprises eleven (11) banks that are listed on the Nigerian Stock Exchange (NSE). The total assets of these banks as at September 2013, represents over 90% of Nigeria's total banking assets. Daily closing equity prices and market capitalization of these banks are recorded on a daily basis from 8th August 2008 to 23rd October 2013, obtained from Reuters. Quarterly book values of liabilities are obtained from on monthly and quarterly basis from eFASS (the regulatory database) starting2009.

Statistics on market capitalization is reported in Table 1 for the banks that trade on NSE.

The second group of data is obtained from regulatory agencies stored in the eFASS database system. The Basel indicator-based measurement approach considers the following factors in the classification of SIFIs: Size, Interconnectedness, Substitutability and Complexity. We obtained Total Assets, Net-Interbank Transactions, Total Credits and Total Deposits, branch network and number of foreign subsidiaries from eFASS in order to determine the Nigerian SIBs.

4.1 Empirical Analysis

In this section, we implement the MES, SRISK, beta (Market data-based models) and Indicator-based approaches (based on regulatory data) and compare the identified banks based on these approaches. Specifically, we rank firms/banks based on their contribution to system risk and then calculate the systemic risk surcharges that banks should pay in the event of financial crisis.

The main goal of systemic risk surcharges are to incentivize firms to limit systemic risk taking or to be well capitalized against systemic risk in order to reduce the cost of these surcharges. In the following section, we implement several approaches to rank SIFIs and then calculate systemic risk surcharges.

For the market data-based models, we estimate MES at the standard risk level of 5% using daily data of equity returns from Reuters DataStream (as suggested by Acharya et al 2010). We then estimated SRISK. In implementing the Basel recommended Indicator-based approach, we used the guidelines and weights of the NDIC/CBN SIFI framework. We considered total assets as principal determinant in the assessment of size, the determinant of interconnectedness is net-interbank transactions and total credits and total deposits of a bank are the determinants of its substitutability. Finally, to represent complexity factor, we considered the branch network and number of foreign subsidiaries of a bank.

The main objective of any systemic risk analysis is to rank firms according to their systemic risk contribution and, in turn, identify the SIFIs. The key question is then to determine whether the different systemic risk measures lead to the same conclusion. A natural way to answer this question is to analyse the SIFIs. The goal is then to identify the top tier banks in terms of contribution to the risk of the overall banking system so as to subject them to additional capital requirements and/or liquidity buffers.

Table 2 ranks the 15 Nigerian banks categorised as SIBs and contributing the greatest fraction to expected aggregate capital shortfall of the largest Nigerian

banks from December 2012 to September 2013. In the CBN and NDIC SIB Framework, size and substitutability factors were assigned weight of 30% each, while complexity and interconnectedness were weighted 25% and 15%, respectively. The determinants within complexity were assigned 12.5% each whereas determinants under substitutability were each assigned 15% weight. Table 1 shows the yearly market capitalization average of all NSE-listed banks. While the Table mimics the ranking obtained using SRISK, there are however a few differences. All banks categorized as SIBs (Bank 3, Bank 2, Bank 1, Bank 4, Bank 5 and Bank 6) appear in Table based on having the largest market capitalization, Bank 12, Bank 11 and Bank 14 are also listed as more systemically important than Bank 7 and Bank 13. Rankings of SIBs based on market capitalization therefore closely follows the SRISK approach than the Basic Indicator approach. This is because SRISK is related to market capitalization because it measuresthefractionofthecapitalrequirementthatisnotcoveredbythecurrentmarketcapitalization

We also observe that the most improved bank in terms of increasing its share of market capitalization from 2011 to 2013 is Bank 11 (appreciated by more than 150% since 2011), followed by Bank 3 (100% increase in market capitalization), and Bank 8 (64%), Bank 5 (59%), Bank 2 (53%) and Bank 6 (52%). Similarly, the bank with decreased market capitalization since 2011 average value is Bank 15 (lost 33%), followed by Bank 7 (25%) and bank 12 (11%) decrease in market capitalization.

Analyzing Banks categorized as SIB

The SRISK approach of Acharya et al (2010) rated Bank3 as highest (1) in contribution to systemic risk for the month of December 2012 with 30% of the whole banking sector risk. Bank 2, Bank 1 and Bank 5 are then rated 2nd(with 29%) , 3rd (16%) and 4th (with 8%) by this approach. Bank 6 and bank 11 are the 5th (with 5%) and 6th (with 3%) in terms of highest contribution to system. However, the BIS Indicator approach as implemented by NDIC/CBN ranked Bank 3 as 4thhighest contributor to systemic risk with 7.7% of the whole

systemic risk weight, Bank 2 as 3rd with 10%, Bank 1 as 1st with 12.64% and Bank 5 as 5th with 7.54%. Full details of systemic risk ranking and contribution of the Nigerian banks for month of December 2012 and January 2013 is shown in Table 2a.

It should be noted that ES, MES, and VaR are typically negative whereas SES and SRISK are typically positive. A financial institution is more systemically risky that another if it has a higher MES, SES or SRISK. In addition, banks with positive SRISK value have to their market capitalisation or equity capital.
Bank 4is 2ndwith 11.7% under the BIS indicator approach but is 8th under the SRISK method. The two methods rank the banks differently and assign different weight to the identified SIB. The higher the ranking of bank in terms of systemic risk in the financial system implies that the bank would be required to pay the greater fraction of systemic risk surcharges.

For the month of Janaury 2013 as shown in Table 2a right pane, Bank 2 contributes the most to systemic risk using SRISK approach with 21% weight while the same bank as 3rd with 11% weight under the BIS Indicator approach. First Bank as 1st with 12.64% based on BIS Indicator approach but ranked 2nd under SRISK approach with 19% weight of the whole systemic risk.

We therefore see that banks identified as systemically important change in terms of weight or degree of importance from one month to the next and also different methods rank the systemic importance of the banks differently.

It should be noted that Bank 1, Bank 3, Bank 4, Bank 2, Bank 6 and Bank 5 have featured as SIBs under the two approaches within the first 8 highest ranked banks, each month from December 2012 to September 2013 using both SRISK and BIS Indicator approaches. This there shows that these 6 banks should be designated as SIBs without any other due consideration. However, Bank 11 has also featured within the first 8 highest banks, at different months, inconsistently, under either SRISK or BIS Indicator approaches, but not together

at the same time. Bank 12 also consistently features as SIB under SRISK approach but hovers around 9-12th position under BIS Indicator approach. Bank 7 and Bank 13 on the other hand, are categorised as SIB under BIS Indicator approach but are rated around 9-13 SIBs under SRISK approach. Bank 14 and Bank 15 are rated with 10-12 range under the two approaches.

Therefore, Bank 14, Bank 15, Bank 12 and Bank 11 should be on SIB watch list because the failure of any one of them could also have ramifications beyond other non-SIBs and they can also easily fall into the category of SIBs.

Table 3 shows the ranking of the Nigerian banks based on their beta and market capitalization for December 2012 to September 2013. The ranking shows that different methods rank the systemic importance of the banks differently but ranking based on market capitalization closely mirrors that based on systemic risk. According to SRISK, a firm has higher systemic risk ranking if the correlation of the riskier firm with the system is higher than the correlation of the less risky institution (beta) and if the riskier firm has the lower market capitalization.

Analyzing Capital Requirements for Banks categorized as SIB

Under SRISK approach, most of expected aggregate capital shortfall is captured by just three banks (Bank 1, Bank 2 and Bank 3) accounting for a minimum of 65% of the whole systemic risk in the industry. The same banks account for less than 40%, but greater than 30%, of the total industry systemic risk under the BIS Indicator approach. These results suggest therefore that based on the period under review, a relatively small fraction of firms are responsible for most systemic surcharges and should be subjected to higher capital and regulatory requirements.

Analysis of Systemic Risk against GDP

The nominal GDP for the fourth quarter of 2012 was estimated at 10,593,714,64 million naira as against the 9,554,854.69 million naira during

the corresponding quarter of 2011. The nominal GDP for the first quarter of 2013 was estimated at 9,493,779.44 million naira as against the 9,142,858.51 million naira during the corresponding quarter of 2012.

Acharya et al (2011b) report some bailout costs and real economy welfare losses associated with banking crises, as estimated by several researchers, generally lies somewhere between 3.2-50% of GDP. The bailout of the thrift industry cost $180 billion (3.2% of GDP) in the US in the late 1980s, 16.8% for Spain, 6.4% for Sweden, 8% for Finland, while others set the cost at 15-50% of GDP.

In 2009, special joint committee of CBN and NDIC conducted a special examination of all the 24 universal banks in Nigeria. The results of the examination of 10 banks revealed that five banks were insolvent. Consequently, the CBN as the lender of last resort had to inject N420 billion into these banks in the form of a subordinated loan. Furthermore, the examination result of the remaining 14 universal banks led to the dismissal of the CEOs of three additional insolvent banks by the regulators and injection of an additional N200 billion into the affected banks. The total bailout costs is about 6% of the nation's GDP, which is in line with several jurisdictions.

Applying the contribution of each bank to systemic crisis, using 1st Quarter GDP of 2013 (N9.1 trillion) and applying bail-out cost of N620 billion representing 6.81% of GDP, will give the systemic surcharge of each bank as tabulated in Table i5.

The firm's contribution to expected losses in the crisis (i.e., the contribution ofeach firm to aggregate losses above a certain threshold) multiplied by the expected systemic costs when the financial sector becomes undercapitalized.

	SRISK Approach		BIS Approach	
	Systemic risk Contribution (%)	Bailout cost Contribution (N)	Systemic risk Contribution (%)	Bailout cost Contribution (N)
Bank 3	26.0%	161,217,272,599	8.2%	51,096,116,818
Bank 2	23.9%	148,189,773,555	8.9%	55,145,585,999
Bank 1	20.3%	125,900,201,331	13.4%	83,245,995,192
Bank 5	6.4%	39,652,015,910	7.1%	44,181,027,435
Bank 4	5.7%	35,302,200,628	14.0%	86,592,368,410
Bank 11	5.2%	32,399,981,793	3.4%	21,140,671,282
Bank 12	5.1%	31,907,948,335	3.2%	19,703,003,308
Bank 6	4.3%	26,912,593,152	6.7%	41,259,722,912
Bank 13	0.7%	4,617,871,827	4.9%	30,273,049,144
Bank 7	0.5%	3,264,490,545	4.4%	27,177,491,797
Bank 10	0.4%	2,687,801,531	2.0%	12,338,000,000
Bank 9	0.4%	2,527,487,587	1.9%	11,842,000,000
Bank 15	0.4%	2,470,560,055	6.7%	41,365,335,533
Bank 8	0.3%	2,159,605,772	2.4%	14,571,865,584
Bank 14	0.1%	790,195,381	3.7%	22,738,222,010

Table i5: Systemic surcharge to bail-out systemic risk

Table i5 quantifies the relative importance of a bank's contribution to overall systemic risk and thus the percentage of total systemic surchargesit must pay. The surcharge component capturesmany of the characteristics considered

important for systemic risk such as size, interconnectedness and concentration all of which serve to increase the expected capital shortfall in a crisis.

