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Overview

The ***Journal of Banking and Financial Economics* (JBFE)** is an open access journal. The submission of manuscripts in free of fee payment. This journal follows a double-blind reviewing procedure.

Aims and Scope

JBFE publishes high quality empirical and theoretical papers spanning all the major research fields in banking and financial economics. The aim of the journal is to provide an outlet for the increasing flow of scholarly research concerning banking, financial institutions and the money and capital markets within which they function. The journal also focuses on interrelations of financial variables, such as prices, interest rates and shares and concentrates on influences of real economic variables on financial ones and vice versa. Macro-financial policy issues, including comparative financial systems, the globalization of financial services, and the impact of these phenomena on economic growth and financial stability, are also within the *JBFE*'s scope of interest. The Journal seeks to promote research that enriches the profession's understanding of the above mentioned as well as to promote the formulation of sound public policies.

Main subjects covered include, e.g.: [1] ***Valuation of assets***: Accounting and financial reporting; Asset pricing; Stochastic models for asset and instrument prices; [2] ***Financial markets and instruments:*** Alternative investments; Commodity and energy markets; Derivatives, stocks and bonds markets; Money markets and instruments; Currency markets; [3] ***Financial institutions, services and regulation***: Banking efficiency; Banking regulation; Bank solvency and capital structure; Credit rating and scoring; Regulation of financial markets and institutions; Systemic risk; [4] ***Corporate finance and governance***: Behavioral finance; Empirical finance; Financial applications of decision theory or game theory; Financial applications of simulation or numerical methods; Financial forecasting; Financial risk management and analysis; Portfolio optimization and trading.

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Proposals of Special Issues should be submitted to at jbfe@wz.uw.edu.pl. All proposals are being reviewed by the Editorial Team on the basis of certain criteria that include e.g.: the novelty, importance and topicality of the theme; whether the papers will form an integrated whole; and the overall 'added value' of a Special Issue.

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The Impact of Credit Risk on Bank Profitability in Nigeria

Charles Onyeiwu[1]
University of Lagos, Akoka-Yaba, Nigeria
chasonyeiwu@yahoo.com
https://orcid.org/0000-0002-8308-6836

Gideon Ajayi
University of Lagos, Akoka-Yaba, Nigeria
ajayigideon@gmail.com
https://orcid.org/0000-0003-3113-9462

Obumneke Muoneke B.
University of Lagos, Akoka-Yaba, Nigeria
nnannamuoneke70@gmail.com
https://orcid.org/0000-0001-7314-9832

ABSTRACT

This study examines the impact credit risk management has on the profitability of commercial banks in Nigeria. The main objective of this material is to show how credit risk parameters are related to the expected performance of commercial banks in Nigeria. Using the regression analysis, relationship was drawn between credit risk parameters (which include capital adequacy ratio and non-performing loan ratio) and the profitability ratio (return on average asset, in particular) of five big Nigerian banks. Mixed research methodology was adopted in that primary data were sourced via questionnaires and secondary data were used via annual report of selected banks. Regression analysis was used to analyse the data. The conclusion drawn from the data analysis shows that there is a strong relationship between credit risk parameters and returns of the bank implying that credit risk management has a strong impact on the profitability of commercial banks in Nigeria. The study recommends that banks' capital should be matched with their total risk exposure and if there is an imbalance, new capital requirements are necessary. Insider-related interests in loan applications should be closely monitored by the regulators to ensure continuous performance of the loan facility. Also, there should be an extant profiling of loan defaulters whether individuals or corporate entities.

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[1]   Corresponding Author, Dr. Charles Onyeiwu, Email Address; chasonyeiwu@yahoo.com. Telephone number: +2348023206015. Postal Address: Department of Finance, Faculty of Management Sciences, University of Lagos, Akoka-Yaba, PMB 1005, Nigeria.

1. INTRODUCTION

Banks play a significant role in all the economic and financial activities in modern society. One of the core activities of the banking industry worldwide and, in particular, Nigeria, is the granting of credit to deserving and deficit units of the economy. It is no more news that the financial crisis between 2008 and 2010 emanated from improper risk management. These show the effect financial institutions can have on the national economy as well as the global economy. As a result, this spurred diverse research into maintaining healthier portfolio mixes and how to assess, measure, monitor, and mitigate the effects of the inherent risks. Between 2014 and date, bank-wide non-performing loans (NPL) have risen by over ₦ 6.5 Trillion. With this inherent risk of default, banks need to revise their risk management processes continually; this will help them determine their risk appetite and risk management methods.

This research will influence risk practices, including rates charged to specific customers and varieties of collaterals required from customers in individual segments, aside from other intelligent risk management decisions. Collateral realization is not a holistic solution to mitigating the effects of bad loans as there are collaterals that take a very long time to realize even when they hav thrown into the market at forced-sale value. Securities like legal mortgage have been exempted by Basel 2 as collateral, given that its realization success is shallow. Aside from issues around litigation, which can potentially delay the realization, mortgages sell at huge sums, which only a handful of the populace can afford at a go (without taking a structured facility). Also, the location of the property will determine how soon or long it will take to sell. Using the time to realization to discount the value of the property to the present value hence further drops the value of the collateral realized. Most prominent audit firms (most notably the *Big Fours*) in Nigeria presently set the haircut for mortgage security at 50% or more, to calculate the impairment on a loan exposure.

It is interesting to know that the financial crisis of 2008, which had a ripple effect for years all around the economies of the world, was triggered by uncollateralized mortgage loans (even when the mortgage properties should have served as collateral for these facilities). Hence the Basel convention derecognizes mortgage as suitable collateral for loans while measuring the capital adequacy ratio of a financial institution.

Like many other countries, Nigeria was affected by the global financial crises, most evident is a slowdown in credit in the real economy. As a result, it hurt the banking system, resulting in reform in the banking sector. It resulted in the dismissal of five managing directors of some commercial banks by the Central Bank of Nigeria. The reason for the action taken stipulated by the Central Bank Governor was the excessively high level of the non- performing loans, lax credit administration process, and non-adherence to the bank's credit risk management practice. (CBN report 2006). There is a need for banks and financial institutions to investigate how credit risk is managed while creating a robust system in the banks which would be responsible for managing such risk. Primarily, this work aims to enlighten risk managers and members of Board Risk Committees and other stakeholders in the business of lending in Nigeria and neighbouring countries. Neighbouring countries that might share the same, or somewhat same macroeconomic conditions as Nigeria should be aware that credit risk management does impact the level of profit the commercial banks make and how much impact this could be. It also enlightens the general public on some risk management practices in commercial banks and guides them in analysing credit applications' acts and perspectives.

There is a deep gap in the credit risk management space, which has been gradually filled by scholars who have written about different blurry sides of credit and on-lending. However, there are many more materials with foreign accents than local articles that address the peculiarity of the West African climes, especially the Nigerian market. Hence, there is a need to provide a reference

document for oncoming and prospective researchers to draw from, add, and build on. This study will increase the availability of literature in the field of risk management, especially credit risk management in the Nigerian banks and other related business associates that involve risk in the businesses' day-to-day running. The result of this study should provide some consciousness and awareness to the commercial banks' risk management department on the severity of the business of lending and how it could impede the growth and profitability of financial institutions in Nigeria and likely its immediate environment.

2. LITERATURE REVIEW

This section explores the literature review based on the variables under study. The literature composes of two parts – theoretical and empirical literature review. These two sections will examine various aspects of risk management and how they are related to the profitability of banks around the world. Immediately after this is a literature gap section and a dashboard of the conceptual framework for this study. The CBN publishes – in its annual Financial Stability Report – the aggregate NPL bank-wide across Nigeria. This report shows the trend of NPL across banks on an annual basis. This bit of information is important to economists, governments, foreign investors, and other stakeholders. It measures different economic metrics in Nigerian Space and gives suggestions and insights about the Nigerian market. How is the quality of a loan measured? According to the International Monetary Fund (2004), loans are classified into five stages, depending on their performance as follows:

- **Performing**: Loans that are not past due more than 30 days. That is, the obligor has not missed a payment for more than 30 days.
- **Watch list**: Facilities are past due for more than 30 days, but less than 90 days fall into the watch list.
- **Substandard**: Credit facilities that are past due for more than 90 days, but less than 180 days, are said to be substandard.
- **Doubtful**: Facilities are past due for more than 180 days, but less than 270 days are said to be doubtful.
- **Lost**: Credit exposures that are past due more than 270 days are said to be lost.

It is worthy of note though that under the IFRS 9 framework, which came into full implementation in Nigeria and many foreign countries and took its full effect from January 2018, credit exposures are classified into three categories:

- **Stage 1 Facilities**: Facilities that are performing and have no significant increase in credit risk. Stage One also includes facilities in their initial recognition stage.
- **Stage 2 Facilities**: These are facilities that have a significant increase in credit risk. These facilities might not have defaulted, but there are already reasons to be concerned about them. Business events around these facilities suggest that there might be a default in the future.
- **Stage 3 Facilities**: These are facilities that are impaired. They have now missed repayments either of principal or interest.

How does the credit risk management of banks affect the non-performance of these facilities? It is evident from all indications that the actions and inactions of credit managers will significantly affect the performance of banks as the asset quality the bank carries and this will, in turn, determine the kind of investors the bank attracts, its cost of funds, its cost of risks, provisioning, and other direct and indirect performance factors of the bank.

2.1. Conceptual Review

Credit exposure is any obligation in which the bank parts with money (or is liable to part with money) to a customer to receive it **later**, either as a lump sum or in instalments at a specified time(s). Not all credit exposures are on-balance sheet exposures, and some credit contracts might be an off-balance sheet. An on-balance sheet exposure is one in which the bank parts with cash, which is recognized in the bank's balance sheet. Examples are loans, drawn portions of overdrafts, drawn portion of credit cards. For off-balance sheet exposures, the bank does not exchange cash at the instant, but the bank is liable to exposure in the case of a default or future occurrences. Examples are the undrawn portion of an overdraft, undrawn portion of a credit card, a bank guarantee, performance bonds, letter of credit and bill of collection.

Under the IAS 39 reporting, off-balance sheet exposures were irrelevant in the measurement of a bank loan provision. However, under the IFRS 9 reporting (enforced by the CBN on all Banks starting January 2018), off-balance sheet exposures would also be measured and assessed for the computation of loan impairment. All off-balance sheet exposures would now have to be converted to on-balance sheet exposures using predictive credit conversion factors (CCF). Banks' profitability took a further hit from this new reporting method as banks had to make more provision for expected loan loss. Every bank is exposed to credit risk because it accepts deposits and grants credit facilities to the deficit units. Of all risks that banks are prone to, credit risk is arguably the top one, and the bank's success depends mostly on how it can assess, measure, and manage this risk in its business activities (Giesecke, 2004). The credit risk management strategies are measures employed by banks to avoid or minimize the adverse effect of credit risk. An apt approach to managing credit risk and forging its framework is crucial for banks to guarantee her survival and ensure her profitability.

2.2. Theoretical Framework

As discussed above, credit risk is one of the most frequent and most menacing of the risks faced by commercial banks. Credit risk is described as the possibility that an obligor will fail to meet its obligations (principal, interests, and commissions), on time, or in tandem with the contractual agreement. Banks are losing many of their returns to provisioning for impaired loans, which is the crux of why banks are prudent in their lending. The bigger banks will instead lend to the least risky obligors; even when it seems they are less profitable in the short run, as their interest income will be lower, this has turned out to be more profitable in the long run.

To put this study into proper context, we examine two relevant theories:

Segmentation Theory

This theory states that there is a relationship between instruments with similar rates and tenors. It explains further that financial instruments with similar interest rates and tenors tend to behave in the same way and are mostly affected by the same conditions and are accessed by somewhat the same market. For instance, long term, substantial value facilities are mostly accessed by manufacturing companies while the medium term, small value loans, are accessed by retail customers, mostly salary earners. Furthermore, the above classification helps categorize the bank's portfolio into homogenous groups, collectively assessed under umbrella conditions.

The Financial Economic Theory

Financial economics methodology to managing risk is borne out of the Modigliani-Miller paradigm and is arguably the most proficient method in terms of theoretical model extensions and empirical research (Klimczak, 2007). The financial-economic theory stipulates that hedging leads

to lower cash flow volatility and ipso facto, **lower firm value volatility**. The theory argues that the climax of hedging is earning the firm a premium – a better value other than the norm (Jin and Jorion, 2006).

2.3. Empirical Framework

This subsection examines works and articles of scholars and students all around the world who have done related researches to the subject of this study. As it is known that knowledge is not isolated, this study is not in isolation of ideas. Around East Africa and other parts of the world, many students and researchers have done diggings and drillings that have suggested that the profitability of commercial banks is dependent on the depth of the credit risk management (CRM) of the banks. Tekalagn, Lu & Md. Shafiqul (2015), strived to derive a relationship between the CRM parameters and profitability of financial institutions in Ethiopia. They found that there is a negative relationship between the capital adequacy ratio (CAR) and the ROA of the banks in Ethiopia, hence suggesting that the more the capital held to mitigate, the less profitable the banks is. They used the method of regression analysis to the CAR on the NPL, ROA, and ROE of banks in Ethiopia. In the study by Serwadda (2018), the objective was to determine if credit factors were significant in determining the performance of banks in Uganda and to determine the level of significance. He utilised panel regression model as the sole econometric method and found that credit risk factors such as non-performing loans (NPLs) and loss provisioning are crucial in determining the profitability of Ugandan banks. Raad (2015), in his article wished to scrutinize how CRM practices could impact on banks profitability and sustainability. Using a regression of ROA to NPL ratio, loss ratio and CAR, he found that banks make a lot of profits from credits and hence should practice good CRM. He however added that the main challenges of CRM were the additional cost of training, deployment of technology and employee motivation. In their article on banks in Sri Lanka, Perera and Morawakage (2016) sought to investigate the effect of credit risk management on shareholder value in listed commercial banks in Sri-Lanka. Relying on OLS regression models, findings shows that credit risk management has a significant effect on shareholder value in the selected eight banks. The above authors highlighted that NPLR (non-performing loan ratio) has the most significant effect on the return on shares buttressed further by the 26.7% predicting ability of NPLR of return on shares.

3. METHODOLOGY

3.1. Research Design

The design of this study chosen is mixed-method research design. Drawing from the mix of qualitative and quantitative approaches inherent in the mixed-method research design, the researcher adopts the primary and secondary data. Primary data is sourced from questionnaires and secondary data from the five banks' financial statements published in their Annual Investor Relations Publications and audited financial statements. These publications are accessible to the general public, investors, auditors, creditors, regulators, and all interested persons devoid of barriers.

3.2. Sample Size and Sampling Techniques

The simple random sampling technique was employed for the primary data analysis. The essence of this is to ensure that every respondent is given equal representation in the exercise. Furthermore, it means that every worker has an equal chance of being selected, and no person will

be omitted deliberately. For the secondary data, different variables of five banks in Nigeria were sourced consistently for seven consecutive years to monitor both trends and eliminate spikes and anomalies that may have occurred in the data during the period under review. The sample was chosen consists of four Tier 1 banks and one Tier 2 bank. The data span the years 2012 to 2018 for all five banks, which are First Bank of Nigeria (FBN), Zenith Bank PLC, Guaranty Trust Bank (GTB), United Bank for Africa (UBA) and First City Monument Bank (FCMB) – FCMB being the only tier 2 bank. These banks put together control about 60 percent of bank credits in Nigeria.

3.3. Data Sources and Instrument

The data sources for this research include the primary and secondary data. The primary data entails responses directly sourced from respondents, mostly bankers and other credit risk analysts, through a questionnaire that was drawn and tested for validity. The sample space for the primary data is bankers and risk managers across Guarantee Trust Bank, Zenith Bank, UBA, FBN, and FCMB. The above decision gives a more rounded database for the data gathered and eliminates biases and enhances versatility.

The secondary data were obtained from published financials of audited data of GTB, Zenith, UBA, FBN, and FCMB for the last seven years. These publications are prepared and published by the banks on their official websites and yearly publications. The secondary data were gathered for years 2012, 2013, 2014, 2015, 2016, 2017, and 2018. It is essential to state that these banks have more than fifty-five percent of the Assets and Liabilities of all the commercial banks in Nigeria as contained in the Central Bank of Nigeria for a half-year, 2019 report.

3.4. Techniques of Data Analysis

The data collected by administering questionnaires were analysed using simple pictorial analysis and graphical representations. Descriptive analysis will also be used to summarize and organize the data.

The secondary data were analysed using Panel Regression. The F-statistic test was used to determine which method would be better off between the Pooled OLS model and the fixed-effect model; then, the Hausman test was used to determine which would be better of the Random effect model and fixed effects model. When these tests were concluded, the most consistent method was used to run a panel regression of the data.

3.5. Model Specification

The model used to analyse the data upon concluding the various diagnostic tests was the fixed effects model panel regression. This model is adopted as the parameters needed to populate the model fit properly with the financial ratios derived from the secondary data. Hence, we do not need to tweak our variables to fit into the model.

A typical panel regression equation is given as

$$Y_{it} = a_0 + a_1 x_{it} + a_2 Z_i + U_{it} \tag{1}$$

(Where the Z_i's are time-invariant heterogeneities across the indices i = 1, 2, …, n and n is he number of observations, a_i's are constants, x_{it}'s are independent variable observations with respect to time, U_{it}'s are error terms with respect to time and Y_{it}'s are dependent variables with respect to time, per observation).

If we hold Zi's constant, our model becomes:

$$Y_{it} = b_i + a_1 x_{it} + U_{it} \qquad (2)$$

(Where $b_i = a_0 + a_2 Z_i$ across observations i = 1, 2, …, n).

The equation (2) above is regarded as a fixed effects model of the panel regression equation (1).
In this study, our independent variables are Non-Performing Loan Ratio and Capital Adequacy Ratio (CAR), and our dependent variable is the Return on Average Asset (RoAA). It is worthy of note that the two independent variables used above are some of the factors with which credit risk management can be measured. They are somewhat reflective of the quality of risk management practiced by the commercial bank.
Hence, our regression equation will be in the form of:

$$RoAA_{it} = e_{it} + a_{it} NPL_{it} + a_{it} CAR_{it} \qquad (3)$$

The a priori expectation is that when the regression is run using data from the banks' financial ratios, there will be a strong coefficient of correlation between the return on average asset and the CRM factors highlighted. Also, we expect that the coefficient of NPL should be negative (since higher NPLs should lead to less profitability for the bank) and CAR should be positive (since the higher this value, the better the quality of the risk assets portfolio of the bank and hence the better the bottom-line of the bank).

3.6. Limitation of Methodology

Shadish, Cook, and Campbell (2002) argue that correlation does not necessarily suggest causation. They argue that most times, we discover some of the necessary conditions (which they call the *inus* conditions) that must be met for an event to occur and not necessarily the cause. However, we often assume that these are the causes rather than factors that increase the probability of occurrence. Hence the fact that the concepts in this material suggest high correlation might not ultimately suggest a causal effect. It is worthy of note; still, that correlation is one of the most mathematical ways to measure causation.
There is no straight method to calculate the returns earned on risk assets. Using the return on average asset might not be a true representation of the returns on risk assets as we are making a major assumption that the banks have a similar proportion of risk assets to non-risk assets. This assumption may not always be the case, as some banks are more risk-averse than others, and the converse also holds.

4. PRESENTATION OF DATA, ANALYSIS AND INTERPRETATION

4.1. Socio-Demographic Characteristics of Respondents

The process of collecting the questionnaires from the sample size was simple. The questionnaire was populated on Google Doc. The link was then sent directly to the mails of 78 persons who are staff members of Guaranty Trust Bank, Zenith Bank, First Bank of Nigeria, United Bank for Africa, and First City Monument Bank. Responses were got from 55 respondents showing a response rate of 70.51%.

4.2. Primary Data Analysis

An analysis of respondents' educational qualifications shows that 40% are BSC/HND holders, 56% are MSc/MBA holders, and 4% have doctoral degrees. The attitudes of respondents to issues are discussed in this section. In order to effectively measure the attitudes, the five-point Likert scale was employed. The Personal Opinion section is tabulated below:

Table 1
Personal Opinions from Study Participants

Most failed Nigerian banks failed due to inadequate credit risk management

Views	Responses	Percentage (%)
Strongly Agree	18	32.73
Agree	19	34.54
Neutral	6	10.91
Disagree	6	10.91
Strongly Disagree	6	10.91
Grand Total	55	100

Poor credit risk management - more than all other factors- has given rise to non-performing loans in Nigeria

Views	Responses	Percentage (%)
Strongly Agree	19	34.55
Agree	20	36.36
Neutral	5	9.09
Disagree	7	12.73
Strongly Disagree	4	7.27
Grand Total	55	100

A good bank should carefully do its risk analysis before it approves a credit proposal

Views	Responses	Percentage (%)
Strongly Agree	34	61.82
Agree	15	27.27
Neutral	1	1.82
Disagree	0	0
Strongly Disagree	5	9.09
Grand Total	55	100

Some banks engage in more risk than their capital can bear

Views	Responses	Percentage (%)
Strongly Agree	10	18.18
Agree	27	49.09
Neutral	12	21.82
Disagree	4	7.27
Strongly Disagree	2	3.64
Grand Total	55	100

If not for regulators, the aggregate non-performing loans across banks in Nigeria would be worse than it is now

View	Responses	Percentage (%)
Strongly Agree	27	49.10
Agree	20	36.36
Neutral	5	9.09
Disagree	0	0
Strongly Disagree	3	5.45
Grand Total	55	100

Personal opinions of bank staff in the selected commercial banks under review answered questions from the research questionnaire administered. The first question in table 1 shows that bank staff, to a great extent, believe that most Nigerian banks failed due to inadequate credit risk management evidenced by a SA – 32.73% and A – 34.54% while others possessed contrary views. The second question in table 1 vis-a-vis the views of selected bank staff reinforces the claim that poor credit risk management remains the principal factor causing the spike in non-performing loans evidenced by SA – 34.55% and A – 36.36%. However, 9.09% of bank staff's responses remained neutral, while 20% of responses by bank staff strongly disagreed that poor credit risk management increases the rate of non-performing loans. The third question in table 1 centred on a thorough risk analysis before credit approval. 89.09% of responses by bank staff depicts a flawless acceptance that banks in utmost carefulness should conduct a thorough risk analysis before approval. The fourth question in table 1 borders on the degree of risk exposures and 67.27% of responses by bank staff. It concurred that banks indeed increases its risk exposure beyond its capital threshold; on the other hand, 21.82% of responses bank staff remained neutral i.e., neither agree nor disagree. The fifth question in table 1 portrayed the importance of the regulators amidst this loan menace affecting banks' health in Nigeria. Bank staff flawlessly agreed that without the regulators' presence and instant wading into the loan menace, NPLs would have grown much worse than it is now. 85.46% of responses by bank staff were in perfect agreement while 9.09% of responses by bank staff remained neutral, and a paltry 5.45% of responses by bank staff strongly disagreed. In addendum to the questionnaire shared amongst the participants contained a question on loan recovery timing and the responses are sorted and a pie chart is effectively employed to present received responses.

Principal Question: How many days does a credit facility have to be past due before the respondent's institution begins the recovery process?

Judging by the responses, it is evident that most banks will commence recovery at 90 days past due that is when the facility is substandard, as seen from the response chart below:

Figure 1
A Pie Chart is showing recovery loan timing responses from staff of selected commercial banks
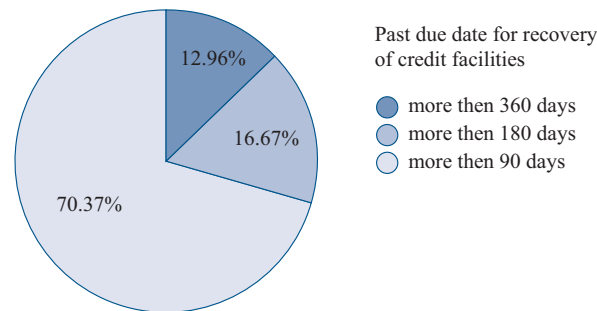
Source: Authors compilation from Field Work, 2019.

4.3. Secondary Data Analysis

The secondary data sourced included the Return on Average Asset, Non-Performing Loan Ratio and Capital Adequacy Ratio for the years 2012 to 2018, for the four-tier one banks and one tier-two bank.
The data for seven years is as follows:

Table 2
Raw Data of RoAA, NPL and CAR for GTB, Zenith, UBA, FBN and FCMB

BANK	YEAR	RoAA	NPLR	CAR
		Percentage (%)		
GTB	2018	5.6	7.3	28.1
	2017	5.2	7.7	25.7
	2016	4.7	3.7	19.8
	2015	4.1	3.2	18.2
	2014	4.2	**3.1**	17.5
	2013	4.7	3.6	21.4
	2012	5.2	3.8	21.6
ZENITH	2018	3.3	5.0	25.0
	2017	3.4	4.7	27.0
	2016	3.0	3.0	23.0
	2015	2.7	2.2	21.0
	2014	2.9	1.8	20.0
	2013	3.3	2.9	26.0
	2012	4.1	3.2	31.0

BANK	YEAR	RoAA	NPLR	CAR
		Percentage (%)		
UBA	2018	1.8	6.5	24.0
	2017	2.1	6.7	22.0
	2016	2.3	3.9	20.0
	2015	2.2	1.7	20.0
	2014	1.8	1.6	17.0
	2013	1.9	1.2	20.0
	2012	2.6	1.9	23.5
FBN	2018	1.1	25.5	17.3
	2017	0.9	22.5	17.7
	2016	0.3	24.2	17.8
	2015	0.1	17.8	17.1
	2014	2.2	2.9	16.7
	2013	2.0	3.0	13.6
	2012	2.5	2.6	21.5
FCMB	2018	1.1	5.9	15.8
	2017	0.9	4.9	16.9
	2016	1.4	3.7	16.5
	2015	0.5	4.2	16.9
	2014	1.9	3.3	18.3
	2013	1.7	3.9	16.1
	2012	1.7	2.5	20.4

4.3.1. Data Analysis and Interpretation

Before econometric testing of the model presented, there is a need to ascertain the order of integration and stationarity of the series. Westerlund & Breitung (2009) posited that the local power of Levin, Lin, and Chu test is greater than that of Im, Pesaran, and Shin test. The decision on the stationarity of variables of interest depends on the Levin, Lin, and Chu test estimate in the perfect hierarchy to other tests. The entire analysis emanates from the outputs of GRETL (2020 version) and is presented thus.

Table 3
Table showing the evidence of stationarity vis-à-vis order of integration

Variables	Coefficient	T-ratio	p-value	Order of integration
ROAA	-1.0733	-6.587	0.0012[*]	I(0)
CAR	-0.83317	-7.129	0.0332[*]	I(0)
NPLR	-1.1552	-6.198	0.0000[*]	I(1)

[*] Denotes significance at 5% level.

Source: Levin, Lin & Chu (2002) test.

After establishing stationarity, the researcher conducts a pooled OLS test and its adjoining diagnostics to ascertain poolability of panel data in this study as shown below.

Table 4
GRETL Pooled OLS Test for NPL, ROAA and CAR

Model 1: Pooled OLS, using 35 observations

Included 5 cross-sectional units

Time-series length = 7

Dependent variable: ROAA

	Coefficient	Std. Error	t-ratio	p-value
const	−1.02641	1.17775	−0.8715	0.3900
NPLR	−0.0742955	0.0339146	−2.191	0.0359**
CAR	0.199468	0.0541743	3.682	0.0008***

Mean dependent var	2.608571	S.D. dependent var	1.554381
Sum squared resid	48.60608	S.E. of regression	1.232453
R-squared	0.408307	Adjusted R-squared	0.371326
F (2, 32)	11.04104	P-value(F)	0.000226
Log-likelihood	−55.40986	Akaike criterion	116.8197
Schwarz criterion	121.4858	Hannan-Quinn	118.4304
rho	0.794356	Durbin-Watson	0.309256

Having run the pooled OLS regression, we can then run the tests to determine which method is best to use. Using the "Panel Diagnostics Test command" on GRETL, the test results are as follows:

Joint significance of differing group means:
$F (4, 28) = 64.8169$ with p-value 9.52514e-014
(A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favour of the fixed effects alternative)

Variance estimators:
between = 2.65565
within = 0.169201
theta used for quasi-demeaning = 0.905027

Breusch-Pagan test statistic:
LM = 72.7237 with p-value = prob. (chi-square (1) > 72.7237) = 1.49131e-017
(A low p-value counts against the null hypothesis that the pooled OLS model is adequate, in favour of the random effects alternative).

Hausman test statistic:
H = 0.674825 with p-value = prob. (chi-square (2) > 0.674825) = 0.713614
(A low p-value counts against the null hypothesis that the random effects model is consistent, in favour of the fixed effects model).