5.0 Tools to manage systemic risk and SIBs in Nigeria

Macro prudential policy is concerned with re-orienting prudential regulation towards risk across the system as a whole system (the so-called systemic risk) and not just individual banks (BoE, 2009).

According to Bank of England (BoE, 2009), systemic risk has two principal sources. First, is the overexposure of financial firms, companies and households, to risk in the upswing of a credit cycle, and to become overly risk-averse in a downswing. Second, individual banks typically fail to take account of the spillover effects of their actions on risk in the rest of the financial network. Macroprudential policy is expected to address both sources of systemic risk.

Systemic risk increases the probability of default (PD) across the financial system and equally increases the loss given default (LGD) of the financial system (that is, the resulting increase in distress felt across the financial system when one bank fails).

Tools advocated by Bank of England (BoE, 2009) to manage systemic risk include the application of a top-up or 'surcharge' over and above microprudential capital requirements (including forward-looking dynamic provisions against expected losses (Systemic capital surcharges) and other complementary measures. These measures are to supplement macroprudential capital requirements with other prudential instruments which could help to achieve macroprudential objectives. An example of complementary measure is time-varying margins or haircuts on certain secured financial transactions between banks and non-banks.

According to IADI (2012), the necessary tools to prevent a systemic crisis by deposit insurers include the information-sharing framework with other FSN players, appropriate level of coverage, public awareness, early detection of risk and timely intervention. Public awareness is essential in preventing bank runs

in crisis times by enhancing public confidence in the deposit insurance system. Equally important is early detection of risk and timely intervention when a bank (s) is deemed to be in a problem.

The CBN created the Financial Policy and Regulation (FPRD) with the key responsibility of macroprudential regulation and supervision in Nigeria. The NDIC carries out several public key awareness campaigns, improved its payout process, extended scope and level of coverage and has strengthened its early warning signals to identify weak banks early and intervene appropriately. Both CBN and NDIC carry out routine stresstesting of the economy to identify systemic vulnerabilities and act accordingly.

Blancher et al (2013) offer a practical guidance on the use of current systemic risk monitoring tools at IMF based on six key questions policymakers are likely to ask.
Finally, all banks identified as systemically important have to be subjected to higher capital and other regulatory requirements than those that are non-SIBs. This is due to the burden they can place on the financial system and the economy when they fail. The CBN/NDIC SIB Framework has recommended higher capital requirement SIBs.

Systemic Risk Regulatory Framework for Financial Stability

No FSN player, whether central bank or deposit insurer, are meant to deal by themselves with systemically significant bank failures or a systemic crisis. In this case, there is a need for a Framework that deals with systemic crisis. Recent crisis shows that to successfully prevent and handle a financial crisis, there must be a framework that clearly defines each FSN player's roles and responsibilities and ensures close coordination among them (IADI, 2010). This is because there is little time to design and build such a framework for systemic risk management during crisis. Therefore, it is desirable that such a

framework for crisis prevention, management and resolution be formally specified through regulation in advance.

A robust Systemic Risk Regulatory Framework for Financial Stability should be built on three pillars: prevention, management and resolution (IADI, 2010). Prevention is concerned with the establishment of effective regulation and supervision that monitors and acts on economy-wide systemic risk; a sound macroeconomic management framework (for monetary, fiscal, and exchange rate policies that can counteract the buildup of systemic vulnerabilities such as asset price bubbles; and creation of a strong international financial architecture thatcan send pointed early warnings and induce effective international policy coordination to reduce systemic risk internationally.

Prevention of systemic risks can be significantly achieved by strengthening of micro-prudential regulation and supervision, establishing a robust framework for coordination of roles and responsibilities among FSN players including the lender of last resort function of the central bank, deposit insurance and resolution of failed financial institutions as well as macro-prudential supervisory functions.

Accoding to IADI (2010), Management of systemic risk deals with provision of timely and adequate liquidity; rigorous examination of financial institutions' balance sheets, including through stress tests; support of viable but ailing financial institutions through guarantees, nonperforming loan removal, and recapitalization; and adoption of appropriate macroeconomic policies to mitigate the adverse feedback loop between the financial sector and the real economy, reflecting the specific conditions and reality of the economy.

The Resolution pillar is concerned with use of mechanisms for restructuring financial institutions' impaired assets and, hence, corporate and household debt; use of well-functioning domestic insolvency procedures for nonviable financial institutions; and use of international mechanisms for resolving

nonviable internationally active financial institutions, including clear burden sharing mechanisms.

Systemic Crisis: Funding the Resolution

All over the world, including Nigeria, financial institutions have benefitted from government support during the financial crisis. However, the financial sector needs to provide a fair contribution to the resolution of the recent systemic crisis. Therefore, the new international best practiceof funding systemic crisis is that the costs of recovery should be first borne by the responsible parties, i.e., shareholders, creditors and depositors of failed financial institutions. Government injection of funds raised with taxpayers' money to stabilize the financial System should be the last resort.

Payment of funds for resolving systemic crisis can be ex ante or ex post fund (including the deposit insurance fund). The recent financial crisis has led to the formation of ex-ante and ex-post fund for systemic crisis management under various names such as the resolution fund and bank levy (IADI, 2010). In Nigeria, the financial stability fund is established for the systemic risk management as an ex-ante fund in line with global best practice.

Germany, Hungary, Sweden, United Kingdom, and the United States have taken a number of different policy approaches to fill the funding gap with regard to systemic crisis resolution (Schich and Kim, 2010). These countries include both ex post levies charged to make financial sectors contribute more fully than they did up to now to the costs of the financial crisis resolution and ex ante premiums to finance systemic crisis resolution in the future.

Specifically, ex-ante funding for future crisis is in place in the case of Sweden called the Stability Fund, Germany referred to as Restructuring Fund, EC known as Bank Resolution Fund and that of IMF is Financial Stability Contribution.

Some other jurisdictions practice ex-post revenue generation for general budget as follows; in United States this fund is called Financial Crisis Responsibility Fee while Austria, France, Hungary and United Kingdom call the fund Bank Levy.

Other ex-ante funds like the United Kingdom's Bank Payroll Tax is also available. Refer to Scich and Kim (2010) for more details.

Deposit insurance schemes are established to share burden in caseof failure by individual deposit-taking institutions. Deposit insurers and other FSN players are not expected to single-handedly deal with a systemic crisis (IADI, 2010), even though deposit insurers are mandated with resolutions of failed banks. Due to the recent crisis, deposit insurers are also equipped with more powers to deal with the resolution of SIBs in crisis situations.

5 Findings, Recommendations and Conclusion

We have identified SIFIs or SIBs and measured their contribution to systemic shortfall based on approaches advocated by BIS (the Indicator-based approach) and by academics using the systemic expected shortfall (SES) or SRISK. We have also provided a comprehensive comparison of the above systemic risk measures by considering the Nigerian Deposit Money Banks (DMBs) over the period 2009-2013.

The identification of systemic risk and SIBs is an integral element in the design and implementation of macroprudential supervision with a view towards enhancing the resilience of the financial sector. However, assessing the magnitude of systemic risk is complex due to several reasons that include lack of universally accepted definition and different approaches that give different ranking of SIFIs.

An advantage of the SRISK market data-based approach over the BIS Indicator approach is that market data is available at a daily frequency and therefore can capture the changing condition of banks at a daily frequency. The BIS Indicator approach can at most be updated at a monthly frequency and can only capture conditions of banks with a month's lag. Financial firms' risks, especially banks'can change very quickly. This implies that the BIS indicator approach

needs to be augmented with a model that usesmore up-to-date information like the SRISK approach.

Applying SRISK market data-based and BIS Indicator approaches to the Nigerian DMBs unambiguously establishes the six banks as systemically important: Bank 1, Bank 2, Bank 3, Bank 4, Bank 5 and Bank 6.

As it is already established, size is not the only criterion to determine systemic importance. We observe that banks identified as systemically important change in terms of weight or degree of importance from one month to the next and also different methods rank the systemic importance of the banks differently.

Basel capital requirements and other recent financial regulations seek to limit each institution's risk appetite. The market-based models show how the external costs of systemic risk are internalized by each bank so each individual firm may take actions to prevent its own collapse and by so doing reduce its negative externality on the system. That is why systemic risk is viewed as a negative externality imposed by each financial firm on the system.

A major advantage of the market-based approach and its feature of calculating systemic risk surcharge is that it makes it possible to understand systemic risk in terms of an individual bank and the broader context of banking subsectors. This implies that it is possible to compute the systemic risk surcharges a regional bankingsector against another region.

The recent financial crisis has shown that no single FSN participant can resolve systemic crisis alone. All the members should participate and collaborate to manage systemic risk. The near-financial crisis of 2009 that involved the collaboration of CBN and NDIC in special examination of all the universal banks, establishment of bridge-banks by NDIC and capital injection of N620 billion involved the coorperation of most FSN players in the country.

Finally, all banks identified as systemically important have to be subjected to higher capital and other regulatory requirements than those that are non-SIBs. This is due to the burden they can place on the financial system and the economy when they fail. The CBN/NDIC SIB Framework has recommended higher capital requirement SIBs.

The necessary tools to prevent a systemic crisis by deposit insurers include the information-sharing framework with other FSN players, appropriate level of coverage, public awareness, early detection of risk and timely intervention. Public awareness is essential in preventing bank runs in crisis times by enhancing public confidence in the deposit insurance system. Equally important is early detection of risk and timely intervention when a bank (s) is deemed to be in a problem. The CBN created the Financial Policy and Regulation (FPRD) with the key responsibility of macroprudential regulation and supervision in Nigeria. The NDIC carries out several public key awareness campaigns, improved its payout process, extended scope and level of coverage and has strengthened its early warning signals to identify weak banks early and intervene appropriately. Both CBN and NDIC carry out routine stress testing of the economy to identify systemic vulnerabilities and act accordingly.

Finally, all banks identified as systemically important have to be subjected to higher capital and other regulatory requirements than those that are non-SIBs. This is due to the burden they can place on the financial system and the economy when they fail. The CBN/NDIC SIB Framework has recommended higher capital requirement SIBs.

Recommendations

- The Corporation should assess its status in terms of systemic risk management as well as examine the legal framework for the resolution of this risk. International Association of Deposit Insurers (IADI, 2012) stated that a coordinated financial safety net (FSN) and legal framework are essential for promoting financial stability. The Association also stated that governments,

central banks or deposit insurers are the leading agencies in systemic crisis management.

- The Corporation, in collaboration with CBN and other FSN players, should establish a legal framework for systemic risk management. Effective systemic risk management requires that a crisis response mechanism should be specified in advance, and a speedy resolution of failed financial institutions should be carried out under the mechanism.