After a thorough observation of the panel diagnostics, inherent interpretations and decisions goes thus;

The computed F-statistic $F(4, 28) = 64.81$ with a corresponding p-value (9.52514e-014) suggests that the fixed effects alternative is adequate compared to the pooled OLS regression evidenced by a p-value of less than 5%. Hence we select the fixed effect model over the option of pooled OLS model. Furthermore, the Breusch-Pagan test statistic LM = 72.7237 with an associated p-value (1.49131e-017), obviously less than 5%, prompts the decision to reject the null hypothesis and posit that the random-effects is the econometrically suitable alternative.

The reported Hausman test statistic H = 0.674825 with a p-value (0.713614) informs the researcher's decision to adopt the random-effects model over the fixed-effects model GRETL generated p-value below 5% level of significance. Furthermore, evidence gathered from the GRETL diagnostics output prompts the researcher to accept the null hypothesis stating that the random-effects model is consistent.

The overriding decision is to adopt the random-effects model as the best estimator over other options, so we resort to using the random-effects model.

Table 5
GRETL Output for the Random Effects Model

Model 1: Random-effects (GLS), using 35 observations

Included 5 cross-sectional units

Time-series length = 7

Dependent variable: ROAA

Variables	Coefficient	Std. Error	T-ratio	p-value
const	0.843113	0.877626	0.9607	0.3367
NPLR	−0.07587	0.01463	−5.186	2.15e-07[***]
CAR	0.10833	0.02522	4.294	1.75e-05[***]

Mean dependent var	2.608571		S.D. dependent var	1.554381
Sum squared resid	53.01405		S.E. of regression	1.267472
Log-likelihood	−56.92900		Akaike criterion	119.8580
Schwarz criterion	124.5241		Hannan-Quinn	121.4687
rho	−0.246491		Durbin-Watson	2.240978

'Between' variance = 2.65565 'Within' variance = 0.169201	Pesaran CD test for cross-sectional dependence –
theta used for quasi-demeaning = 0.905027	Null hypothesis: No cross-sectional dependence
corr(y,yhat)^2 = 0.382487	Asymptotic test statistic: z = 1.319932 with p-value = 0.187.
Joint test on named regressors –	Test for normality of residual –
Asymptotic test statistic: Chi-square(2) = 39.1096 with p-value = 3.21708e-009	Null hypothesis: error is normally distributed
Breusch-Pagan test – Null hypothesis: Variance of the unit-specific error = 0	Test statistic: Chi-square(2) = 16.036 with p-value = 0.0003
Asymptotic test statistic: Chi-square(1) = 72.7237 with p-value = 1.49131e-017	

Robust regression is a dire alternative in the presence of outliers and influential observations. Our case arises from the NPLR variable evidenced further by FBN non-performing loans spike from 2015–2018. Also, the need to use the robust standard error option emanates from the advice posed by Bickel (1978) and Koenker (1981) that the Breusch-Pagan test is not accurate for data that is not normally distributed. The estimated random-effects model above is suffering from the problem of heteroskedasticity. Hence, prompting the use of robust standard errors (HAC). Also, there is no cross-sectional dependence evidenced by a p-value above 5%.

Using the robust standard error option did not alleviate the model from heteroskedasticity at a 5% level of significance. Evidenced by a BPGT asymptotic test statistic: Chi-square (1) = 72.7237 with p-value = 1.49131e-017 and the null hypothesis of normal distribution was rejected evidenced by Chi-square (2) = 16.036 with p-value 0.0003. The researcher resorted to heteroskedasticity-corrected options on GRETL and problems of heteroskedasticity was corrected efficiently and presented below;

Table 6
Heteroskedasticity-corrected GRETL output

Model 2: Heteroskedasticity-corrected, using 35 observations
Dependent variable: ROAA

	Coefficient	Std. Error	t-ratio	p-value
Const.	−0.453565	1.11404	−0.4071	0.6866
NPLR	−0.0659960	0.0173426	−3.805	0.0006***
CAR	0.166068	0.0544604	3.049	0.0046***

Statistics based on the weighted data:

Sum squared resid	99.17062	S.E. of regression	1.760421
R-squared	0.516112	Adjusted R-squared	0.485869
F(2, 32)	17.06551	P-value(F)	9.03e-06
Log-likelihood	−67.88899	Akaike criterion	141.7780
Schwarz criterion	146.4440	Hannan-Quinn	143.3887

Statistics based on the original data:			
Mean dependent var	2.608571	S.D. dependent var	1.554381
Sum squared resid	49.51194	S.E. of regression	1.243884

Test for normality of residual –

Null hypothesis: error is normally distributed

Test statistic: Chi-square (2) = 19.5945 with p-value = 5.56054e-005

Variance Inflation Factors

Minimum possible value = 1.0

Values > 10.0 may indicate a collinearity problem

NPLR 1.035

CAR 1.035

4.4. Interpretation of Results

We will base our interpretations in the build-up to hypothesis testing on the transformed model estimates extracted from GRETL.

The adjusted R-squared of 49% approximately reinforces the degree of variations in the dependent variable explained by the independent variables. The F-test statistic (F = 17.065510, p-value = 9.03e-06) suggests that the chosen independent variables are jointly significant in explaining variations in the dependent variable and approves the fit of the chosen model. As established earlier, NPLR is expected to possess a negative sign, and CAR is expected to possess a positive sign as established by theoretical and empirical evidence.

In the above output, NPLR is negatively signed and significant in its effect on Return on Average Asset in that a 1% increase in NPLR of commercial banks in Nigeria will result in a 0.065 unit decrease in the Return on Average Asset conforming to a-prior expectations. CAR is positively signed and has a significant effect on ROAA, evidenced by a p-value of less than a 5% level of significance conforming to set a-priori expectations. A 1% increase in Capital Adequacy Ratio of commercial banks in Nigeria will result in a 0.17 increase in Return on Average Assets. If all variables are kept constant, ROAA will decrease by 0.45 units.

4.4.1. Hypothesis Testing

H_o: *Credit Risk Management has no significant impact on the profitability of commercial banks in Nigeria.*

It is succinct to conclude that CAR and NPLR are significant in explaining variations in ROAA from 2012–2018 with a sample of 5 Nigerian commercial banks. In light of the available econometric evidence, we forge ahead to state the null hypothesis and reach a decision. In this case, we reject the null hypothesis as all variables were significant at 5% level. Therefore, we accept the alternate hypothesis stating that Credit Risk Management has a significant impact on commercial banks' profitability in Nigeria.

Comparing these results to the study findings in Perera & Morawakage (2016), the model used in their Sri Lankan study was modified and applied thus. However, it differed in the sample and distinct regulations across multi-banking jurisdictions. However, Perera & Morawakage (2016) posited that NPLR had the greatest effect on ROAA compared to CAR and LDR from 2009–2015 using Sri-Lankan banks. Tweaking the model in Perera & Morawakage (2016) to eliminate the measure of liquidity risk proxied by loan to deposit ratio. Nigerian bank-based evidence emanating from this research suggests that Capital Adequacy Ratio remains the principal factor engendering bank development and its continued existence. Therefore, more exposure to risk should cause an increase in its capital position. Furthermore, the constant intervention and monitoring of bank capital by regulators in different banking jurisdictions reinforces its importance in covering credit risk and other recognised variety of risks under the purview of banks. Following the GRETL output – an increase in bank capital affords an increase in loans to its clientele and acts as a buffer for unexpected losses. On the other hand, an increase in non-performing loans will result in lower incomes and a lower return on average assets.

5. SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

When data is carefully queried, it yields its underlying information. As Ronald Coase would say, "If you torture the data long enough, it will confess to anything" (Coase, 2009). Having carried out rigorous mining and digging of the primary and secondary data, we have – at this point – come to some conclusions as found below:

5.1. Summary of Findings

In the attainment of this research objective, seventy-eight (78) questionnaires were distributed to selected financial institutions with a view of collecting relevant data for the study, but fifty-five (55) were collected and collated. Moreover, research questions were developed to facilitate the attainment of the broad objective of the study. After careful analysis and interpretation of the data collected, the following findings were made:

Percentages were conducted on received responses to questions posed by the researcher and deductions made are discussed thus;

Personal opinions of bank staff in the selected commercial banks under review answered questions from the research questionnaire administered. The first question in table 1 shows that bank staff, to a great extent, believe that most Nigerian banks failed due to inadequate credit risk management evidenced by a SA – 32.73% and A – 34.54% while others possessed contrary views. The second question in table 1 vis-a-vis the views of selected bank staff reinforces the claim that poor credit risk management remains the principal factor causing the spike in non-performing loans evidenced by SA – 34.55% and A – 36.36%. However, 9.09% of bank staff's responses remained neutral, while 20% of responses by bank staff strongly disagreed that poor credit risk management increases the rate of non-performing loans. The third question in table 1 centred on a thorough risk analysis before credit approval. 89.09% of responses by bank staff depicts a flawless acceptance that banks in utmost carefulness should conduct a thorough risk analysis before approval. The fourth question in table 1 borders on the degree of risk exposures and 67.27% of responses by bank staff continuation instead of the full stop. It concurred that banks indeed increases its risk exposure beyond its capital threshold; on the other hand, 21.82% of responses bank staff remained neutral i.e., neither agree nor disagree. The fifth question in table 1 portrayed the importance of the regulators amidst this loan menace affecting banks' health in Nigeria. Bank staff flawlessly agreed that without the regulators' presence and instant wading into the loan menace, NPLs would have grown much worse than it is now. 85.46% of responses

by bank staff were in perfect agreement while 9.09% of responses by bank staff remained neutral, and a paltry 5.45% of responses by bank staff strongly disagreed.

After estimating the random-effects model, findings show that CAR and NPLR have a significant effect on the dependent variable; Return on Average Asset, a proxy for bank profitability in this study, is valid at a 5% level of significance. The estimated coefficients of the independent variables are in perfect consonance with the stated a-priori expectations. This study's findings are in perfect alignment with the study of Serwadda (2018) and Perera & Morawakage (2016) but differ greatly from the findings of Tekalagn, Lu & Md. Shafiqul (2015), where an increase in capital adequacy ratio causes a decrease in return on assets. The observed phenomenon may arise from strict regulatory capital requirements, the scope of operations, and banks' risk appetite.

5.2. Conclusion

This research aims to investigate the impact of credit risk management on bank profitability in Nigeria. The paucity of studies of local inclination on credit risk management vis-a-vis the dangerous effect on credit risk on bank capital spurred the researcher to embark on an immediate investigation to seek empirical answers. This research reinforces the role of adequate regulatory and economic capital in ensuring the long-term sustainability of Nigeria's top banks. The influx of new banks in the industry may necessitate tight regulatory beam-light to ensure their risk exposure is moderate in favour of creditors, shareholders, and depositors. There is a commendable success on the IFRS adoption in the banking industry, with a corresponding decrease in non-performing loans across the top banks in Nigeria. However, there are notable worries on the in-built flexibility possessed by banks' top management to build a bank-specific ECL system in deciding the percentage set aside for loan loss provisions and reporting procedures when there is an excess or a shortage. The overall call is for increased scrutiny by the regulators on banks' balance sheet and off-balance sheet activities to obtain the true health of banks in the banking system.

5.3. Recommendations

Based on our research findings on the impact of credit risk management on bank profitability in Nigeria, the following suggestions are proffered:
• Matching of bank capital to total risk exposure of commercial banks in Nigeria and if there is a deficit, new capital requirements are necessary.
• Insider-related interests in loan disbursement should be monitored closely by regulators to ensure favourable performance of the loan facility.
• AMCON's mandate should be reviewed to make them take a more active role in activating recovery procedures against insider-related loans without fear or favour.
• There should be profiling of loan defaulters whether businesses or individuals to decrease their creditworthiness.

References

Bickel P.J. (1978) Using residuals robustly I: Test for heteroscedasticity and nonlinearity. *Annals of Statistics*. Vol. 6, 266–291.
Giesecke K. (2004) Correlated default with incomplete information. *Journal of Banking and Finance*. Vol. 28(7); 1521–1545.
International Monetary Fund (2004), Article IV Consultation, Sixth Review under the Poverty Reduction and Growth Facility, and Request for Waiver of Performance Criteria – Staff Report; Staff Statement; and Public Information Notice and Press Release on the Executive Board Discussion, Republic of Armenia.

Jin Y. & Jorion P. (2006) Firm Value and Hedging: Evidence from U.S. Oil and Gas Producers. *The Journal of Finance*. Vol. 61(2); 893–919.

Klimczak K.M. (2007) Risk Management Theory; A Comprehensive Empirical Assessment. Kozminski Working Papers Series, Leon Kozminski Academy of Entrepreneurship and Management in Warsaw, Poland.

Koenker R. (1981) A note on studentizing a test for heteroscedasticity. *Journal of Econometrics.* Vol. 17, 107–112.

Onwumere J.U.J. (2005), "Business and Economic Research Methods", Lagos: Don-Vinton Press Ltd.

Perera L.A.S & Morawakage P.S. (2016) Credit Risk Management and Shareholder Value Creation; With Special Reference to Listed Commercial Banks in Sri Lanka. *Kelaniya Journal of Management.* Vol. 5(2); 1–16.

Raad M.L. (2015) Credit Risk Management (CRM) Practices in Commercial Banks of Bangladesh: "A Study on Basic Bank Ltd." *International Journal of Economics, Finance and Management Sciences.* Vol. 3(2); 78–90.

Ronald C. (1993), Ronald Coase and Methodology, *Journal of Economic Perspectives*, Volume 7, No 4, American Economic Association, Nashville, USA.

Serwadda I. (2018) Impact of Credit Risk Management System on the Financial Performance of Commercial Banks in Uganda. *Acta Universitatis Agriculturae Et Silviculturae Mendelianae Brunensis*. Vol. 66(6); 1627–1635.

Shadish W.R., Cook T.D. & Campbell D.T. (2002), Experimental and Quasi-Experimental Designs for Generalized Causal Inference, Boston, New York.

Tekalagn G., Lu A. & Md. Shafiqul B. (2015) Credit Risk Management and Its Impact on Performance of Commercial Banks: In of Case Ethiopia. *Research Journal of Finance and Accounting.* Vol. 6(24); 53–64.

Westerlund J. & Breitung J. (2009) Myths and Facts about Panel Unit Root Tests. No. 380, Working Papers in Economics, University of Gothenburg, Department of Economics.

Annual Reports

First City Monument Bank (2012–2018), Audited Annual Reports *2012–2018*, Lagos.
First Bank of Nigeria (2012–2018), Annual Investor Relations Report *2012–2018*, Lagos.
Guarantee Trust Bank, (2012–2018), Annual Investor Relations Report *2012–2018*, Lagos.
United Bank for Africa (2012–2018), Investor Analyst Presentations *2012–2018*, Lagos.
Zenith Bank PLC (2012–2018), Investor Updates and Records *2012–2018*, Lagos.

Reconciling Macroeconomic Determinants with Stock Market Performance in Selected Sub-Saharan African Countries: an ARDL Approach

Kareem Abidemi Arikewuyo[1]
Department of Business Administration,
Faculty of Social and Management Sciences,
Southwestern University, Okun-Owa, Nigeria
kareem.arikewuyo@yahoo.com
http://orcid.org/0000-0002-0439-8859

Akeem Adekunle Adeyemi
Department of Accounting,
Faculty of Administration and Management Sciences,
Olabisi Onabanjo University, Ago-Iwoye, Nigeria
kunleadeyemi01@gmail.com
http://orcid.org/0000-0003-2625-4781

Eunice Titilayo Omodara
Department of Banking and Finance,
Faculty of Administration and Management Sciences
Olabisi Onabanjo University, Ago-Iwoye, Nigeria
unikenotop@gmail.com
http://orcid.org/0000-0001-6242-5184

Lateef Adewale Yunusa
Department of Banking and Finance,
Faculty of Administration and Management Sciences
Olabisi Onabanjo University, Ago-Iwoye, Nigeria
yunusalateef@gmail.com
http://orcid.org/0000-0001-7958-8844

ABSTRACT

Prior studies have adduced unstable macroeconomic factors to stock price movement overtime but the relationship between the duo remained unsettled. Autoregressive Distributed Lag (ARDL) technique was used to reconcile the macroeconomic determinants with performance of stock markets in selected Sub-Saharan Africa (SSA) covering the period of 1999:1–2017:4. It was found that macroeconomic indicators were essential in determining stock market performance in Nigeria while South African stock market did not show any predictable linkage but the contemporaneous

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[1]   Corresponding Author: Kareem Abidemi Arikewuyo Ph.D, c/o Department of Banking and Finance, Faculty of Administration and Management Sciences, Olabisi Onabanjo University, P. M. B. 2002, Ago – Iwoye, Nigeria. +234803 406 1631

effect of oil price changes on stock market performance in selected SSA. The study, therefore, recommended that countries in SSA should reduce overdependence on oil to minimize external influence in order to promote stability of the stock markets.

JEL Classification: E6, G1, R5

Keywords: Macroeconomic Determinants, Stock Market Performance, External Shock, Sub-Saharan Africa

1. INTRODUCTION

Stock market is one of the cardinals which is expected to propel any economy but the prosperity of this market may be retarded by the conduct of key macroeconomic factors as this would affect behaviour of economic agents, hence economic growth. The ability of the market to allocate funds into productive sector, the more the economy grows as it mirrors the strength of the productive capacity and projects the stability of the financial system. This submission by Onwe (2013 as cited in Arikewuyo & Akingunola, 2019) led credence to the fact that financial system is driven by its economic size and any economy's developmental process is dependent on efficient repackaging of funds between surplus economic providers and deficit economic demanders.

The stock market was designed to provide long-term funds to business organisations but the decisions of providers of funds and trading activities in the market are vulnerable to a lot of macroeconomic factors which are undiversifiable in nature which led to unimpressive stock market performance thereby resulted into loss of confidence and reduced consumer savings habit as well as rise in risk of equity investment and these had greatly affected business environment (Arestis, Demetriades & Luintel, 2001; Mala & Reddy, 2007).

It was the opinion of scholars such as Levine (1991); Bencivenga and Smith (1991) that the best avenue through which surplus economic units deferred their consumption for future – yielding financial claims and easy convertibility of such claims at will without altering the available capital of firms is stock market. That is why Singh (1997 as cited in Olweny & Kimani, 2011) established that some factors such as instability in macroeconomic variables, volatility and pricing process may not provide good haven for long run economic growth to be achieved through stock market. Unstable macroeconomic environment as corroborated by Akingunola and Arikewuyo (2016) was one of the contributory factors to low savings in developing nations as this had led to resource gap which has contributed to stock market retardation in sub-Saharan African (SSA).

Macroeconomics determinants (MED) are derived from macroeconomics covers the conduct of the economy as a whole which bothers on core economic-based performance indicators, such as gross domestic product (GDP); interest rate, exchange rates as well as inflation and the interrelationship among diverse economic sectors (Karl, Ray & Shannon, 2009). It includes economic growth captured by gross domestic product (GDP), interest rates, exchange rates and inflation rates. Chen, Roll and Ross (1986) viewed these macroeconomic indicators as significant in determining firm performance and gains to investors. Macroeconomic factors influencing stock prices are those characteristics of the macro-economy that affect pricing of shares in the market through stock market activities within such economy. These macroeconomic determinants vary in their respective levels of significance from one economy to another and cannot be directly controlled by any individuals, managerial decisions and activities.

In recent times, the inherent exposure of Sub-Saharan African (SSA) stock markets have been mirrored profoundly in the movement of stock prices on the floor of their respective stock exchanges. The Nigerian stock market, for instance, has displayed unpredictable movements that

have resulted into return diminutions and capital loss across all sectors (Abosede & Oseni, 2011) but as activities in the Nigerian capital market continues to fall and selling pressures remain high, a section of market participants has attributed the trend to panic and unstable macroeconomic variables. In the same vein, Lettau and Ludvigson (2001) as reported in Charteris and Strydom (2016) from South Africa's study that the changing patterns of macroeconomic variables are likely to assist in forecasting future share returns.

Records showed that SSA has continued to experience decline in number of initial public offerings (IPOs) which signaled loss of confidence in the market in the last five years. Statistics revealed that total number of IPOs on Nigerian stock exchanges was three with total capital of 571 million (US dollars) while that of South Africa accounted for forty-three IPOs with total capital of 5,895 million (US dollars) over five-year period (2014–2018).

Next to Nigeria is the Bourse Régionale des Valeurs Mobilières (BRVM) housing eight countries (Benin, Burkina Faso, Guinea – Bissau, Côte d'Ivoire, Mali, Senegal, Niger & Togo) had nine IPOs with total capital of 400 million (US dollars) and the country with least IPOs is Zimbabwe which recorded one IPOs with 1 million (US dollars). In terms of IPOs outside African region (outbound IPOs), Nigeria and South Africa recorded 538 million (US dollars) and 35 million (US dollars) on oil & gas and basic materials respectively (Africa Capital Market Watch, 2019). This has further exposed financial markets in SSA to external shock.

Previous studies have established evidence that macroeconomic factors influenced stock prices – short-term interest rate (Rigobon & Sack, 2004); inflation rate (Engle & Rangel, 2005; Saryal, 2007; Bekaert & Engstrom, 2010). Findings of different researchers affirmed that macroeconomic factors are some of the predictive powers of stock prices. This was further corroborated by Singh (1997) that macroeconomic variables have great deal in the interaction of both stock market and economic growth.

There are numerous ways through which macroeconomic determinants do influence financial system performance. As Levine (1996) posited that economic growth of any economy can be influenced by the efficiency of intermediation role of financial system. This is well documented in the demand – following or supply – leading hypothesis, although empirical findings established stock market as a prima-facie to achieving macroeconomic objectives (Aduda, Chogii & Maina, 2014). What can be deduced from this is that macroeconomic variables contribute to oscillating stock prices as this is expected to influence the behaviour of investors.

This study contributes to the existing stock market performance literature in the following ways: First, empirical evidence is based on decomposition of the exchange rate into official and parallel market exchange rates in Nigeria context. Second, the inclusion of financial deepening in the study is to ascertain the interrelatedness between credit creation habit of deposit money banks (DMBs) and stock market performance. Third, it was observed that majority of the previous studies was bedeviled with variable measurement fraught as there were indiscriminate measurements of oscillating and fluctuating variables. To the best of our knowledge in this regard, a crucial gap is the consideration of the characteristic nature of variables as espoused by theories and reality as interest rate and inflation do fluctuate while stock prices and oil prices are volatile. In finance perspective, variable nomenclature matters in measurement. This is one of the major uniqueness of this paper compared to previous studies.

This study examines the short and long – run relationships of macroeconomic indicators on stock prices in some selected SSA economies. Hence, this study examines the effect of macroeconomic determinants on stock market performance in emerging economies with particular reference to Nigeria and South Africa. The choice for South Africa and Nigeria was because the two countries were adjudged to have the largest stock exchanges, in terms of number of listed companies and market capitalisation, in SSA (Dirk *et al*, 2018). The remaining part of this paper includes section two which reviews literature, section three delves into methodology as section four centres on results while section five concludes the paper.

2. LITERATURE REVIEW

The emergence of stock market in Nigeria was to accelerate the pace of economic development (Arikewuyo, 2018) but the change in equity prices informed investor's decision on the kind of available investment opportunities and shape the behaviour of corporate financial policy (Gordon, 1959 as cited in Inyiama, 2015) and an investor's objective of maximising returns on investment is not jeopardized (Ebrahimi & Chadegani, 2011 as cited in Inyiama, 2015). Maku and Atanda (2009) posited that macroeconomic fundamentals do shape prices of stock and it was generally believed that monetary policy as well as macroeconomic events has a large influence on the stock prices and its behaviour in relation to macroeconomic indicators has great implication as unimpressive stock market performance may weaken confidence in the market.

In a study of Asaolu and Ogunmuyiwa (2010) on the impact of macroeconomic variables on average share price in Nigeria between 1986–2007 in which the study adopted co integration and Error Correction Method (ECM) for analysis. The study employs data on twenty-five (25) quoted companies and macroeconomic variables to determine how changes in macroeconomic variables explained stock prices movements in Nigeria. From the model of the study, average stock prices (ASP) was captured as explained variable while external debt, inflation rate, fiscal deficit, exchange rate, foreign capital inflow, industrial output and inflation rate were the explanatory variables adopted. Finding from the co-integration and ECM framework showed a long-run relationship between ASP macroeconomic variables during the period while a weak relationship between ASP and macroeconomic variables in Nigeria.

Adaramola (2011) investigated how macroeconomic variables impacted on stock prices in Nigeria covering the period of 1985–2009 based quarterly data. The study employed panel model and the variables used include stock price, money supply, interest rate, exchange rate, inflation rate, oil price and gross domestic product. The finding revealed that all macroeconomic variables used in this study have significant impacts on stock prices in Nigeria except inflation rate and money supply.

In another study by Kuwornu and Owusu-Nantwi (2011) examining the relationship between macroeconomic variables and stock market returns in Ghana covering 1992–2008 on monthly basis. The study employed full information maximum likelihood estimation procedure to estimate the variables of interest. The variables used include All-Share index, inflation rate, crude oil price, exchange rate and 91-day Treasury bill rate. The outcome revealed that consumer price index had a positive significant effect while exchange rate and T-bill rate have negative significant influence on stock market returns. It was further discovered that crude oil prices did not have any significant effect on stock returns in Ghana.

Gupta and Modise (2013) employed predictive regression model comprising MSE-F and ENC-NEW test statistics to investigate in – sample and out – of – sample predictability of South African stock return using macroeconomic variables. The study which covered the period of 1990:01–2010:06 found that macroeconomic and financial variables have no predicting linkage with South African stock return in a linear predictive regression framework.

Zubair (2013) used Johansen's cointegration and Granger-causality estimations covering before and during the global financial crisis for Nigeria for the period 2001:1–2011:12. Findings revealed no long-run relationship before and during the crisis while Granger-causality test shows a unidirectional causal relationship running from M2 to ASI before the crisis while during the period of the crisis there is no causal relationship between the variables. This implies that ASI responds to M_2.

Hunjra, Chani, Shahzad, Farooq and Khan (2014) investigated how macroeconomic variables impacts on stock prices in Pakistan. The estimation techniques employed include Granger-causality and cointegration tests covering 2001:1–2011:12. The variables considered include interest rate, exchange rate, GDP, inflation and stock prices. Findings revealed a significant relationship

between GDP and stock prices; an insignificant relationship between/among exchange rate, inflation rate and interest rate on stock prices. Furthermore, no relationship between dependent and explanatory variables in the short-run and strong relationship in the long-run was established.

Omorokunwa and Ikponmwosa (2014) examined the relations between stock price volatility and few macroeconomic variables in Nigeria using an annual data from 1980–2011. The tool of estimation was Generalized Autoregressive Conditional Heteroskedasticity (GARCH) and the variables included were stock prices, inflation, exchange rate, GDP and interest rate. Findings showed an indirect and significant relationship. It was further discovered that stock prices in Nigeria were volatile and that previous market information influences current volatility of the stock price. It established weak influence of interest rate and exchange rate on stock price volatility while inflation is key in stock price volatility in Nigeria.

Kirui, Wawire and Onono (2014) evaluated the influence of macroeconomic variables on stock market returns in Kenya. Threshold Generalized Autoregressive Conditional Heteroskedasticity (TGARCH) statistical technique was used covering 2001:1–2012:4. The variables considered include GDP, T-bill, exchange rate, inflation and stock market return and findings revealed negative relations between stock return and exchange rate while other macroeconomic variables were not significant in explaining stock returns.

In the study of Balcilar, Gupta and Kyei (2015) which analysed whether prediction of South African stock returns is based on a measure of economic policy uncertainty (EPU) of South Africa and twenty-one developed and emerging markets. It employed nonparametric causality – in – quartiles test covering 1990:01–2012:03 found that economic policy uncertainty of twenty-one countries including that of South Africa is significant in predicting South African stock market and it was concluded that South African stock market is inefficient.

Ligocká, Pražák and Stavárek (2016) examined the relationship between macroeconomic fundamentals and selected Swiss real estate companies' stock prices. Vector Error Correction and Granger causality techniques were employed covering the period of 2005–2014 with GDP, interest rate, price level and stock prices as variables of interest. It was found that macroeconomic variables and the interest rate in particular have a long-run relationship with behaviour of stock prices in Switzerland.

In the study of Ntshangase, Mingiri and Palesa (2016) on South Africa examined how stock market was influenced by macroeconomic policy variables based on Johansen cointegration test and the restricted VAR model for estimation covering 1994–2012 annualised data. The variables considered include stock market index, government expenditure, money supply, domestic real interest rate, exchange rate and inflation rate. It was revealed that all monetary variables considered transmitted into the stock market.

Charteris and Strydom (2016) carried out a study to ascertain whether consumption aggregate wealth ratio can predict share returns in South Africa. The study covered the period of 1990:03 – 2013:01 and used cointegration single equation method and it was found that consumption aggregate ratio predicts returns in short-run within a year but cannot be applicable in the long-run.

Jareño and Negrut (2016) analysed the association between US stock market and some relevant macroeconomic factors with correlation covering 2008–2014 on quarterly basis. The variables included were GDP, the consumer price index (CPI), the industrial production index, the unemployment rate, long-term interest rates and Dow Jones market index. Findings revealed positive and significant relationship among US stock market, GDP and industrial production index while negative and significant relationship existed among stock market, unemployment as well as US interest rate.