- The Corporation shares failure resolution responsibility with CBN. While, resolution of SIB can be quite tedious and demanding, international best practice requires the SIBs to submit resolution plans to resolution authorities at a predefined frequency, usually yearly. The NDIC/CBN SIB Framework requires all Nigerian banks designated as SIBs to develop and submit resolution and winding-down plan ("Living Will") annually to CBN. The Corporation should also be a recipient of the SIBs' annual Living Wills given its responsibility in failure resolution. Guidance should be issued to the identified SIBs on how to submit their respective plans including their strategy for rapid and orderly resolution in the event of failure of the bank.

- The Corporation should equally examine and if necessary strengthen its resolution processes for large complex financial institutions or SIBs. The Corporation should develop a resolution mechanism to safely wind down failing, systemically important banks in line with recent global financial reforms.
- Payment of funds for resolving systemic crisis can be ex ante or ex post fund. The recent financial crisis has led to the formation of ex-ante and ex-post fund for systemic crisis management under various names such as the resolution fund and bank levy. In Nigeria, the financial stability fund is established for the systemic risk management as an ex-ante fund in line with global best practice. However, the contribution of each bank to the financial stability fund should be based on individual bank's systemic risk capital surcharge. Systemic risk surcharge of each bank should be used in computing the bank's contribution to bail-out cost in crisis situations.

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Analysing Financial System Stability: Research Department

Executive Summary

The recent 2007-09 global financial crisis and the 2009 Nigerian near-financial crisis have emphasized the need for the analysis and integrated management of global and domestic financial systems. International standard setting institutions, like the Basel Committee for Banking Supervision and the International Monetary Fund (IMF), Central Banks Worldwide as well as the private sector have been working on a series of proposals so as to have a more stable and efficient financial system. The key initiatives pursued in this regard include measuring and managing systemic risk and the development and usage of macro-prudential policies that utilise macro-prudential indicators to ensure stability of financial systems. The overall aim of these two and several other initiatives are the measurement and strengthening of financial system stability.

Analyzing financial system stability is necessary because by identifying individual institutions, particularly Systemically Important Financial Institutions (SIFIs) posing big threats to financial system stability, measures and targets can help in targeting increased supervisory standards. In addition, by indicating that the potential for financial instability is rising (i.e., providing early warning signals), metrics can signal to policymakers a need to tighten the so-called macro-prudential policies.

However, financial system stability is not easy to define and measure due to the interdependence and the complex interactions of different parts of the overall financial system among themselves with the real economy and with cross-border dimensions of elements. The adopted framework to

measure financial stability should incorporate three elements: probabilities of failure in individual financial institutions, loss given default in the financial institutions, and correlation of defaults across the institutions.

Several researchers from standard setting organisations, central banks and academia have attempted to measure systemic risk as a step to measuring financial stability. Bank Negara Malaysia and German Central Bank (Deutsche Bundesbank) have used the Contingent Claims Analysis (CCA) to analyze their financial system stability. The IMF has also used the CCA approach in stress testing exercises of the Financial Sector Assessment Program (FSAP) for Germany, Spain, Sweden, the United Kingdom, and the United States between 2010 and 2012 and the Global Financial Stability.

Analysis of financial stability is usually carried out using macro-prudential indicators, based on FSIs. However, there is increasing use of more sophisticated market-based indicators (such as relative stock market indices, and distance-to-default indicators) and stress testing in addition to using the macroprudential indicators to analyse financial stability.

The CCA approach was used to estimate the implied market value of assets and their volatility for the firms considered (63 in total, with market capitalization representing 10% of the new rebased GDP). This was then used to calculate the Distance-to- Distress/Default (DD), the Probability-of-Default (PD), as well as the expected losses of the firms, sectors and the whole system. Expected loss for the system is the sum of all the implicit put options of each institution.

Findings

- This paper derives default Probabilities of Default and Distance-to-Default from Merton model and applies this to a number of Nigerian financial and non-financial quoted companies over the period from January 2, 2012 to December 2013. We argue that this model satisfies the macro-prudential approach to financial system stability analysis. On the basis of the Merton model, we constructed a system -wide financial stability measure for Nigeria, which builds on the put options of the banking, insurance, pension sectors, corporate and manufacturing sectors as traded on the floor of the Nigerian Stock Exchange (NSE).

- Distance-to-Distress measure of financial stability (Weighted DD) presents a decrease in financial stability from June 2012 to December 2013, disagreeing with Average Unweighted DD, which can be attributed to Banking, Financial and General Services sectors' instability as depicted by the PD measure. Distance-to-Distress measure of financial system stability could be used for financial system stability analysis by the FSRCC, CBN and other related agencies.

- Our analysis suggests that the Merton model appears to be useful in ranking sectors according to their contribution to financial system stability. The model also provided a means of measuring financial system stability based on individual firms, sectors and the financial system as a whole using several forward-looking measures.

- Our analysis suggests that it is useful to look at the financial system as a portfolio of counterparty exposures, the counterparties being

financial institutions, and then analyze the contribution of each firm to different sectors and the whole system as a portfolio of firms.

- The presented measures for financial stability (broken down in probability and distance to default measures) offer a number of insights which may prove useful for policy purposes. First, they contribute to measuring financial system stability, thus facilitating the identification of risks and providing a guideline for policy efforts. This function has been enhanced since the measures were applied to individual firms and sub-sectors as in this paper. This could help to map vulnerabilities more precisely which could form the basis for pre-emptive or corrective action to improve the stability of the system.

- The analysis also shows that forward-looking risk measures that utilise market data provide useful information for carrying out surveillance and risk assessments of financial system stability and for stress testing. They are a good complement to the main efforts in fundamental analysis of quantitative and qualitative factors. A forward-looking monitoring program to identify sources of systemic risk can help to develop pre-emptive policies to promote financial stability.

- The study indicates the importance of probability-of-default (PD) as a key concept in any analysis of financial fragility and central to the Basel II and III regulatory frameworks, (Goodhart and Tsomocos, 2007). Similarly, financial (in)stability is generated by the probability-of-default (PD) and bankruptcy of firms within the system. A model that captures probability of default of individual firms, that can be aggregated into a system-wide measure should

therefore be used for financial stability analysis since "any serious theory of systemic (in)stability has to focus on PD" (Goodhart and Tsomocos, 2007)

Recommendations

- This analysis was carried out based on only two time periods: June 2012 and December 2013. The FSRCC and NDIC/CBN should carry out this analysis on a quarterly basis so as to *pre-emptively avert, mitigate or manage any potential threat* before it materializes. German central bank (Deutsche Bundesbank ,2005), and Bank Negara Malaysia use this approach as part of their Financial Stability Review. The IMF has also used Contingent Claims Analysis Approach for stress testing exercise of the Financial Sector Assessment Program (FSAP) for Germany, Spain, Sweden, the United Kingdom, and the United States between 2010 and 2012 and the Global Financial Stability (Jobst and Gray, 2013).

- The FSRCC, NDIC, CBN and other stakeholders should initiate or continue enhancing the forward-looking capability of its surveillance framework by having a more robust assessment of risks in the banking, financial services and corporate sectors in an integrated or holistic manner so as to better enhance the stability of the overall financial system. Forward-looking models, like the Distance-to-Default model used in this paper, should be used in conjunction or as complementary tools to standard regulatory measures to enhance financial system stability.

  For instance, Bank Negara Malaysia uses the z-score (based on discriminant analysis) and modified distance to default which

"*provide important insights on emerging stress and risks, thereby providing sufficient lead time for the Bank to formulate appropriate policy measures pre-emptively to avert, mitigate or manage such threats. The quantification and measurement of risks enable more robust stress tests to be performed to assess the direct and possible feedback effects from plausible shocks to the system. ...*

Movements in the median z-score and weighted average modified distance to default are tracked to detect changes in the direction and average level of credit risk both at the macro as well as industry and company specific levels. In addition, Altman z-scores at the 75th and 25th percentile are also used to monitor the changes in the level of credit risk for firms with higher and lower credit quality, enabling a more complete assessment across different credit qualities."..Bank Negara, 2008

Suggested areas requiring further research are as follows:

- Given the varying business characteristics across different firms and sectors, the FSRCC, NDIC and CBN should develop sector specific z-scores based on the financial statements and default experiences of Nigerian businesses. These stakeholders should map the modified distance to default model to historical incidences of bond and loan defaults by Nigerian businesses, thereby enabling estimates of default probability and frequency to be more reflective of the future level of non-performing loans in the corporate sector.

- The FSRCC, CBN and other agencies can also build a model that incorporates forward-looking measures with macro-economic variables for better measurement of financial system stability. The time pattern of asset returns of each financial institution (or of the

risk indicators) can be used as the dependent variable in a factor model. Key factors driving these asset returns could include GDP, domestic and foreign interest rates, exchange rate, domestic and foreign equity indices, etc. A separate macroeconomic scenario generating model, e.g. a macroeconomic vector autoregressive model, could then be used to test the impact of scenarios on the key factors, which feed into the financial institution's assets. This, in turn affects the credit risk indicators and the value of equity capital.

- The NDIC carried out a previous study on measuring systemic risk based on the widely acclaimed SRISK approach pioneered by professors from Stern Business School. Given the complexity of the financial system and its multidimensional nature, the recommendation of using several models simultaneously to measure financial system stability should be considered. The implemented SRISK approach and the DD measures adopted in this paper should be used in tandem for enhancing financial system stability.

Introduction

The recent 2007-09 global financial crisis and the 2009 Nigerian near-systemic financial crisis has emphasized the need for the analysis and integrated management of global and domestic financial systems. International standard setting institutions like the Basel Committee for Banking Supervision and the International Monetary Fund (IMF) central banks worldwide as well as the private sector have been working on a series of proposals and initiatives with the aim of building be more stable and efficient financial systems. The key initiatives pursued in this regard

include measuring and managing systemic risk and the development and usage of macroprudential policies that utilise macroprudential indicators (MPIs) to ensure stability of financial systems. The overall aim of these two and several other initiatives are the measurement and strengthening of financial system stability.

Systemic risk is very important due to its link with financial stability. It is necessary to measure, and manage occurrence of events that could lead to systemic risk in order to ensure financial stability. In addition, a key lesson drawn from the global crisis is the limitation of the traditional micro-prudential regulations to identifying weaknesses of the financial system as a whole, such as the build-up of systemic risk. This has resulted in a shift towards macro-prudential approach in financial stability analysis. In contrast to the micro-prudential analysis, the macro-prudential analysis emphasises a holistic approach to monitoring stability of financial systems by observing macroeconomic and market-based data, qualitative and structural information, and the MPIs and financial soundness indicators (FSIs).

Alexander (2010) provides four distinct policy applications of systemic risk and financial stability measures, as follows:

(a) by identifying individual institutions, particularly, systemically important financial institutions (SIFIs) posing big threats to financial stability, measures and targets can help in targeting increased supervisory standards;

(b) by identifying specific structural aspects of the financial system that are particularly vulnerable, measures and targets can help policymakers identify where regulations need to be changed;

(c) by identifying potential shocks to the financial system posing big threats to stability metrics may help guide policy to address those threats; and
(d) by indicating that the potential for financial instability is rising (i.e., providing early warning signals),metrics can signal to policymakers a need to tighten so-called macroprudential policies.