Marshal (2017) investigated how macroeconomic dynamics influenced Nigerian bank lending behaviour between 1976 and 2016. The study employed ordinary least square (OLS), Johansen multivariate co integration and granger causality techniques. Findings revealed that bank

capitalization ratio and money supply are the most potent variables influencing lending behavior of Nigerian banks.

Chandrashekar, Sakthivel, Sampath and Chittedi (2018) explored the significance of macroeconomic variables on stock prices for emerging economies. Dynamic ordinary least squares (DOLS) and short run panel causality covering 2001:1–2016:8 were used. Findings of this study revealed long-run equilibrating relationships among stock prices, inflation, industrial production, real exchange rates and interest rate in India and Brazil. More so, industrial production and exchange rate have positive effect on stock prices while inflation and interest rates have no significant impact on prices of stock in the selected countries namely India and Brazil.

3. METHODOLOGY AND DATA

In considering the effect of macroeconomic determinants on stock market performance, this section delves into the sources and process of data collection as well as the analytical technique for achieving the purpose of this study. It employed *ex-post facto* case study design type and being secondary in nature, it covered the period of 1999–2017 on quarterly basis having its sources of information from Central Bank of Nigeria statistical bulletin, Federal Reserve Bank of St. Louis and Nigerian Stock Exchange (NSE) databank. This period was considered necessary in emerging markets because it was after Asian financial crisis through global financial crisis which affected stock market. The study employed Autoregressive Distributed Lag (ARDL) technique for analysis at 5% level of significance. The data needed include All-Share Index (asi), inflation (ifl), rate of interest (itr), growth in money supply (gms), real exchange rate (rex), parallel market exchange rate (pex), prices of international oil (opr) and financial deepening (fdp).

This study adapted models of Asaolu and Ogunmuyiwa (2010), Adaramola (2011), Omorokunwa and Ikponmwosa (2014) as well as Chandrashekar, Sampath and Chittedi (2018) with modifications where appropriate to suit the objectives of this study. For clarity, this study modified the models using economy-wide data as against firm-specificity in the studies of Asaolu and Ogunmuyiwa (2010) as well as Adaramola (2011) and quarterly data as against Omorokunwa and Ikponmwosa (2014) as well as Chandrashekar *et al* (2018) that bother on the nature of data (annual and monthly respectively).

The model employed was specified in equation (3.1), thus:

$$skp_t = f(med_t, nof_t) \tag{3.1}$$

where:
skp_t = stock price at period t;
med_t = macroeconomic determinants at period t; and
nof_t = notable factors at period t.

The components of macroeconomic determinants (med_t) were shown in equation (3.2):

$$med_t = f(ifl_t, itr_t, gms_t) \tag{3.2}$$

where:
ifl_t = inflation rate at period t;
itr_t = interest rate at period t;
gms_t = growth in money supply at period t.

Furthermore, the components of other notable factors (nof_t) were depicted in equation (3.3):

$$nof_t = f(rex_t, pex_t, opr_t, fdp_t) \tag{3.3}$$

where:
rex_t = real exchange rate at period t;
pex_t = parallel market exchange rate at period t;
opr_t = change in international oil price at period t; and
fdp_t = financial deepening at period t.

In furtherance to the equations (3.1)–(3.3), the linear relationship was specified in equation (3.4) as follows:

$$skp_t = \alpha_0 + \alpha_1 ifl_t + \alpha_2 itr_t + \alpha_3 gms_t + \alpha_4 rex_t + \alpha_5 pex_t + \alpha_6 opr_t + \alpha_7 fdp_t + \varepsilon_t \tag{3.4}$$

Thus, the ARDL model for equation (3.4) is given, thus

$$\Delta skp_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta skp_{t-1} + \sum \alpha_2 ifl'_{t-1} + \sum \alpha_3 itr'_{t-1} + \sum \alpha_4 gms'_{t-1} +$$

$$\sum \alpha_5 rex'_{t-1} + \sum \alpha_6 pex'_{t-1} + \sum \alpha_7 opr'_{t-1} + \sum \alpha_8 fdp'_{t-1} + \alpha_9 skp_{t-1} + \alpha_{10} ifl'_{t-1} + \tag{3.5}$$

$$\alpha_{11} itr'_{t-1} + \alpha_{12} gms'_{t-1} + \alpha_{13} rex'_{t-1} \alpha_{14} pex'_{t-1} + \alpha_{15} opr'_{t-1} + \alpha_{16} fdp'_{t-1} + \varepsilon_i$$

3.1. Justification of Variables

The inclusion of variables was based on literature of previous studies and the importance of such variables in economic activities

skp = Stock Price reflects the expectation of future performance of firms and can be used as a measure of economic performance (Nasseh & Strauss, 2000; Adjasi & Biekpe, 2006; Maysami et al., 2004; Kuwornu & Owusu-Nantwi, Victor, 2011). This was captured by All-Share Index (ASI) and represents the explained variable;

ifl = Inflation Rate depicts strength of consumption rate over time (Akingunola & Arikewuyo, 2016). It will affect stock prices as swings in inflation rate influences economic activities in Nigeria (Obasan & Arikewuyo, 2012). However, fluctuation of inflation rate was considered because this is usually reported on periodic basis.This is one of the explanatory variables representing macroeconomic factors;

itr = Interest Rate plays an important role and it is price for waiting and consumption postponement (Omorokunwa & Ikponmwosa, 2014). Its fluctuation also influences the investors' behaviour in the stock market thereby affecting stock market performance. This is another explanatory variable representing macroeconomic factor;

gms = Growth in Money Supply measured with broad money, M_2 (Ntshangase, Mingiri & Palesa, 2016). This is expected to influence the savings habit of investors. However, the direction of its influence depends largely on policy embarked by the government, which may either expansionary or contractionary. This is another explanatory variable representing macroeconomic factor;

rex = Real Exchange Rate; this becomes necessary because the countries operate open economies and exchange rate behaviour (real) has impact on any economic activities. This is another explanatory variable representing macroeconomic factor;

pex = Parallel Exchange Rate; this is expected to have effect on the economy, most especially an economy where the apex bank could not meet up the demand for foreign currency (Arikewuyo, 2018). This is another explanatory variable representing macroeconomic factor but peculiar to Nigeria as data on this could not be obtained for South Africa;

opr = change in Oil Prices; this is expected to influence the stock performance (Adebiyi *et al*, 2009; Asaolu & Ilo, 2012). This represents foreign factor that influences stock market performance and an inverse relationship is expected based on extant literature; and

FDP = Financial Deepening measured as credit to private sector as a ratio to GDP; this is expected to influence behaviour of bankable public whose savings habit depend largely on economic activities.

α_0 = intercept term

$\alpha_1 - \alpha_7$ = parameters to be estimated

ε = stochastic error term (used to represent the Gaussian white noise).

4. RESULTS

This paper considered the need for correlation matrix to determine whether collinearity exists between/among variables or not; stationarity test, using Augmented Dickey Fuller (ADF), of all the variables used in this study to understand the properties of the data from the two (2) countries (Nigeria and South Africa) so as to provide a guide for technique appropriateness and the data include volatility of share price indexes, fluctuation of inflation rates based on consumer price index (cpi), fluctuation of interest rate of the two countries, growth in money supply (gms), volatility of international oil prices (opr), financial deepening (fdp), real exchange rate (rex) based on CPI as well as parallel exchange rates (pex) for only Nigeria. Due to country-specificity, the exchange rate for Nigeria was decomposed into real and parallel market exchange rates due to the pressure of foreign currency demand in Nigeria, being an import-dependent country but this could not be so in South Africa context as a result of inaccessibility of such data.

Table 1 shows the extent of association between variables of the model and exhibits where there is problem of multicollinearity. Pairwise correlation matrix revealed positive association between/among all variables except among inflation/money supply/financial deepening/real exchange rate and real exchange rate/prices of international oil for Nigeria; negative association only exists between inflation/real exchange rate as well as prices of international oil/real exchange rate for South Africa. Thus, the associations between/among variables did not suggest any 'strong' relationship as correlation coefficient of all the variables is below 0.7 (Schober, Boer & Schwarte, 2018).

Table 2 showed the outcome of the Augmented Dickey Fuller (ADF) unit root test for Nigeria and South Africa showed differed and similar order of integration. For instance, the ADF test showed that Nigeria and South Africa have similar order of integration, I(0) and I(1) for fluctuations of inflation rates, interest rates, international oil volatility and growth in money supply, stock market financial deepening respectively while differed order of integration was witnessed in volatility of share price indexes and real exchange rates.

Table 1
Correlation Matrix

	ifl	itr	gms	opr	fdp	rex	pex
ifl:							
Nigeria	1						
South Africa	1						
itr:							
Nigeria	0.0029	1					
South Africa	0.5989	1					
gms:							
Nigeria	-0.0008	0.1436	1				
South Africa	0.0998	0.2069	1				
opr:							
Nigeria	-0.0834	-0.2803	0.2126	1			
South Africa	0.1446	-0.2846	0.2261	1			
fdp:							
Nigeria	-0.0158	0.1211	0.6813	0.4412	1		
South Africa	0.0063	0.2192	0.6247	0.1362	1		
rex:							
Nigeria	-0.4937	0.0948	0.0355	-0.0704	-0.0422	1	
South Africa	-0.0087	0.0484	0.4162	-0.0360	0.4971	1	
pex:							
Nigeria	0.0047	0.1303	0.4669	0.0184	0.3151	0.4235	1

Source: Authors' Computation, 2019.

Table 2
Unit Root Test

Variable	ADF		Order of Integration	
	Nigeria	South Africa	Nigeria	South Africa
skp	-6.3779	-3.2781	I(1)	I(0)
ifl	-10.0701	-4.5615	I(0)	I(0)
itr	-5.1968	-4.5946	I(0)	I(0)
gms	-8.5426	-5.3225	I(1)	I(1)
opr	-3.6315		I(0)	I(0)
fdp	-6.7256	-4.0443	I(1)	I(1)
rex	-5.9160	-5.9800	I(0)	I(1)
pex	-3.6270	-	I(1)	-

Source: Authors' Computation, 2019.

With such mixture of different orders of integration, we applied the Autoregressive Distributed Lag (ARDL) following Pesaran, Shin and Smith (2001) as this technique combines both short-run and long-run coefficients. The Vector Autoregression (VAR) lag order selection criteria for Nigeria was six (6) and eight (8) for South Africa. The ARDL bound F-tests were displayed in Table 3 which showed a long-run equilibrating relation between macroeconomic indicators and stock market performance in Nigeria while South Africa displayed no long-run equilibrating relation given their respective F-statistic of 4.5705 and 2.2586 at 5% level of significance. Different diagnostic statistic for the two economies revealed the absence of serial correlation and heteroscedasticity ($p > 0.05$) which implied that the model was reliable. Findings showed that explanatory variables included were of good fit and explained about 73% for Nigeria and 78% for South Africa, using Adj. R^2 measure.

Table 3
ARDL Bound Test

Estimated Equation:	$SPI_N = f(IFL\ ITR\ GMS\ REX\ PEX\ FDP\ OPR)$		
	$SPI_S = f(IFL\ ITR\ GMS\ REX\ FDP\ OPR)$		
F-statistic:	Nigeria (N)	4.5705	
	South Africa (S)	2.2586	
Optimal lag length		(2, 1, 2, 2, 2, 2, 2, 1)	
		Critical values	
Significance level		Lower bound	Upper bound
1%:	Nigeria	2.96	4.26
	South Africa	3.15	4.43
5%:	Nigeria	2.32	3.5
	South Africa	2.45	3.61
10%:	Nigeria	2.03	3.13
	South Africa	2.12	3.23
Diagnostic Tests		Statistics	
R^2:	Nigeria	0.8481	
	South Africa	0.9731	
Adjusted R^2:	Nigeria	0.7282	
	South Africa	0.7787	
F-statistics:	Nigeria	7.0736 (0.0000)	
	South Africa	5.0029 (0.0102)	
Breusch-Godfrey Serial Correlation LM Test:	Nigeria	1.1808 (0.3411)	
	South Africa	1.0528 (0.4719)	
ARCH LM Heteroscedasticity Test:	Nigeria	0.2671 (0.9500)	
	South Africa	0.3575 (0.9378)	
Specification Error – Ramsey RESET Test:	Nigeria	17.3598 (0.0008)	
	South Africa	15.0026 (0.0029)	

Source: Authors' Computation, 2019.

Furthermore, the CUSUM and CUSUM-SQ statistic for the two countries was within the acceptable bound of 5% significant level which implied that the CUSUM stability test of the model is stable while CUSUM of squares were conducted to establish the constancy of short-run dynamics of long-run parameters except for Nigerian case that revealed unstable situation between 2005:Q1 and 2008:Q4 which coincided with financial reform period (recapitalisation and rationalisation of Deposit Money Banks) to the global period of financial crisis. It is, therefore, imperative to state that this model is structurally stable and an indication that the model will produce a reliable result for policy implication.