There is no widely accepted definition of 'financial stability' unlike price stability (Gadanecz and Jayaram, 2009) and therefore, equally, no consensus on what policies should be pursued in the interests of financial system stability (Allen and Wood, 2006). Financial stability is not easy to define and measure due to the interdependence and the complex interactions of different parts of the overall financial system among themselves with the real economy and with cross-border dimensions of elements (Gadanecz and Jayaram, 2009). In the words of the Swedish central bank Governor, 'the concept of stability is slightly vague and difficult to define'. However, it is well understood that "that financial stability is about the absence of system-wide episodes in which the financial system fails to function (crises), and about resilience of financial systems to stress" (Čihák, 2007).

Several researchers from standard setting organisations, central banks and academia have attempted to measure systemic risk as a step to measuring financial stability, develop MPIs and FSIs to capture conditions of financial stability as well as measure the stress or stability of the financial system through several models using the MPIs and other indicators (Evans et al (2000) and Van den End & Tabbae (2005)).
As recognised by (Nelson and Perli (2005), Van den End (2006)), in addition to balance-sheet based information, there is need for market

information so as to capture the interactions between bank- and non-bank financial intermediation. In this study we employ contingent claims analysis (CCA) that utilises market information to study measure or assess financial systemic stability. CCA is a proven approach to analyzing and managing risk, including sovereign and financial system stability. The idea of using market data (equity prices) for assessment of financial institutions' soundness comes from the insight that corporate securities are contingent claims on the asset value of the issuing firm.

The CCA is a generalization of the option pricing theory pioneered by Black–Scholes (1973) and Merton (1973). Option pricing methodology has been applied to a wide variety of contingent claims. When applied to the analysis and measurement of credit risk, CCA is commonly called the "Merton Model." It is based on three principles: (i) the values of liabilities are derived from assets; (ii) assets follow a stochastic process; and, (iii) liabilities have different priority (i.e., senior and junior claims).

The basic analytical tool in this framework is the risk-adjusted balance sheet, which shows the sensitivity of the country's assets and liabilities to external "shocks" (Gray et al, 2007). At the national level, the sectors of the country economy are then viewed as interconnected portfolios of assets, liabilities, and guarantees. The Merton model used in this study is a multi -sector model that integrates the default risks of various sectors into a systemic model. This approach has been found to be reliable in predicting default and fits in the macro-prudential approach (Borio, 2003 and Gray & Malone (2008)) and makes it useful for measuring financial stability (Gray et al (2007), Gray & Malone (2008) and Van den End & Tabbae (2005)).

The adopted framework incorporates the three elements, argued by Cihak (2007), that a good measure of systemic stability needs to possess, namely: probabilities of failure in individual financial institutions, loss given default in the financial institutions, and correlation of defaults across the institutions. According to Gray et al (2007), the "CCA framework provides a forward-looking market-based set of indicators to measure the vulnerability of various sectors of the economy and is well-suited to capturing nonlinearities and to quantifying the effects of asset-liability mismatches within and across institutions".

The contribution of this paper is in using probability of default, distance to default and market data coupled with balance sheet liabilities data based on individual institutions' forecasted failures or stability metric, as key measures of stability.

Financial stability analysis, macroprudential supervision and measuring system risk are set out in section 2. The section also discusses macroprudential indicators and the various ways of studying financial stability. Section 3 deals with the details of Contingent Claims Analysis, including option pricing theory to study financial system stability. The section explains the Merton model with a description of the way in which it can be applied to the various sectors of the economy and the financial system so as to measure financial system stability. Subsequently, section 4 presents the data used in the analysis and applies the CCA approach to analyse financial stability in Nigeria, with an evaluation of the measure's reliability and a discussion of the possibilities for stress testing. The paper concludes with some policy -relevant observations. Finally, in Section 5, we summarize our findings and propose possible lines of further research in order to measure financial system stability in Nigeria.

3.0 Financial Stability Analysis, Macroprudential Supervision and Measuring System Risk

2.1 What is financial stability?

Unlike price stability, financial stability has neither an established definition (Čihák, 2006), (Gadanecz and Jayaram, 2009) nor an aggregate indicator that the central bank can use as a measure of financial instability (Čihák, 2006). There is no consensus on the basic theoretical financial stability framework and no such framework that relates to systemic stability (Goodhart and Tsomocos, 2007). The lack of consensus on the definition of financial system stability could be due to the fact that financial stability is a multi -faceted concept, making it hard to measure (Van den End & Tabbae, 2005).

The financial system is regarded as stable in the absence of excessive volatility, stress or crisis (Gadanecz and Jayaram, 2009). The European Central Bank defined financial stability as "a condition in which the financial system – comprising financial intermediaries, markets and market infrastructure – is capable of withstanding shocks and the unravelling of financial imbalances, thereby mitigating the likelihood of disruptions in the financial intermediation process which are severe enough to significantly impair the allocation of savings to profitable investment opportunities" (ECB, 2007).

Monitoring financial stability therefore requires an explicit understanding of both how traditional and evolving financial markets relate to each other and how they relate to economic conditions (Brave and Butters, 2011).

According to Van den End & Tabbae (2005), financial stability relates to the functioning of financial markets, institutions and infrastructure and to the interaction between the financial sector and the real economy. This

complexity implies that financial stability cannot easily be summarised in a single measure, like the inflation index for price stability.

The complexity and vagueness of the definition of financial system stability has led many analysts and researchers to focus on the risks and vulnerabilities of the financial system due to their ease of modelling. The problem with this approach is that viewing financial stability from crisis angle is too narrow given that different countries have experienced different types of crises ranging from banking crisis, currency crisis to debt crisis or even stock market crises. Each crisis can also be defined in several ways and is based on different quantifiable variables, Gadanecz and Jayaram (2009).

2.2 What is Systemic Risk

The task of measuring systemic risk is difficult because there is no agreed definition of such an important risk. This is because it is difficult to manage what cannot be measured and before we can measure systemic risk, we need to define or characterize it. Policymakers, regulators, academics and practitioners have given different definitions to systemic risk.

Systemic risk has been defined as the probability that a series of correlated defaults among financial institutions, occurring over a short time span, will trigger a withdrawal of liquidity and widespread loss of confidence in the financial system as a whole (Billio et al, 2010).The European Central Bank (ECB, 2010) views systemic risk as a risk of financial instability so widespread that it impairs the functioning of a financial system to the point where economic growth and welfare suffer materially. Acharya et al, 2010 define this risk in terms of correlated exposures, Mishkin (2007) focussed on information disruptions, Moussa

(2011) defined this risk with respect to contagion and in terms of negative externalities by (Financial Stability Board, 2009). Systemic risk occurs if and only if there is an aggregate shortage of capital in the financial sector such that a reduction in lending by the failure of one bank cannot be offset by other financial institutions (Acharya and Steffen, 2012).

A dominant definition is that systemic risk has to do with "the risk of experiencing an event that will affect the well-functioning of the entire financial system" (Marquez et al, 2009). Bank for International Settlements in its annual report of 1993-1994 defined systemic risk as " the risk that the failure of a participant to meet its contractual obligations may in turn cause other participants to default, with the chain reaction leading to broader financial difficulties". However, systemic risk can simply be defined as any broad-based breakdown in the financial system

It can be inferred that systemic risk has two components; namely: An event that causes the failure or dysfunctionality of a critical number of market participants, and a contagion mechanism which propagates the failure and/or dysfunctionality to a broader number of participants or the entire system (Marquez et al, 2009). The objective of financial stability is to limit the build-up of systemic risk.

There are several techniques proposed in the literature for measuring systemic risk, financial stability analysis and the systemic importance of institutions (Bisias et al., 2012) mainly developed both before and during the 2007-09 financial crisis. A widely used technique for measuring systemic risk and assessing financial system stability is based on Merton (1974) structural model or contingent claims analysis.

To measure systemic risk, the portfolio is basically all the firms that make up the financial system. In this context, a number of assumptions regarding the likelihood of default (PDs) and the severity of losses (LGDs) and an assumed dependence structure, an aggregate loss distribution, which represents the total losses of all the institutions in the financial system, can be derived from the losses of the individual institutions. Others, like Huang, Zhou and Zhu (2009) use the contingent claim analysis framework as a first step in determining the systemic importance of financial institutions. In particular, in a second step they use specific allocation procedures to allocate the total level of systemic risk to individual institutions.

The IMF has used Contingent Claims Analysis Approach the stress testing exercise of the Financial Sector Assessment Program (FSAP) for Germany, Spain, Sweden, the United Kingdom, and the United States between 2010 and 2012 and the Global Financial Stability (Jobst and Gray, 2013).

Van den End and Tabbae (2005), construct a system -wide financial stability measure for the Netherlands that builds on the put options of the banking, insurance and pension sectors. This measure approximates the probability and the potential loss of stress in the financial system. The authors argue that this method satisfies the macro-prudential approach. Van den End and Tabbae tested the measure against various indicators of default risk, and concluded that it is a reliable proxy.

Gray and Jobst (2010) propose using contingent claims analysis (CCA) to measure systemic risk from market-implied expected losses, with immediate practical applications to the analysis of implicit government contingent liabilities, i.e., guarantees. In addition, the framework also helps quantify the individual contributions of financial institutions to

overall contingent liabilities in the event of a systemic distress. Gray and Jobst (2010) use CDS spreads in a contingent claims analysis of financial firm risk. Adrian and Brunnermeier's (2010) conditional value at risk (CoVaR) and the International Monetary Fund's (2009b) related "Co-Risk" models of shared exposures similarly rely on firm-level market prices.

The "Co-Risk" measure, first proposed in the IMF's 2009 Global Financial Stability Review (International Monetary Fund, 2009a), examines the co-dependence between the CDS of various financial institutions. It is more informative than unconditional risk measures because it provides a market assessment of the proportional increase in a firm's credit risk induced, directly and indirectly, from its links to another firm. The distressed insurance premium (DIP) of Huang, Zhou, and Zhu (2009b) measures the conditional expected shortfall (CoES) of an institution, conditional on systemic distress. The DIP represents a hypothetical insurance premium against systemic distress, defined as total losses exceeding a threshold level of 15% of total bank liabilities.

Using stock-market information, Lehar (2005) monitors the risk in a bank regulator's portfolio by estimating the probability of a simultaneous default of several banks using the Merton (1974) model.