Figure 1
a. Cumulative Sum (CUSUM) Plot for Nigeria
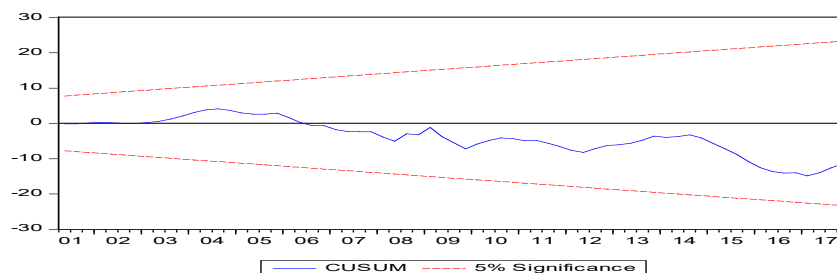
b. Cumulative Sum (CUSUM) of Recursive Residuals Plot for Nigeria

Figure 2
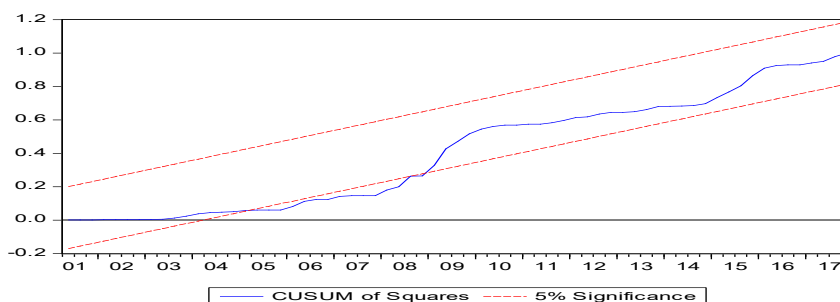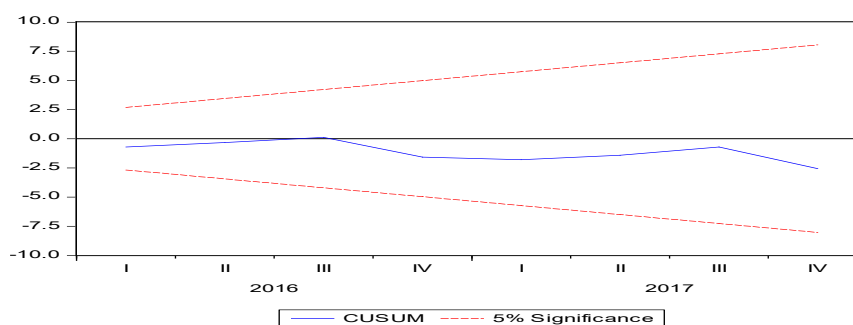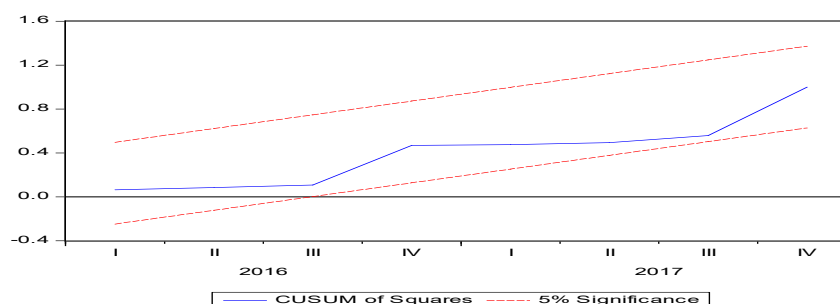**a.** Cumulative Sum (CUSUM) Plot for South Africa

b. Cumulative Sum (CUSUM) of Recursive Residuals Plot for South Africa

Bound test in Table 3 necessitated the estimations of long-run and short-run dynamics through ECM to establish adjustment speed despite absence of long-run relationship in the case of South Africa. Empirical findings from ARDL result as depicted in Table 4 showed that error – correction term (ect) coefficient is in line with theoretical postulation as it is correctly signed. This indicates that about 83% and 99% departure from long-run equilibrium is due for adjustment in each quarter and it is significant and insignificant at 5% level for Nigeria and South Africa respectively. Thus, the magnitude of the adjustment mechanism (ect) shows that the adjustable speed toward long-run equilibrium is low as about 83% and 99% disequilibrium, despite non-significance of the latter, from the preceding quarter's shock converged to long-run in the current quarter for Nigeria and South Africa respectively.

Table 4
Short-run and Long-run Elasticities of ARDL Results for Nigeria and South Africa

	Short-run Elasticities			Long-run Elasticities	
	Coefficients			Coefficients	
Variables	Nigeria (5,0,0,2,4,6,6,0)	South Africa (8, 6, 7, 8, 8, 7, 8)	Variables	Nigeria	South Africa
D(skp(-1))	0.3722** (0.0178)	0.2608 (0.5762)	ifl	-842387.32 (0.6422)	-673.2945 (0.2698)
D(skp(-2))	0.3989* (0.0085)	0.1568 (0.7808)	itr	-15085913.5 (0.3415)	-90.0871 (0.5607)
D(skp(-3))	0.1354 (0.3177)	0.9544 (0.0917)	gms	-1034.5761* (0.0002)	0.0000 (0.5479)
D(skp(-4))	-03355* (0.0080)	0.5600 (0.2212)	opr	53021.274* (0.0000)	0.0544* (0.0020)
D(skp(-5))	-	-0.1543 (0.6889)	fdp	59920158.4* (0.0000)	-0.3325 (0.1483)
D(skp(-6))	-	-0.7247 (0.0851)	rex	-2870.2941 (0.3233)	-0.1032 (0.3857)
D(skp(-7))	-	0.4979 (0.1775)	pex	2709.8398* (0.0002)	-
D(ifl)	-697024.6* (0.0000)	-298.3507 (0.1807)	c	-20728017.6* (0.0000)	39.9404 (0.1286)
D(ifl(-1))	-	-112.8331 (0.6745)			
D(ifl(-2))	-	-401.3083 (0.1912)			
D(ifl(-3))	-	-406.6712 (0.1993)			
D(ifl(-4))	-	461.4451 (0.1307)			
D(ifl(-5))	-	327.0439 (0.3432)			
D(itr)	-1248268.2* (0.0000)	58.7196 (0.1347)			
D(itr(-1))	-	52.2475 (0.3000)			

| | Short-run Elasticities | | | Long-run Elasticities | |
| | Coefficients | | | Coefficients | |
Variables	Nigeria (5,0,0,2,4,6,6,0)	South Africa (8, 6, 7, 8, 8, 7, 8)	Variables	Nigeria	South Africa
D(itr(-2))	-	68.6897 (0.1408)			
D(itr(-3))	-	63.4332 (0.1674)			
D(itr(-4))	-	-41.3698 (0.2523)			
D(itr(-5))	-	-26.9970 (0.4883)			
D(itr(-6))	-	59.5630 (0.0575)			
D(gms)	-3507.31 (0.1563)	-0.0000 (0.7359)			
D(gms(-1))	3464.41 (0.1740)	-0.0000** (0.0193)			
D(gms(-2))	-	0.0000 (0.9688)			
D(gms(-3))	-	0.0000** (0.0313)			
D(gms(-4))	-	-0.0000 (0.5582)			
D(gms(-5))	-	0.0000 (0.9169)			
D(gms(-6))	-	-0.0000** (0.0366)			
D(gms(-7))	-	0.0000** (0.0113)			
D(opr)	10541.16** (0.0342)	0.0087 (0.0542)			
D(opr(-1))	2473.85 (0.6120)	-0.0085 (0.2152)			
D(opr(-2))	-18551.89* (0.0007)	0.0205** (0.0367)			
D(opr(-3))	7017.14 (0.1556)	0.0012 (0.8659)			
D(opr(-4))	-10235.67** (0.0479)	-0.0326* (0.0085)			
D(opr(-5))	-6793.38 (0.1850)	-0.0001 (0.9958)			
D(opr(-6))	-	0.0020 (0.7754)			
D(opr(-7))	-	-0.0180 (0.0268)			

	Short-run Elasticities			Long-run Elasticities	
	Coefficients			Coefficients	
Variables	Nigeria (5,0,0,2,4,6,6,0)	South Africa (8, 6, 7, 8, 8, 7, 8)	Variables	Nigeria	South Africa
D(fdp)	-7408135.7* (0.0000)	-0.6472 (0.1040)			
D(fdp(-1))	13569504.6* (0.0000)	-0.4995 (0.3007)			
D(fdp(-2))	-21741560.7* (0.0000)	0.8134 (0.2952)			
D(fdp(-3))	-16867926.9* (0.0000)	-0.3211 (0.7048)			
D(fdp(-4))	36211571.7* (0.0000)	0.2499 (0.6621)			
D(fdp(-5))	-42609762.1* (0.0000)	-0.4249 (0.3231)			
D(fdp(-6))	-	0.2357 (0.3734)			
D(rex)	-2374.99 (0.3308)	0.0198 (0.1293)			
D(rex(-1))	-	0.0048 (0.4161)			
D(rex(-2))	-	-0.0049 (0.2723)			
D(rex(-3))	-	0.0077 (0.2521)			
D(rex(-4))	-	-0.0662 (0.0246)			
D(rex(-5))	-	0.1489 (0.1074)			
D(rex(-6))	-	0.0977 (0.2224)			
D(rex(-7))	-	-0.0514 (0.2213)			
D(pex)	943.79 (0.0927)	-			
D(pex(-1))	-92.4873 (0.8670)	-			
D(pex(-2))	-1409.91* (0.0037)	-			
D(pex(-3))	-788.70 (0.1707)	-			
CointEq(-1)	-0.8274* (0.0000)	-0.9856 (0.0941)			

Note: *, ** are significant at 1% and 5% levels respectively.

Source: Authors' Computation, 2019.

In Nigerian case, the significance of 'ect' was further supported by majority of the macroeconomic variables considered which include one-period, two-period and four-period lagged of stock price volatility, current period oil price volatility as well as one-previous and four-period lagged of financial deepening were positively significant in the short-run at various 1% and 5% level. Also, current inflation and interest rates, two-period and four-period lagged of oil price volatility, financial deepening at different lagged period of one, three and five as well as two-period parallel market exchange rate volatility were negatively significant at 1% and 5% levels. What we deduced from this result is that of all the variables considered; only growth in money supply and real exchange rate volatility were insignificant, in the short-run.

Furthermore, long-run result revealed that out of seven macroeconomic variables considered in Nigerian case, only three were insignificant (ifl, itr and rex) and those that were significant include oil price volatility, financial deepening, parallel market exchange rate and growth in money supply which only exerted negative impact on volatility of stock price. It is intuitive that certain macroeconomic variables have incursion into Nigerian stock market behaviour. This suggests that stock market activity is greatly influenced by macroeconomic behaviour and this may have far-reaching implication on investor confidence in Nigeria.

Unlike Nigeria, the non-significance of ect for South Africa suggested no causal relations between monetary variables and volatility of stock prices in the country. Thus, empirical finding revealed that all domestic monetary variables were not significant except growth in money supply (gms) whose influence can only be felt by the market three (3) months after its manipulation and this suggests that the manipulation of monetary policies by the monetary authority may not influence the behaviour of South African stock market.

It is crystal clear that stock markets of sampled economies are influenced by external factor (that is change in international oil price). The effect of changes in prices of oil exerted positive influence, in the short-run (precisely 6 months), on the volatility of the stock price in South Africa and this may be as a result of non-importation of refined crude oil by South Africa. More so, only oil price volatility affected South African stock price volatility, in the long-run. This implication of this is that stock market is contemporaneously affected by external factor and not domestic macroeconomic variables of the country.

5. CONCLUSIONS

This paper sets out to investigate the relationship between macroeconomic determinants and stock market performance of the two largest nations in the sub-Saharan Africa (South Africa and Nigeria) over the period of 1999:1–2017:4. The use of ARDL technique was based on the outcome of stationarity test and GARCH series was generated for oil prices and stock prices before estimation of short and long run effect (ARDL).

Following the empirical findings, macroeconomic variables were found to be significant in Nigerian stock market. Intuitively, any monetary or government policy changes will have a far reaching implication on the stock market. The implication which may either have negative or positive feedback as espoused by Summer (1988) in Edo (2009) thereby affecting confidence in the market. In furtherance to this, Nigerian government in conjunction with her South African counterpart, being the two largest economies in SSA, should pursue a paradigm shift through intra – African integration and cooperation to stem the tide of unstable macroeconomic environment that would culminate into stability of stock market in SSA continent.

Unlike Nigeria, South African stock market did not show any undoubtedly predictable linkage between macroeconomic variables and performance of stock market but showed contemporaneous effect of changes in oil price on performance of stock market which is also applicable to Nigerian

situation. The inference from this is that sub-Saharan Africa economies are exposed to external shocks (i. e. foreign shocks)

Based on these, it is our candid opinion that Nigeria embarks on policies that can drive the stock market to enviable position that will promote stock market participation and engender growth of the economy. More so, both South Africa and Nigeria should reduce overdependence on oil through diversification of economy as additional source of revenue as well as generation of energy through other viable means to checkmate high rate of demand for foreign currencies thereby reducing external influence so as to promote stability of the stock market, hence economic growth.

References

Abosede A.J. & Oseni J.E. (2011). Theoretical analysis of firm and market – specific proxies of information asymmetry on equity prices in the stock markets. *Australian Journal of Business and Management Research*, Vol. 1(2), 1–13.

Adaramola A.O. (2011). The impact of macroeconomic indicators on stock prices in Nigeria. *Developing Country Studies*, Vol. 11(2), 1–14.

Adebiyi M.A., Adenuga A.O, Abeng M.O. & Omanukwe P.N. (2009), Oil price shocks, exchange rate and stock market behaviour. Retrieved 12/12/2018 from http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.589.4418&rep=rep1&type=pdf

Adjasi K. & Biekpe B. (2006). Stock exchange and economic growth: The case of selected African countries, *University of Stellenbesch Business School Publication*, Cape Town, South Africa.

Aduda J., Chogii R. & Maina T.M. (2014). Effect of capital market deepening on economic growth in Kenya. *Journal of Applied Finance and Banking*, Vol. 4(1), 141–159.

Africa Capital Markets Watch 2018 (2019). Retrieved 21/11/2019 from www.pwc.co.za/en/assets/pdf/africa-capitalmarkets-watch-2018.pdf

Akingunola R.O. & Arikewuyo K.A. (2016). Determinants of savings mobilisation by deposit money banks in Nigeria (1986–2014). *Gashua Journal of Science and Humanities*, Vol. 2(2), 101–110.

Arikewuyo K.A. (2018). *Foreign exchange rate behaviour and stock market development in Nigeria*. An unpublished Ph.D. thesis submitted to Olabisi Onabanjo University, Ago-Iwoye, Nigeria

Arikewuyo K.A. & Akingunola R.O. (2019). Impact of interest rate deregulation on fund mobilisation of deposit money banks in Nigeria. *Izvestiya Journal of Varna University of Economics*, Vol. 63(2), 89–103.

Asaolu T.O. & Ilo B.M. (2012). The Nigerian stock market and oil price: A cointegration analysis. *Kuwait Chapter of Arabian Journal of Business and Management Review*, Vol. 1(6), 109–118.

Asaolu T.O. & Ogunmuyiwa M.S. (2010). An econometric analysis of the impact of macroeconomic variables on stock market movement in Nigeria. *Asian Journal of Business Management*, Vol. 3(1), 72–78.

Balcilar M., Gupta R. & Kyei (2015). South African stock returns predictability using domestic and global economic policy uncertainty: evidence from a non-parametric causality – in-quantiles approach. *Department of Economics Paper Series*, University of Pretoria. Retrieved 21/11/2017 from – pdfs.semanticscholar.org/351b/ee141c470ef5cb673b0acbcde8464f844d1c.pdf

Bekeart G. & Engstrom E. (2010). Inflation and the stock market: Understanding the "Fed Model". *Journal of Monetary Economics*, Vol. 57, 278–294.

Bencivenga V.R. & Smith B.D. (1991). Financial intermediation and endogenous growth. *Review of Economic Studies*, Vol. 52(2), 195–209.