2.3 Macroprudential Indicators and Policy

Macro-prudential analysis relies on micro indicators (that is indicators of risks of individual institutions), which are then aggregated and used for macroprudential analysis (Van den End & Tabbae, 2005). The IMF's Financial Soundness Indicators (FSIs), which contain a basic set of such macro-prudential indicators[2], as well as aggregated micro data, macro -

[2] The macroprudential indicators (MPIs) are developed as indicators of the health and stability of financial systems and conceived to be critical in producing reliable assessments of the strengths and vulnerabilities of financial systems and to enhancing disclosure of key financial information to markets.

economic variables (such as interest rates, GDP growth and credit expansion) are also used as financial stability indicators.

There are a total of 39 FSIs divided into two groups. The first group consists of the main indicators (the core set) relating to the banking sector (12 indicators). The remaining 27 recommended indicators belong to the second group (the encouraged set), which includes some other banking sector indicators, but also indicators from non-bank financial institutions, non-financial corporations, households, financial markets and property markets. The inclusion of non-banking sector indicators in the FSIs reflects the interconnection of the financial and real sectors, for example, unfavourable developments in the corporate sector pass through to the loan portfolio of banks and may thus have a negative effect on financial stability.

According to Geršl and Heřmánek (2006), the objective of the set of financial stability indicators is to provide users with a rough idea of the soundness of the financial sector as a whole. On the other hand, the objective of macro-prudential policy is to focus on how financial institutions, markets, infrastructure and the wider economy interact with each other. The development of macroprudential policy instruments involves adapting existing microprudential tools, such as the individual FSIs, and limits on activities that increase systemic vulnerabilities and risks.

The Committee on the Global Financial System of the Bank of International Settlemennt (CGFS, 2010) discussed the issues involved in operating macroprudential instruments. According to CGFS, assessing the transmission of macroprudential interventions using MPIs in the financial system is very difficult because we have not fully understood how the financial system behaves and interacts with the macroeconomy. The first reason for the lack of the understanding is the plenitude of instruments

(like lending restrictions) that are helpful as policy measures which could potentially be tailored to conditions in particular sectors. It should be noted however that measures targeting specific markets might increase imbalances in other areas. Second, the transmission mechanism is likely to change over time with changes in financial intermediation practices and the structure of the financial system. Innovations in Financial products, consolidation and can change risk distributions in unpredictable ways.

Signal extraction to understand build-up of financial risks using macroprudential policy framework is also difficult (CGFS, 2010). There is a need to accurately assess financial imbalances and vulnerabilities at both the aggregate and disaggregated levels, which may be more apparent at the sectoral level, given that imbalances and exposures do not typically develop evenly across the financial system or sectors of the real economy. "The difficulty of aggregating sector-specific measures into credible evidence of an overall macroprudential problem might lead policymakers to take action mainly at a disaggregated level, even though the actions might be motivated primarily by macroprudential concerns. The danger here is that the intent of macroprudential policy might not be clear" (CGFS, 2010).

Another signal extraction issue is that that policy measures will not be applied uniformly and proportionately across sectors. After all, macroprudential indicators, though useful, are mostly sector-specific, and therefore do not quantify the multifaceted nature of financial stability (Van den End and Tabbae, 2005).

2.4 Quantifying financial stability

Definition of financial stability is only useful for crisis prevention and management as well as policy analysis when it is operational and quantifiable. The analysis of financial stability is generally based on several risk factors therefore a single model may not satisfactorily capture all the risk factors. Rather, a number of models is needed (Bårdsen et al, 2006).

Bårdsen et al (2006) outline the minimum structural characteristics that models quantifying financial stability should ideally be able to include as follows: the possibility of contagious failures between banks and their borrowers; as an important element in contagion. It is essential that a model exploring contagion should include a default parameter; since another important aspect of the real world is that markets are incomplete and not every eventuality can be hedged, it is also essential for a model exploring systemic risk to include liquidity risk and/or the incompleteness of financial markets and include genuine macroeconomic conditions. Other characteristics are structural micro-foundations due to regime changes and discontinuous changes of economic and financial variables; be empirically tractable with analytically coherent framework that may be more relevant for financial stability analysis; be useful for forecasting and policy analysis and can be tested.

The indicator needed to quantify financial stability must be made up of different components of the financial system, as "financial stability can be seen as being consistent with various combinations of the conditions of its constituent parts…" (Van den End and Tabbae, 2005). According to Cihak (2007), a good measure of financial systemic stability should incorporate three elements of: probabilities of failure in individual financial institutions, loss given default in the financial institutions, and correlation of defaults across the institutions.

The construction of an aggregate financial stability indicator is still in the research and experimental phase (Geršl and Heřmánek, 2006).

The complexity and vagueness of financial stability implies that it can be represented by several indicators that include accounting ratios (e.g., capital to assets), MPIs/FSIs, measures of PoD derived from market prices and option pricing theory, supervisory early warning systems, and others obtained from stress testing. Generally, most balance sheet indicators (nonperforming loans for example) are typically backward-looking indicators of financial distress while market information and ratings of individual institutions are in principle forward-looking (CGFS, 2010).

Analysis of financial stability is usually carried out using macroprudential indicators, based on FSIs. However, there is increasing use of more sophisticated market-based indicators (such as credit-default swaps, relative stock market indices, and distance-to default indicators) and stresstesting in addition to using the MPIs/FSIs to analyse financial stability (Čihák, 2007).

Probability of default (PoD) is a key concept in any analysis of financial fragility and central to the Basel II and III regulatory frameworks (Goodhart and Tsomocos, 2007). Similarly, financial (in) stability is generated by the PoD and bankruptcy of firms within the system. A model that captures PoD of individual firms, that can be aggregated into a system-wide measure should therefore be used for financial stability analysis since "any serious theory of systemic (in) stability has to focus on PoD" (Goodhart and Tsomocos, 2007).

The argument of Goodhart and Tsomocos (2007), further implies that financial instability is characterized by both high probabilities of default and low profits, at both the individual and aggregate levels.
Furthermore, (Brave and Butters, 2011) argues that a way to judge the

validity of measures of financial stability is to follow the narrative approach and link their values to significant events in a nation's financial history

Given the above desired characteristics of models and indicators of financial stability, we therefore focus the attention of this paper to market data and models that explicitly measure probability of default or the default likelihood for each institution.

3.0 Contingent Claims Analysis

A contingent claim is any financial asset whose future payoff depends on the value of another asset. CCA is used to construct risk-adjusted balance sheets, based on three principles: (i) the values of liabilities (equity and debt) are derived from assets; (ii) liabilities have different priority (i.e., senior and junior claims); and (iii) assets follow a stochastic process. The liabilities consist of senior claims (such as senior debt), subordinated claims (such as subordinated debt) and the junior claims (equity or the most junior claim). Balance sheet risk is the key to understanding credit risk and crisis probabilities. Default happens when assets cannot service debt payments. Uncertain changes in future asset value, relative to promised payments on debt, is the driver of default risk. As total assets decline, the value of risky debt declines and credit spreads on risky debt rise. The asset price of a firm (such as the present value of income flows and proceeds from asset sales) changes over time and may be above or below promised payments on debt which constitute a default barrier. Uncertain changes in future asset value, relative to the default barrier, determine the probability of default risk, where default occurs when assets decline below the barrier. When there is a chance of default, the repayment of debt is considered "risky," unless it is guaranteed in the event of default. Contingent claims analysis is a generalization of the

option pricing theory pioneered by Black-Scholes (1973) and Merton (1974).

In the model of Merton (1974), the equity of the firm is a call option on the underlying value of the firm with a strike price equal to the face value of the firm's debt. As inputs, Merton's model requires the current value of the company's assets, the volatility of the company's assets, the outstanding debt, and the debt maturity. To calculate the probability of default, the model subtracts the face value of the firm's debt from an estimate of the market value and then divides this difference by an estimate of the volatility of the firms' assets. The outcome is known as the distance to default, which is then substituted into a cumulative density function to calculate the probability that the value of the assets will be less than the value of debt at the forecasting horizon.

The Merton DD model makes two important assumptions; the first is that the value of a firm follows geometric Brownian motion,

$$dV = \mu V dt + \sigma_V V dW \qquad \text{eqtn. (1)}$$

Where V is the total value of the firm, μ is the continuously compounded return on V, σ_V is the volatility of the firms' assets and dW is a standard Wiener process. The second assumption of the Merton DD model is that the firm has issued only one zero-coupon bond maturing in time T. In the model, the equity of the firm is a call option on the underlying value of the firm with a strike price equal to the value of the firm's debt and a maturity of time T. The value of this call option can be described by the Black-Scholes-Merton formula. By put-call parity, the value of the debt is equal to the value of a risk-free discount bond minus the value of a put option. The Merton model specifies that the equity value of a company satisfies

$$E = V\mathrm{N}(d_1) - e^{-rT} F\mathrm{N}(d_2) \qquad \text{eqtn. (2)}$$

In which E is the market value of the firm's equity, *F* is the face value of the debt, *r* is the risk-free rate, *N(.)* is the cumulative standard normal distribution function and d_1 and d_2 are given by

$$d_1 = \frac{\ln(V/F) + (r + 0.5\sigma_V^2)T}{\sigma_V \sqrt{T}} \qquad \text{eqtn. (3)}$$

and

$$d_2 = d_1 - \sigma_V \sqrt{T} \qquad \text{eqtn. (4)}$$

The Merton DD model is based upon two important equations. Equation (2) expresses the equity value as a function of the total value. Equation (3) relates the volatility of the firm's asset value to the volatility of its equity. The value of equity is a function of the value of the firm and time, so that it follows from Ito's Lemma that

$$\sigma_E = \left(\frac{V}{E}\right)\frac{\partial E}{\partial V}\sigma_V \qquad \text{eqtn. (5)}$$

In the Black-Scholes-Merton model, it can be shown that $\partial E/\partial V = \mathrm{N}(d_1)$, so that the volatilities of the firm's assets and its equity are related by

$$\sigma_E = \left(\frac{V}{E}\right)\mathrm{N}(d_1)\sigma_V \qquad \text{eqtn. (6)}$$

In the Merton DD model the value of the option is observed as the total value of the firm's equity, while the underlying value of the asset is not directly observable. The equity value E can be observed from the market by multiplying the outstanding shares by the current stock price. The volatility of the equity σ_E can be estimated by using historical stock return data. It is typical to use a forecasting horizon of one year (T = 1), and as such a 12-months risk-free rate can be applied. For the face value of debt *F*, we can use the book value of the total liabilities. All variables are thus

observable except for the value of the assets V, and its volatility σ_V. These values have to be inferred from equations (2) and (5). First an initial value of σ_V is estimated by

$$\sigma_V = \sigma_E \left(\frac{E}{E+F} \right) \qquad \text{eqtn. (7)}$$

The value of the assets V can then be calculating by using equation (2) and the calculated σ_V from equation (7). This will be done on a daily basis of the previous year. With these values of V, we will calculate the implied log return on assets each day, and use this return series to generate new estimates of σ_V and μ. Once this numerical solution is obtained, the distance to default can be calculated by

$$DD = \frac{\ln(V/F) + (\mu - 0.5\sigma_V^2)T}{\sigma_V \sqrt{T}} \qquad \text{eqtn. (8)}$$

The corresponding probability of default is

$$PoD = \mathrm{N}(-DD) \qquad \text{eqtn. (9)}$$

The basic analytical tool in the CCA is the risk-adjusted balance sheet, which shows the sensitivity of the enterprise's assets and liabilities to external "shocks."

At the national level, the sectors of an economy are viewed as interconnected portfolios of assets, liabilities, and guarantees—some explicit and others implicit. Traditional approaches have difficulty analyzing how risks can accumulate gradually and then suddenly erupt into a full-blown crisis. The CCA approach is well-suited to capturing such "non-linearities" and to quantifying the effects of asset-liability mismatches within and across institutions. Risk adjusted CCA balance

sheets facilitate simulations and stress testing to evaluate the potential impact of policies to manage systemic risk.

The same general principles of contingent claims that apply to analysis of a single firm can also be applied to an aggregation of firms. The liabilities of a firm, a portfolio of firms in a sector, or the financial sector can be valued as contingent claims on the assets of the respective firm or sector.

Financial Stability Risk Measures based on CCA

The Merton model solves for risk-neutral probabilities of default that represent the probability that the asset value of a firm will fall below the value of debt, assuming that the underlying asset return (change in asset value) process has a mean return equal to the risk-free rate. This model views a firm's liabilities (equity and debt) as contingent claims issued against the firm's underlying assets. By backing out asset values and volatilities from quoted stock prices and balance sheet information, the Merton model produces instantaneous updates of a firm's default probability. The default probability in the model is a nonlinear function (where the default probability has to be solved for iteratively) of the firm's stock price, stock price volatility, and leverage ratio.

The famous rating agency, Moody's, has developed a procedure for estimating the default probability of a firm that is based conceptually on Merton's 1974 option-theoretic, zero-coupon, corporate bond valuation approach.

Chan-Lau (2006) and Gropp, Vesala and Vulpes (2002) showed equity prices are used in the famous Merton model (Merton, 1974) and its several variants is very useful not only for predicting distress but also for systemic risk analysis and stress testing financial systems. Chan-Lau,

Jobert, and Kong (2004) estimated bank distress using Merton (1974) model for 38 banks in 14 emerging market countries. Their results showed that Merton (1974) model can predict a bank's credit deterioration up to nine months in advance.

Bank Negara (2008) use forward-looking models (z-score and modified distance to default) to provide important insights on emerging stress and risks of the corporate sector. Saldias (2012a and 2012b) compute aggregated and forward-looking distance-to-default called aggregated distance to default (ADD) and portfolio distance to default (PDD) to measure systemic risk in the European banking system.

Market indicators have also been playing a more important role in assessing the efficiency and stability of public sector credit institutions at German central bank (Deutsche Bundesbank, 2005). The distance to default indicator derived by using theoretical option-price-based measures is used by the Bank to measure the improvement in the efficiency and resilience of the German listed firms in both banking and insurance sectors.

Firms or sectors with shorter distances to default are assessed to be associated with higher credit risk and hence a greater probability of default.

For example, European Central Bank (2005) treats the DD as an important forward-looking indicator that can provide early signs of financial fragility.

The distance to default measures the number of standard deviations the expected asset value is away from the default. Thus, a high distance to

default is associated with a low default probability. The DD is defined by the number of the standard deviation of the market value of assets away from the default point. The larger the DD, the greater is the distance of a company from the default point, and the lower is the probability of default. For example, a DD of 2.0 means that default within a year is a two-standard deviation event, presuming the fluctuation of the market value of assets follows the recent historical value, using the current market value of assets as a starting point. Even if the DD becomes zero, it does not mean that the bank fails at that point of time. If short-term debts (liabilities with maturity less than a year) are not rolled over, then the bank would need to exhaust assets in order to repay within a year. The DD being 0.0 or even negative means that the bank will be highly likely to fail unless the asset value improves.

As for the models used to calibrate the DD series, at each point in time t, the Average Distance-to Default (ADD) is obtained by taking the simple average across the N individual bank DD series. The definition of the inputs in the PDDs case is the same as in DD and ADD. However, the PDD assumes that individual banks are regarded as a big bank and the balance sheet data of the PDD banks are aggregated into a single series. Hence, the individual annual and interim data on total assets, short-term liabilities and equity are added up across the actual constituents from the portfolio to compute quarterly portfolio's distress barrier before daily interpolation.

In this paper, financial system is viewed as a set of interrelated balance sheets with five sectors – banks, financial services, corporate (manufacturing), corporate (oil and gas) and general services. The liabilities of a firm, a portfolio of firms in a sector, can be valued as contingent claims on the assets of the respective firm or sector. The principles of contingent claims are applied to each firm and then

aggregated to obtain a systemic risk measure based on the recommendation of Gray and Malone (2008) by weighting the individual default probabilities and distance to distress by the estimated market value of assets of each institution to get a system risk indicator. The authors also suggested using the median PoD for the subsector or group and then summing the implicit put options of a portfolio of institutions to get the system expected loss for a given horizon period.

In this section, we applied Merton 1974 model to the firms and sectors. We derive the probability of default and distance to default (DD) based on Merton (1974) model. The probability of default (PoD) and DD in this case are a function of the bank's capital structure, the volatility of the asset returns and the current asset value. The PoD is bank specific and can be mapped into any rating system to derive the equivalent rating of the obligor (Crouhy et. al., 2000).

CCA was used to estimate the implied market value of assets and their volatility for the banks. The market value of equity (i.e. total market capitalization from stock price data) and its volatility was used together with the distress barrier to calculate implied assets and their volatility for each firm in the sectors identified. This was then used to calculate the distance to distress, PDDs, ADDs, the probability of default, as well as the expected losses of the firms, sectors and the whole system. Expected loss for the system is the sum of all the implicit put options of each institution. While some studies (Gray, Merton and Bodie, 2008) aggregate all equity prices and market capitalization as one large firm and the financial sector as one large institution and derive risk measures in this way, one can look at each firm and financial institutions separately and group the firms into sub-sectors. The individual firms can then be aggregated into Average or Weighted PDs or DDs as appropriate. This enables the analyst to identify

the firm or sector that is contributing to the most to financial system instability or has the potential to do same. Remedial or pre-emptive action can then quickly be taken before it becomes a serious issue.

This paper measures financial system stability by analysing systemic risk, based on PDs, DDs and ADDs, for individual firms, sectors and the whole system.

4.0 The Data and Empirical Analysis

It is well-known that stock market prices reflect the full range of available market information (about credit, currency, interest rate, liquidity and operational risks, etc.). Due to the fact that the financial stability measures are determined based on market prices (equity market capitalisation, volatility of stock prices and interest rates), they also reflect other stability risks in addition to default risk.

Burton and Seale (2005) presented several examples where Moody's KMV distress prediction model, which is based on Merton's 1974 model, could have been used by FDIC to identify when default expectations for an insured institution began to deviate from those for peer institutions. In the presented example, the market provided an unambiguous and quantifiable signal of financial weaknesses that led to the institution's failure some 21 months later.

Our sample is the set of all firms that are listed on the Nigerian Stock Exchange. We include all firms with complete market capitalization and stock price series as well as liabilities information from 2nd Janaury 2012 to the end of 2013. The data set includes data (stock returns and market capitalizations, from Datastream) and quarterly data of liabilities.

In our sample, there are 16 banks and 11financial-services firms (including insurance companies, pension funds and investment management firms). Other firms include 15 oil and gas firms as well as 16 manufacturing firms. The sectors considered in our system-wide financial stability is therefore in line with Van den End and Tabbae (2005), that constructed a system -wide financial stability measure for the Netherlands based on put options of the banking, insurance and pension sectors. The market capitalization of all the firms used is shown in Table 1.

Table 1: Market capitalization of all the firms used in the analysis

S/No	Sector	No of Firms Used	Total Market Cap (N Millions)	
1	Banks	16	2,917,600.00	35.21%
2	Oil and Gas	15	150,360.00	1.81%
3	Manufacturing	16	5,152,900.00	62.18%
4	Financial Services	8	35,784.00	0.43%
5	General Services	8	30,051.00	0.36%
			8,286,695.00	

The manufacturing sector carries over 62% of the market capitalization of all the firms considered. This is principally due to the influence of Dangote Cement. Banking carries over 35% of the whole market capitalization considered. The cumulative market capitalization for the 63 institutions is 8.286 trillion Naira. For the banking sector, the firms listed

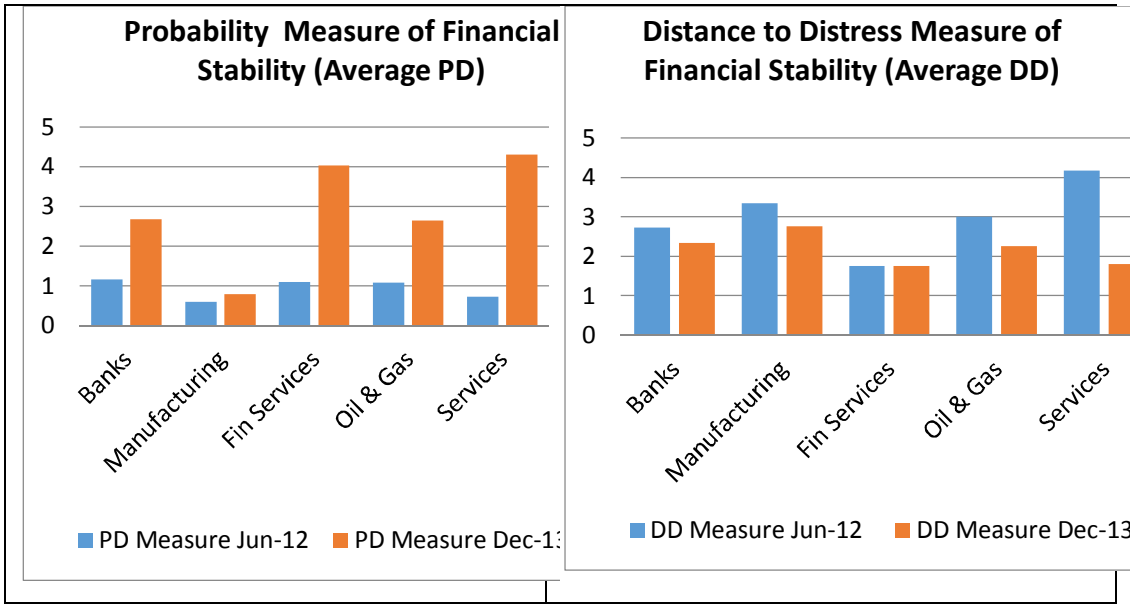
on the NSE and used in this analysis have assets worth more than 90% of the total banking industry assets.

Nigeria's GDP in 2013 had been revised from 42.4 trillion naira to 80.2 trillion naira ($510 billion). Therefore, the total market capitalisation of the firms used for the analysis is about 10% of the rebased GDP.