Chandrashekar R., Sakthivel P., Sampath T. & Chittedi K.R. (2018), Macroeconomic variables and stock prices in emerging economies: A panel analysis. *Theoretical and Applied Economics*, XXV-3(616), 91–100.

Charteris A. & Strydom B. (2016). Stock return predictability in South Africa: An alternative approach. *Economic Research Southern Africa (ERSA) working paper 608*, 1–21.

Chen N., Roll R. & Ross S. (1986). Economic forces and stock market. *Journal of Business*, 59, 383–403.

Chidozie U.E. & Ayadi F.S. (2017). Macroeconomy and banks' profitability in Nigeria. *African Research Review*, Vol. 11(2), 121–137.

Dirk F.A., Grimm M. & Bretschneider F. (2018). Public corporation in Nigeria: A continental survey on stock exchanges and capital market performance. *Jena Economic Research Papers No. 2018-013*, Friedrich Schiller University, Jena.

Edo S.E. (2009). The behaviour of an emerging stock market in disequilibrium. *Journal of Economic Management*, Vol. 7, 143–160.

Gupta R. & Modise M.P. (2013). Macroeconomic variables and South African stock returns predictability. Retrieved 13/12/2017 from: repository.up.ac.za/bitstream/handle/2263/21156/Gupta_Macroeconomic(2013).pdf

Hunjra A.I., Chani M.I., Shahzad M. & Khan M.F.K. (2014), The impact of macroeconomic variables on stock prices in Pakistan, *International Journal of Economics and Empirical Research*, Vol. 2(1), 13–21

Inyiama O.I. (2015). Effects of banks' financial performance on share prices: Evidence from Nigerian banking industry (2004–2013). *European Journal of Research and Reflection in Management Sciences*, Vol. 3(3), 69–79.

Jareño J. & Negrut L. (2016), US stock market and macroeconomic factors. *The Journal of Applied Business Research*, Vol. 32(1), 325–340.

Karl E., Ray C. & Shannon M. (2009). *Principles of economics*. Pearson International Edition, Prentice Hall.

Kirui E., Wawire N.H.W. & Onono P.O. (2014). Macroeconomic variables, volatility and stock market returns: A case of Nairobi securities exchange, Kenya. *International Journal of Economics and Finance*, Vol. 6(8).

Kuwornu J.K.M. & Owusu-Nantwi V. (2011). Macroeconomic variables and stock market returns: Full Information Maximum Likelihood Estimation. *Research Journal of Finance and Accounting*, Vol. 2(4), 49–63.

Lettau M. & Ludvigson S. (2001). Consumption, aggregate wealth and expected stock returns. *Journal of Finance*, Vol. 56(3), 815–849.

Levine R. (1991). Stock markets, growth and tax policy. *Journal of Finance*, Vol. 46(4), 1445–1465.

Ligocká M., Pražák T. & Stavárek D. (2016). The effect of macroeconomic factors on stock prices of Swiss real estate companies. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*, Vol. 64(6), 2015–2024.

Mala R. & Reddy M. (2007). Measuring stock market volatility in an emerging economy. *International Journal of Finance and Economics*, Vol. 8(1), 126–133.

Marshal I. (2017). The impact of macroeconomic dynamic on bank lending behaviour in Nigeria. *Noble International Journal of Economics and Financial Research*, Vol. 2(10), 131–139.

Maysami R.C., Howe L.C., & Hamzah M.A. (2004). Relationship between macroeconomic variables and stock market indices: Cointegration evidence from Stock Exchange of Singapore's All-Sector Indices. *Jurnal Pengurusan*, Vol. 24, 47–77.

Nasseh A. & Strauss J. (2000). Stock prices and domestic and international macroeconomic activity: A cointegration approach. *The Quarterly Review of Economics and Finance*, Vol. 40(2), 229–245.

Ntshangase K., Mingiri K.F. & Palesa M.M. (2016). The interaction between the stock market and macroeconomic policy variables in South Africa. *J. Economics*, Vol. 7(1), 1–10.

Obasan K.A. & Arikewuyo K.A. (2012). The effect of pre-post bank consolidation on the accessibility of finance to SMEs in Nigeria. *Business and Management Research*, Vol. 1(3), 108–120.

Olweny T.O. & Kimani D. (2011). Stock market performance and economic growth: Empirical evidence from Kenya using causality test approach. Advances in Management and Applied Economics, Vol. 1(3), 153–196.

Omorokunwa O.G. & Ikponmwosa N. (2014). Macroeconomic variables and stock price volatility in Nigeria. *Annals of the University of Petroşani Economics*, Vol. 14(1), 259–268.

Rigobon R. & Sack B. (2004). The impact of monetary policy on asset prices. *Journal of Monetary Economics*, Vol. 5(8), 1553–1575.

Saryal F.S. (2007). Does inflation have an impact on conditional stock market volatility? Evidence from Turkey and Canada. *International Research Journal of Finance and Economics*, Vol. 11, 123–133.

Schober P., Boer C. & Schwarte L.A. (2018). Correlation coefficients: Appropriate use and interpretation. *Anesthesia & Analgesia*, Vol. 126(5), 1763–1768. Retrieved 21/11/2019 from www.anesthesia-analgesia.org

Singh A. (1997). Stock market, financial liberalization economic development. *Economic Journal*, Vol. 107(442), 771–782.

Yartey C.A. & Adjasi C.K. (2007). Stock market development in sub-Saharan Africa: Critical issue and challeneges. *IMF Working Paper No. WP/07/209*, 1–33.

Zubair A. (2013). Causal relationship between stock market index and exchange rate: Evidence from Nigeria. *CBN Journal of Applied Statistics*, Vol. 4(2), 87–110.

The use of the bootstrap method for the assessment of investment effectiveness and risk – the case of confidence intervals estimation for the Sharpe ratio and TailVaR

Klaudia Jarno[1]

Poznań University of Economics and Business,
al. Niepodległości 10, 61-875 Poznań, Poland
klaudia.jarno@gmail.com
https://orcid.org/0000-0001-9034-9246

Łukasz Smaga

Adam Mickiewicz University, Faculty of Mathematics and Computer Science,
ul. Uniwersytetu Poznańskiego 4, 61-614 Poznań, Poland
ls@amu.edu.pl
https://orcid.org/0000-0002-2442-8816

ABSTRACT

This paper is aimed at presenting application of bootstrap interval estimation methods to the assessment of financial investment's effectiveness and risk. At first, we give an overview of various methods of bootstrap confidence interval estimation, i.e. bootstrap-t interval, percentile interval and BCa interval. Then, bootstrap confidence interval estimation methods are used to estimate confidence intervals for the Sharpe ratio and TailVaR of the Warsaw Stock Exchange sectoral indices. The results show that the bootstrap confidence intervals of different types are quite similarly positioned for each of the analysed index and measure. Taking into the account the locations of confidence intervals for both the Sharpe ratio and TailVaR, the real estate sector tends to be the most advantageous from the investor's viewpoint.

JEL Classification: C130, C150, G110

Keywords: Bootstrap, confidence intervals, Sharpe ratio, TailVaR, stock market index

1. INTRODUCTION

The assessment of investment effectiveness and risk is an essential step in evaluating a particular investment opportunity. However, selecting a right measure of either effectiveness or risk and the way to compute it possesses a problem for both academics and practitioners. The problem is getting worse when a researcher not only wants to calculate a point estimation

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[1] Corresponding author.

of a particular measure, but he or she is also interested in finding a confidence interval for the measure.

In general, it is historical values that are usually used to compute confidence intervals for different effectiveness and risk measures. Two main approaches can be distinguished here. One assumes that rates of return are independently and identically distributed (hereinafter: i.i.d.) random variables. The methods based on this assumption are easy to apply, however results may be biased (because of a serial correlation and/or deviations from the normal distribution). The other approach relaxes the assumption of i.i.d. rates of return and utilises the ARMA-GARCH models. The methods here are much more computationally advanced but, in return, they can give better results.

The aim of this paper is to present how to use an alternative approach, i.e., the bootstrap method in evaluating investment effectiveness and risk based on confidence intervals for the Sharpe ratio and TailVaR. We focus on three types of bootstrap confidence intervals, i.e. the bootstrap-t confidence interval, the percentile bootstrap confidence interval and the BCa bootstrap confidence interval. The paper demonstrates how to use them to estimate the Sharpe ratio and TailVaR and how the results should be interpreted.

This paper is organised as follows. The first section provides a literature review on attempts to use the bootstrap method for point and confidence interval estimation for Sharpe ratio and VaR-family risk measures. The next section gives an overview of three types of bootstrap confidence intervals that are used in our analysis. The third section introduces the methodology of empirical research, and the fourth section presents its results. The final section concludes.

This paper is based on the diploma thesis by K. Jarno (2019).

2. LITERATURE REVIEW

The Sharpe ratio is frequently used to assess investment effectiveness. The ratio measures the excess rate of return (the rate of return above the risk-free rate) per unit of a total risk measured by the standard deviation of the rate of return in line with the following formula (Sharpe 1966)

$$SR = \frac{\mathbb{E}(R_t) - R_f}{\sqrt{\mathrm{Var}(R_t)}}, \tag{1}$$

where R_t denotes the rate of return in period t while R_f is the risk-free rate.

The basic Sharpe ratio estimator (the so-called ex post Sharpe ratio) is calculated by subtracting the proxy for the risk-free rate from the sample's average rate of return and dividing the result by the sample's standard deviation of the rate of return (this estimator is used in many empirical studies, c.f. Pilotte and Sterbenz 2006, Hodges, Taylor, and Yoder 1997, Auer and Schuhmacher 2013).

Assuming that returns are i.i.d., the confidence interval can be computed based on the quantiles of Student's t-distribution. Since the distribution of the basic Sharpe ratio estimator approaches the normal distribution when sample size approaches infinity, another solution is to compute an approximate confidence interval (Lo 2002, pp. 37–39).

Although bootstrap methods are listed among the possible approaches used to estimate the confidence interval for the Sharpe ratio (Riondato 2018), they are not popular. A study by Scherer (2004) is a rare example. It involved the computation of percentile bootstrap confidence intervals for the Sharpe ratio and the Sortino ratio of hedge funds while assuming that returns are i.i.d. followed by an introduction of methods that allow giving up this assumption. In turn, Ledoit and Wolf (2008) developed a statistical test for comparing the Sharpe ratios of two investments.

The test does not assume any particular distribution of returns and utilizes the bootstrap method. Finally, in their study, Chaudhry and Johnson (2008) opted for bootstrap percentile confidence intervals to estimate the 95% confidence interval for the skewness of differential rates of return (rates of return above a specified benchmark).

The skewness and kurtosis of returns are of particular importance when it comes to any portfolio analysis because the findings of many empirical studies suggest that distributions of returns deviate from the normal distribution (c.f. Mandelbrot 1963, Fama 1965, Cont 2001, Rachev, Menn, and Fabozzi 2005). Heavy tails of distributions pose a problem especially when assessing the VaR-family (value at risk) risk measures since they aim at capturing the properties of distribution tails. One of the representatives of this group of risk measures is TailVaR (also called *tail conditional expectation*) which is defined as follows (Artzner et al. 1999, p. 223)

$$TailVaR_\alpha(R_t) = -\mathbb{E}\left[R_t \mid R_t \leq -VaR_\alpha(R_t)\right], \tag{2}$$

where $VaR_\alpha(R_t)$ denotes VaR which is computed as α-quantile of returns (R_t) distribution with the reversed sign.

TailVaR quantifies the expected value of the loss given that the rate of return is equal to or smaller than $-VaR_\alpha(R_t)$.

Although the Monte Carlo methods are frequently used when computing VaR-family risk measures (c.f. Hull 2009), bootstrap methods are rarely applied. Lin, Wang, and Fuh (2006) introduced a novel approach to estimate the loss probability and developed an algorithm for evaluating VaR that utilizes the bootstrap method. In turn, Mancini and Trojani (2011), applied the bootstrap approach combined with GARCH models estimation.

3. BOOTSTRAP CONFIDENCE INTERVALS

In this section, we shall discuss the basic bootstrap procedure to approximate the distribution of a random variable and present different bootstrap methods to construct confidence intervals.

Let us start with introducing the concept of an empirical distribution function which is crucial for our further discussion. The empirical distribution function (Krzyśko 2004, p. 13) for a sample $\mathbf{X} = (X_1, X_2, \ldots, X_n)^\top$ is a function $F_n : \mathbb{R} \times \mathbb{R}^n \to [0,1]$ defined as

$$F_n(t, \mathbf{X}) = \frac{\#\{1 \leq j \leq n : X_j \leq t\}}{n}, \tag{3}$$

where $t \in \mathbb{R}$, $\mathbf{X} \in \mathbb{R}^n$, and # denotes the number of elements of the set.

Efron (1979, p. 2) introduced the bootstrap method to statistics by applying it to the problem of the approximation of the distribution of a random variable. Let $R(\mathbf{X}, F)$ be a random variable depending on a random sample $\mathbf{X} = (X_1, X_2, \ldots, X_n)^\top$ from a population, where F is the distribution function for population. The bootstrap sample is the random sample $\mathbf{X}^*$ of size n from the distribution of the fixed sample $\mathbf{X}$. The problem is how to approximate the distribution of R using the realizations of sample $\mathbf{X} = (X_1, X_2, \ldots, X_n)^\top$. To solve this problem Efron (1979, pp. 3–4) proposes the following bootstrap procedure:

1. Based on the realization of random sample $\mathbf{X} = (X_1, X_2, \ldots, X_n)^\top$ construct empirical distribution function F_n.
2. Select B independent bootstrap samples $\mathbf{X}^{*1}$, $\mathbf{X}^{*2}, \ldots, \mathbf{X}^{*B}$ from $\mathbf{X}$. B is a big number, e.g., $B = 1000$.
3. For each bootstrap sample and the empirical distribution function F_n, compute the value of random variable $R(\mathbf{X}, F)$. Let $R_1^*, R_2^*, \ldots, R_B^*$ denote the values obtained.

4. Approximate the distribution of random variable $R(\mathbf{X}, F)$ using the bootstrap distribution based on the values $R_1^*, R_2^*, \ldots, R_B^*$.

Let us now focus on different constructions of confidence intervals based on the bootstrap methods. Let θ denote a parameter of population distribution, which we would like to estimate.