Results

In this section, we applied Merton 1974 model to the firms and sectors. We derive the probability of default and distance to default (DD) based on Merton (1974) model. The probability of default (PoD) and DD in this case are a function of the bank's capital structure, the volatility of the asset returns and the current asset value. The PoD is bank specific and can be mapped into any rating system to derive the equivalent rating of the obligor (Crouhy et. al., 2000). This paper measures financial system stability by analysing systemic risk, based on PoDs, DDs and Average DDs (ADDs), for individual firms, sectors and the whole system.

Chart 1: Probability of Default Financial System Stability Measure



The chart above shows both Average probability of default (PD) and Average
distance to default (DD) measures for the Nigerian banking, manufacturing, financial services, oil and gas and general services sectors. Based on the unweighted average, the PD measure suggests that financial stability has decreased since June 2012 as at December 2013 for all the sectors. The General Services sector has presented the greatest increment of financial instability from June 2012 to December 2013, followed closely by Financial Services sector. Both Banking as well as Oil and Gas sectors presented very similar increases and are the second most stable sectors of the economy. This measure presented the Manufacturing and General Services as the sectors that contribute the most and the least to financial system stability, respectively. We expected default risk to be typically higher for banks than for other sectors (higher PDs or lower DDs), given the higher leverage in the banks' balance sheets (owing to their funding with borrowed funds, such as deposits and interbank loans, which have relatively short maturities). The Banking sector risk profile has not projected this profile. A clear explanation for this has to be established which may be connected to the risk profiles of the other sectors of the banks. The Appendix shows the individual estimated risk measures for all the firms that form a sector. Analyzing the biggest contributors or firms with the biggest change can add further insight or help in addressing the financial instability.

The unweighted average DD, also reported a decrease in financial system stability from June 2012 to December 2013. As in unweighted average PD measure, the analysis presented Manufacturing and General Services as the sectors that contribute the most and the least to financial system stability, respectively. Oil & Gas and Banking sectors presented very

similar increase and are the second and third most stable sectors of the economy, respectively.

It should be noted from the graphs that the unweighted average PD measure has recorded more dramatic increase in instability than the unweighted average DD measure. It should also be noted that the higher the PD, the more the instability of the sector or firm. However, the higher the DD, the higher the stability of the sector or firm.

Chart 2: Distance to Default Financial System Stability Measure

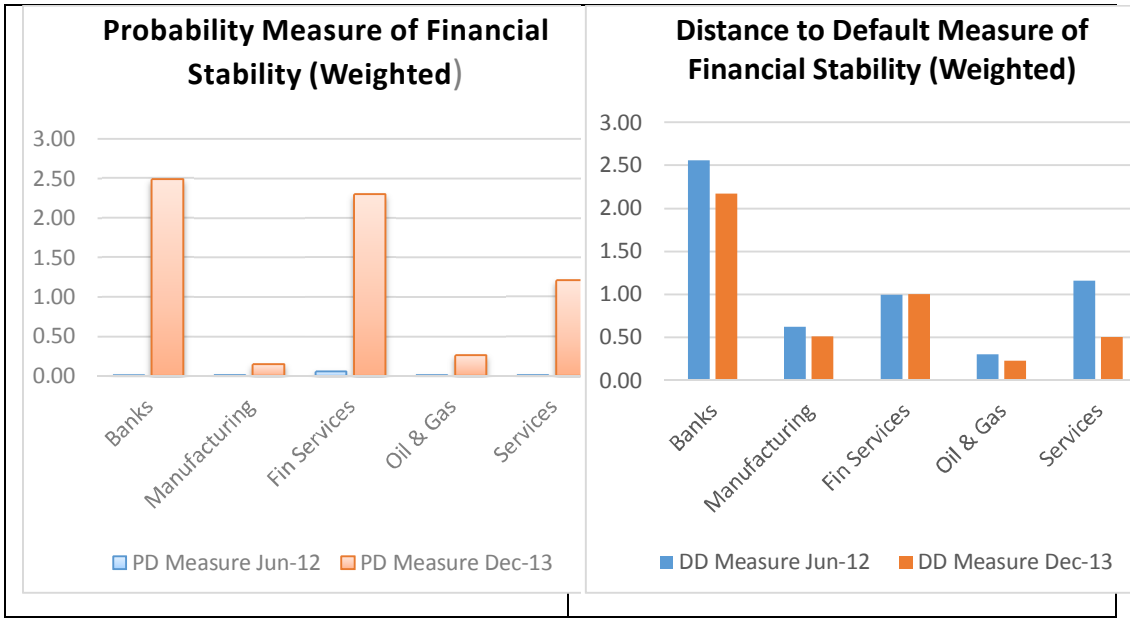


Chart 2 above, the weighted PD and DD measures, also reported a decrease in financial system stability from June 2012 to December 2013. However, the weighted PD measure reported the sectors that contributed the most to financial instability, in decreasing order, as Banking, Financial Services, General Services, then Oil and Gas and finally Manufacturing sector. The weighted DD measure also reported decrease in financial system stability, except in Financial Services that remained the same. The Banking sector contributed the most to financial system stability, followed by Financial Services and then followed by General Services.

Chart 3: Aggregated Financial System Stability Measures

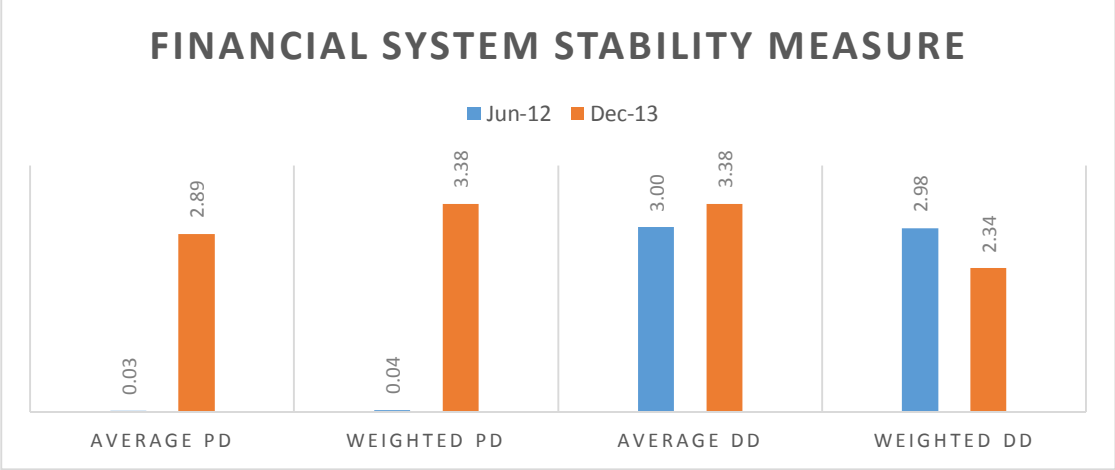


Chart 3 shows that the financial system instability has increased dramatically when analysed based on June 2012 and December 2013 data, using the probability of default risk measure. Based on the PD measure (Charts 1 and 2, left), it is the Banking, Financial and General Services sectors that caused the instability.

Distance to Distress measure of financial stability (Average DD) has not shown the dramatic decrease in financial stability presented by Average PD. However, there is still a noticeable and clear increase in financial stability from June 2012 to December 2013.

Distance to Distress measure of financial stability (Weighted DD) presents a decrease in financial stability from June 2012 to December 2013, disagreeing with Average Unweighted DD, which can be attributed to

Banking, Financial and General Services sectors instability as depicted by the PD measure.

We expected default risk to be typically higher for banks than for other sectors (higher PDs or lower DDs) given the higher leverage in the banks' balance sheets[3] (owing to their funding with borrowed funds, such as deposits and interbank loans, which have relatively short maturities). The Weighted DD measures confirm this observation and should therefore be adopted for financial system stability analysis because the measure considers each sectoral contribution to systemic risk as fairly as possible.

It is easy to stress a particular firm, a sector or the whole economy based on interest rate, equity price and total capitalisation or other variables so as to enhance financial system stability as estimated using PD and DD.

Risk Transmission between sectors

Risk is easily transmitted between different sectors due to pass-through effects. In the CCA model, it is the implicit put options in risky debts and contingent liabilities, through volatility, that allow for risk to be transmitted between sectors. Without volatility the risk transmission between sectors is lost. The risk-transmission patterns can be dampened or may be magnified depending on the capital structure and linkages.

The manufacturing and services sector's financial distress, which can be caused by stock market decline, commodity price drops, or recession, can be transmitted to the banking sector. The value of the assets of the firms in this sector decline because its collateral value goes down and the expected loss on bank loans together with the value of the debt (and equity). This in turn leads to a decline in bank assets and an increase in banking sector credit risk.

[3] However, financial intermediaries, like banks, are better capable of bearing certain (complex) risks

Similarly, the manufacturing and services sector's financial distress could cause the funding position of the pension funds to worsen since they invest in the corporate sector. The insurance sector insures the sectors and therefore could also experience a loss. These developments the banking and pension sectors could lead to second-round effects on the economy. A decline in these sectors' assets could cause their equity value to drop. This, in turn, increases the government guarantee to the pension system and the implicit guarantee to banks. As a result of these developments that could lead to the banks' deteriorating solvency, the supply of credit may be curtailed.

Generally, risk is transmitted across the sectors and balance sheets through the implicit put options in risky debts and guarantees (Gray et al, 2008).

5.0 Recommendations and Conclusions

This paper derives default probabilities and distance to default from Merton model and applies this to a number of Nigerian financial and non-financial quoted companies over the period from Janaury 2, 2012 to the December 2013. We argue that this model satisfies the macro-prudential approach to financial system stability analysis. On the basis of the Merton model, we constructed a system -wide financial stability measure for Nigeria, which builds on the put options of the banking, insurance, pension sectors, corporate and manufacturing sectors as traded on the Nigerian Stock Exchange (NSE).

Distance to Distress measure of financial stability (Weighted DD) presented a decrease in financial stability from June 2012 to December 2013, disagreeing with Average Unweighted DD, which can be attributed

to Banking, Financial and General Services sectors instability as depicted by the PD measure. Distance to Distress measure of financial stability should be used for financial system stability analysis by the FSRCC, NDIC, CBN and other related agencies.

Our analysis suggests that the Merton model appears to be useful in ranking sectors according to their contribution to financial system stability. The model also provided a means of measuring financial system stability based on individual firms, sectors and the financial system as a whole using several forward-looking measures.

The key point of this article is that it is useful to look at the financial system as a portfolio of counterparty exposures, the counterparties being financial institutions, and then analyze the contribution of each firm to different sectors and the whole system as a portfolio of firms.

Recommendations

- This analysis was carried out based on only two time periods: June 2012 and December 2013. The FSRCC and NDIC/CBN should carry out this analysis on a quarterly basis so as to *pre-emptively avert, mitigate or manage any potential threat* before it materializes. German central bank (Deutsche Bundesbank ,2005), and Bank Negara Malaysia use this approach as part of their Financial Stability Review. The IMF has also used Contingent Claims Analysis Approach for stress testing exercise of the Financial Sector Assessment Program (FSAP) for Germany, Spain, Sweden, the United Kingdom, and the United States between 2010 and 2012 and the Global Financial Stability (Jobst and Gray, 2013).

- The FSRCC, NDIC, CBN and other stakeholders should initiate or continue enhancing the forward-looking capability of its surveillance

framework by having a more robust assessment of risks in the banking, financial services and corporate sectors in an integrated or holistic manner so as to better enhance the stability of the overall financial system. Forward-looking models, like the Distance-to-Default model used in this paper, should be used in conjunction or as complementary tools to standard regulatory measures to enhance financial system stability.

For instance, Bank Negara Malaysia uses the z-score (based on discriminant analysis) and modified distance to default while "*provide important insights on emerging stress and risks, thereby providing sufficient lead time for the Bank to formulate appropriate policy measures pre-emptively to avert, mitigate or manage such threats. The quantification and measurement of risks enable more robust stress tests to be performed to assess the direct and possible feedback effects from plausible shocks to the system. ...*

Movements in the median z-score and weighted average modified distance to default are tracked to detect changes in the direction and average level of credit risk both at the macro as well as industry and company specific levels. In addition, Altman z-scores at the 75th and 25th percentile are also used to monitor the changes in the level of credit risk for firms with higher and lower credit quality, enabling a more complete assessment across different credit qualities."..Bank Negara, 2008

Suggested areas requiring further research are as follows:

- Given the varying business characteristics across different firms and sectors, the FSRCC, NDIC and CBN should develop sector specific z-

scores based on the financial statements and default experiences of Nigerian businesses. These stakeholders should map the modified distance to default model to historical incidences of bond and loan defaults by Nigerian businesses, thereby enabling estimates of default probability and frequency to be more reflective of the future level of non-performing loans in the corporate sector.

- The FSRCC, CBN and other agencies can also build a model that incorporates forward-looking measures with macro-economic variables for better measurement of financial system stability. The time pattern of asset returns of each financial institution (or of the risk indicators) can be used as the dependent variable in a factor model. Key factors driving these asset returns could include GDP, domestic and foreign interest rates, exchange rate, domestic and foreign equity indices, etc. A separate macroeconomic scenario generating model, e.g. a macroeconomic vector autoregressive model, could then be used to test the impact of scenarios on the key factors, which feed into the financial institution's assets. This, in turn affects the credit risk indicators and the value of equity capital.

- The NDIC carried out a previous study on measuring systemic risk based on the widely acclaimed SRISK approach pioneered by professors from Stern Business School. Given the complexity of the financial system and its multidimensional nature, the recommendation of using several models simultaneously to measure financial system stability should be considered. The implemented SRISK approach and the DD measures adopted in this paper should be used in tandem for enhancing financial system stability.

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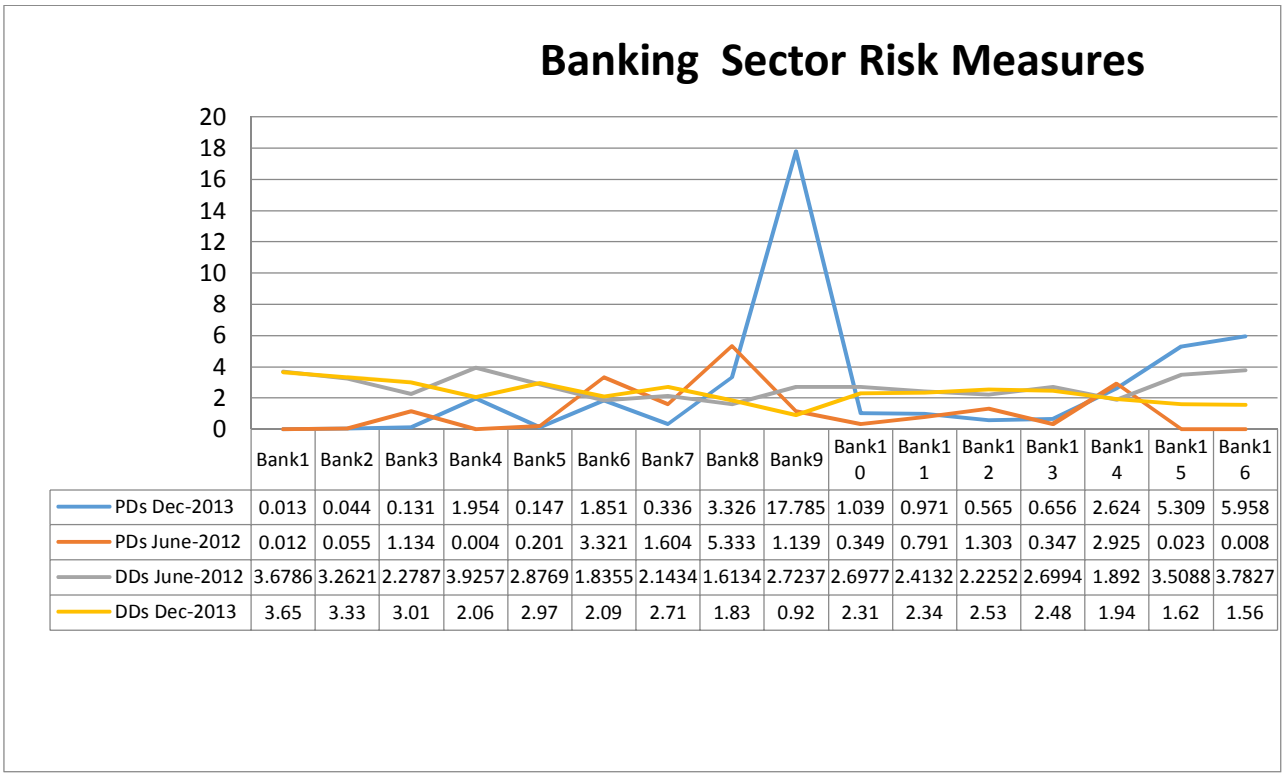
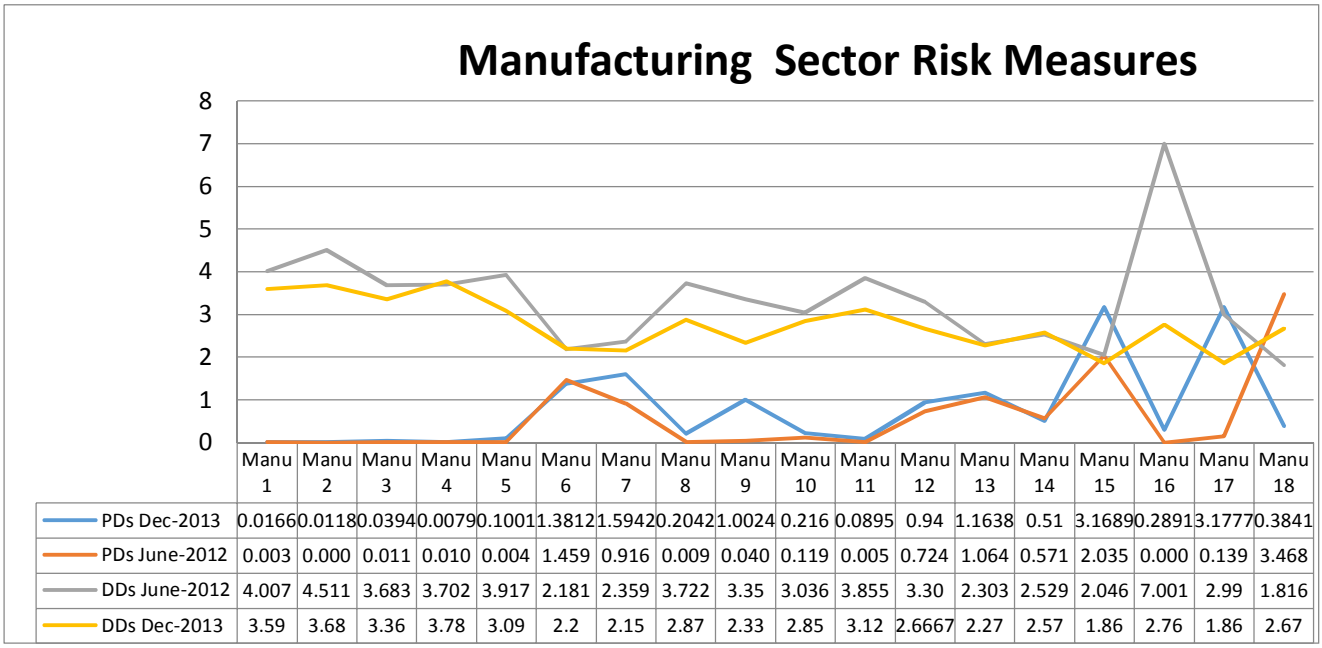
Appendix



	Bank1	Bank2	Bank3	Bank4	Bank5	Bank6	Bank7	Bank8	Bank9	Bank10	Bank11	Bank12	Bank13	Bank14	Bank15	Bank16
PDs Dec-2013	0.013	0.044	0.131	1.954	0.147	1.851	0.336	3.326	17.785	1.039	0.971	0.565	0.656	2.624	5.309	5.958
PDs June-2012	0.012	0.055	1.134	0.004	0.201	3.321	1.604	5.333	1.139	0.349	0.791	1.303	0.347	2.925	0.023	0.008
DDs June-2012	3.6786	3.2621	2.2787	3.9257	2.8769	1.8355	2.1434	1.6134	2.7237	2.6977	2.4132	2.2252	2.6994	1.892	3.5088	3.7827
DDs Dec-2013	3.65	3.33	3.01	2.06	2.97	2.09	2.71	1.83	0.92	2.31	2.34	2.53	2.48	1.94	1.62	1.56



	Manu 1	Manu 2	Manu 3	Manu 4	Manu 5	Manu 6	Manu 7	Manu 8	Manu 9	Manu 10	Manu 11	Manu 12	Manu 13	Manu 14	Manu 15	Manu 16	Manu 17	Manu 18
PDs Dec-2013	0.0166	0.0118	0.0394	0.0079	0.1001	1.3812	1.5942	0.2042	1.0024	0.216	0.0895	0.94	1.1638	0.51	3.1689	0.2891	3.1777	0.3841
PDs June-2012	0.003	0.000	0.011	0.010	0.004	1.459	0.916	0.009	0.040	0.119	0.005	0.724	1.064	0.571	2.035	0.000	0.139	3.468
DDs June-2012	4.007	4.511	3.683	3.702	3.917	2.181	2.359	3.722	3.35	3.036	3.855	3.30	2.303	2.529	2.046	7.001	2.99	1.816
DDs Dec-2013	3.59	3.68	3.36	3.78	3.09	2.2	2.15	2.87	2.33	2.85	3.12	2.6667	2.27	2.57	1.86	2.76	1.86	2.67