3.1. The bootstrap-t confidence interval

The construction of the bootstrap-t confidence interval (Efron and Tibshirani 1998, pp. 153–162) is similar to the constructions of confidence intervals for the expected value based on random variables with normal or Student's t-distributions under the normality assumption. However, we do not make any specific assumption about the distribution of population in this bootstrap method. Given B bootstrap samples, we compute

$$Z_b^* = \frac{\widehat{\theta}_b^* - \widehat{\theta}}{\widehat{se}_b^*},$$ (4)

where $\widehat{\theta}_b^* = s(x^{*b})$, $b = 1, 2, \ldots, B$ is the value of estimator $\widehat{\theta}$ of θ for a given bootstrap sample x^{*b}, and $\widehat{se}_b^*$ is a standard error of this estimator under the bootstrap sample. The distribution of statistic Z_b^* is approximated based on the data by the procedure described above. The α-th quantile $\widehat{t}^{(\alpha)}$ of this distribution is defined as

$$\frac{\#\{Z_b^* \leq \widehat{t}^{(\alpha)}\}}{B} = \alpha.$$ (5)

The bootstrap-t confidence interval with confidence level $1 - 2\alpha$ is as follows

$$\left(\widehat{\theta} - \widehat{t}^{(1-\alpha)} \times \widehat{se}, \widehat{\theta} - \widehat{t}^{(\alpha)} \times \widehat{se}\right).$$ (6)

Note that in the denominator of (4), there is $\widehat{se}_b^*$, which requires an iterated bootstrap to be obtained (Shao and Tu 1995, pp. 131–132), which we shall describe in Section 4. To compute the quantiles, we first have to rank the values Z_b^* in the non-decreasing order. For example, when $B = 10000$, then the 0.05-th quantile is the 500-th ordered value of Z_b^*, while the 0.95-th quantile is the 9500-th ordered value of Z_b^*. When $B \times \alpha$ is not an integer number, computation is a little more complicated. Efron and Tibshirani (1998, pp. 160–161) propose the following method to obtain the quantiles:
1. Compute the largest integer number k such that $k \leq (B + 1) \times \alpha$.
2. The α-th and $(1 - \alpha)$-th quantiles are k-th and $(B = 1 - k)$-th ordered values of Z_b^*.

When $B = 9999$, $k = 500$, since $(9999 + 1) \times 0{,}05 = 500$. Again the 0.05-th quantile is the 500-th ordered value of Z_b^*, and the 0.95-th quantile is the 9500-th ordered value of Z_b^*.

3.2. The bootstrap percentile confidence interval

The bootstrap percentile confidence interval is based on the quantiles of the bootstrap distribution of an estimator (Efron and Tibshirani 1998, pp. 170–176). Like in the case of the bootstrap-t confidence interval, we consider the semi-parametric model. The distribution of estimator $\widehat{\theta}$ is approximated using the Efron procedure described above. Let $\widehat{\theta}_B^{*(\alpha)}$ be α-th quantile of this bootstrap distribution. The bootstrap percentile confidence interval with confidence level $1 - 2\alpha$ is as follows

$$\left(\widehat{\theta}_B^{*(\alpha)}, \widehat{\theta}_B^{*(1-\alpha)}\right). \tag{7}$$

The bootstrap percentile confidence intervals have some advantageous properties such as range preserving and transformation invariance (c.f. Efron and Tibshirani 1998, pp. 173–176). In practice, bootstrap percentile confidence intervals are determined using the method discussed earlier for the bootstrap-t confidence interval.

3.3. The BC_a bootstrap confidence interval

Like the percentile confidence interval, the BC_a bootstrap confidence interval (Efron and Tibshirani 1998, pp. 184–188) is also based on the quantiles of the bootstrap distribution of estimator, but these quantiles are not the α-th and $(1 - \alpha)$-th quantiles. The name BC_a is the abbreviation of bias-corrected and accelerated.

The BC_a bootstrap confidence interval with confidence level $1 - 2\alpha$ is as follows:

$$\left(\widehat{\theta}_B^{*(\alpha_1)}, \widehat{\theta}_B^{*(\alpha_2)}\right), \tag{8}$$

where

$$\alpha_1 = \Phi\left(\hat{z}_0 + \frac{\hat{z}_0 + z^{(\alpha)}}{1 - \hat{a}\left(\hat{z}_0 + z^{(\alpha)}\right)}\right), \tag{9}$$

$$\alpha_2 = \Phi\left(\hat{z}_0 + \frac{\hat{z}_0 + z^{(1-\alpha)}}{1 - \hat{a}\left(\hat{z}_0 + z^{(1-\alpha)}\right)}\right), \tag{10}$$

$\Phi(\cdot)$ denotes the distribution function of the standard normal distribution $N(0, 1)$, and $z^{(\alpha)}$ is the α-th quantile of this distribution. Moreover, $\hat{z}_0$ is a bias-correction of the form

$$\hat{z}_0 = \Phi^{-1}\left(\frac{\#\{\widehat{\theta}_b^* < \widehat{\theta}\}}{B}\right), \tag{11}$$

where $\Phi^{-1}(\cdot)$ is the inverse function of the distribution function of the standard normal distribution. $\hat{z}_0$ measures median bias of $\widehat{\theta}^*$, i.e., the difference between the median of $\widehat{\theta}_b^*$ and $\widehat{\theta}$. On the other hand, the acceleration $\hat{a}$ is defined in the following way

$$\hat{a} = \frac{\sum_{i=1}^{n}\left(\widehat{\theta}_{(\cdot)} - \widehat{\theta}_{(i)}\right)^3}{6\left[\sum_{i=1}^{n}\left(\widehat{\theta}_{(\cdot)} - \widehat{\theta}_{(i)}\right)^2\right]^{3/2}}, \tag{12}$$

where $\widehat{\theta}_{(\cdot)} = \sum_{i=1}^{n} \frac{\widehat{\theta}_{(i)}}{n}$ and $\widehat{\theta}_{(i)} = s(x_{(i)})$, and $x_{(i)}$ is the original sample without i-th observation.

From among the presented bootstrap confidence intervals, the BC_a bootstrap confidence interval has the best properties, i.e., it automatically adjusts the endpoints of the interval due to its transformation-respecting property and is characterized by second-order accuracy, i.e., its error tends to zero at the rate of $1/n$. For comparison, the bootstrap percentile confidence interval also has the first-mentioned property, but it is characterized by first-order accuracy, i.e., its error tends to zero at the rate of $1/\sqrt{n}$. In turn, the bootstrap-t confidence interval is characterized by

second-order accuracy, but it is not automatic due to transformations (Efron and Tibshirani 1998, pp. 187–188). For more on the accuracy of individual types of bootstrap confidence intervals, see Davison and Hinkley (1997, pp. 211–220).

4. METHODS AND DATA

A stock sectoral index is a theoretical portfolio that reflects changes in market valuation of companies that operate in a particular sector of the economy and their shares are traded in the public market. A comparison of the performance of different sectoral indices can form a basis for conclusions on the effectiveness and risk of various sectoral investment strategies. The study includes 14 sectoral indices of the Warsaw Stock Exchange, i.e., WIG-automobiles&parts, WIG-banking, WIG-chemical, WIG-clothes, WIG-construction, WIG-energy, WIG-food, WIG-IT, WIG-media, WIG-mining, WIG-oil&gas, WIG-pharmaceuticals, WIG-real estate, and WIG-telecom.

The data was sourced from the Stooq.pl website. Based on daily closing prices for the time period ranging from 2 January 2017 to 28 June 2019 (620 observations in total for each index) logarithmic rates of return were computed according to the following formula

$$R_t = \ln\left(\frac{P_t}{P_{t-1}}\right), \qquad (13)$$

where P_t is the closing price on day t and P_{t-1} is the closing price on the previous day. We assumed that returns were i.d.d.

The histograms of return for WIG-banking, WIG-construction, and WIG-chemical along with the density function of the normal distribution are presented in Figures 1–3. Empirical distributions tend to have kurtosis larger than the normal distribution. What is more, some asymmetries can be observed.

Figure 1
Histogram of WIG-banking returns
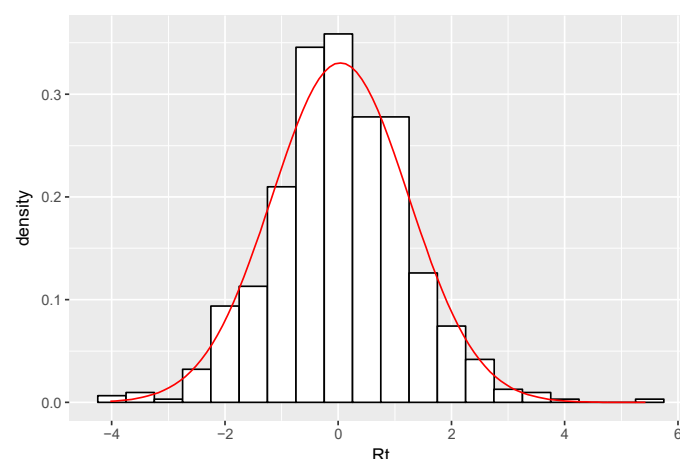
Source: Authors' calculations based on data provided by Stooq.pl

Figure 2
Histogram of WIG-construction returns
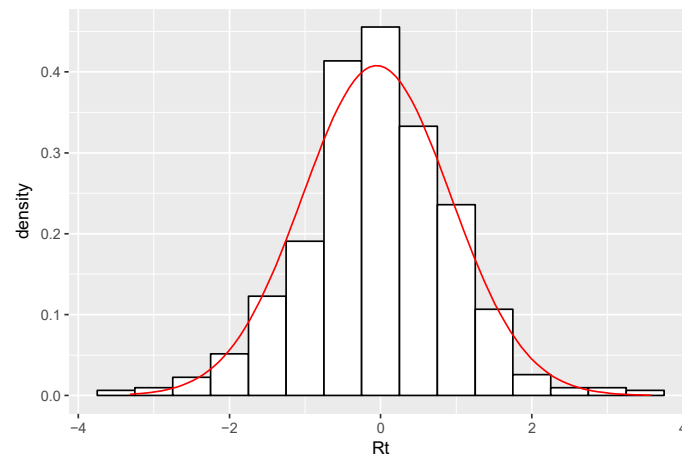
Source: Authors' calculations based on data provided by Stooq.pl

Figure 3
Histogram of WIG-chemical returns
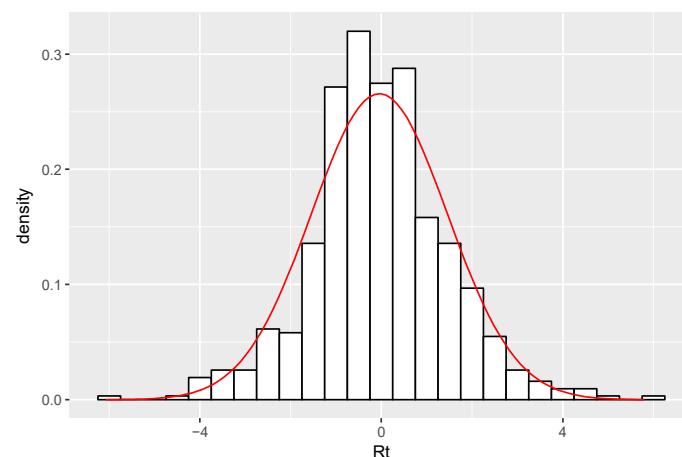
Source: Authors' calculations based on data provided by Stooq.pl

The next step of the study was to compute the 95% bootstrap confidence intervals discussed in the previous section for the Sharpe ratio and TailVaR for all the indices.

1/365 of the reference rate of the National Bank of Poland, which remained unchanged (1.5%) during the whole period of the analysis, was used as a proxy for the risk-free rate, i.e., 0.0041%.

$VaR_\alpha(R_t)$ was computed for probability $\alpha = 5\%$.

With a view to estimating bootstrap confidence intervals for the Sharpe ratio, 2000 bootstrap samples were performed for all the said types of these intervals. As regards the bootstrap-t confidence interval, the number of "nested" replications was also set to 2000. Due to the fact that TailVaR is a parameter the value of which is situated on the left tail of the distribution, 5000 bootstrap samples were used to construct bootstrap confidence intervals (there again 5000 nested bootstrap samples in the bootstrap-t confidence interval). Standard errors were estimated according to the procedure described below.

Let $x = (x_1, x_2,\ldots, x_n)$ be the realization of the random sample $\mathbf{X} = (X_1, X_2,\ldots, X_n)^\top$ from a certain distribution with distribution function F. Based on x, the value of estimator $\hat{\theta} = s(x)$ for $\theta = t(F)$ was computed. To estimate the standard error for the bootstrap estimator, we use (iterated) bootstrap method as mentioned in Section 3. Namely, we first select (with replacement) B independent bootstrap samples $x^{*1}, x^{*2},\ldots, x^{*B}$ from original sample x. Then for each bootstrap sample we compute the value of estimator, i.e.,

$$\hat{\theta}_b^* = s(x^{*b}), \ b = 1, 2,\ldots, B \tag{14}$$

and estimate the standard error $se_F(\hat{\theta})$ by using the standard deviation computed based on B bootstrap samples:

$$se_B = \sqrt{\frac{\sum_{b=1}^{B}\left(\hat{\theta}_b^* - \hat{\theta}^*\right)^2}{B-1}}, \tag{15}$$

where $\hat{\theta}^* = \dfrac{\sum_{b=1}^{B}\hat{\theta}_b^*}{B}$.

5. RESULTS

Table 1 presents the estimates of bootstrap confidence intervals for the Sharpe ratios of 14 sectoral indices created by the Warsaw Stock Exchange. The bounds of different bootstrap confidence intervals are similar for a given index and any pattern of mutual position of confidence intervals of different types is not visible. All the intervals for Sharpe ratios include zero and negative values. This fact is not favourable from the viewpoint of a potential investor. The lower bounds of bootstrap-t confidence intervals range from the level of -0.1448 for WIG-construction up to -0.04 for WIG-real estate. The corresponding numbers for percentile confidence intervals are -0.1343 (WIG-construction) and -0.0393 (WIG-real estate), while for BC_a confidence intervals the range is from -0.1378 (WIG-construction) to -0.0403 (WIG-real estate). The upper bounds of bootstrap-t confidence intervals range from 0.0214 for WIG-construction up to 0.1216 for WIG-real estate. The range for percentile confidence intervals is 0.0263–0.1193, while for BC_a confidence intervals it is 0.0225–0.1186 (in both cases the minimal result refers to WIG-construction and the maximal result is due to WIG-real estate).

In general, the intervals for the following indices have the most advantageous location (i.e., the lower bound is least negative and the upper bound is most positive): WIG-banking, WIG-media, WIG-real estate (the leader), and WIG-telecom. At the other end are confidence intervals for WIG-automobiles&parts, WIG-chemical, WIG-construction, and WIG-food which tend to be worst located.

Table 2 presents the estimates of bootstrap confidence intervals for TailVaR of 14 sectoral indices created by the Warsaw Stock Exchange. Like in the case of the Sharpe ratios, the bounds of different bootstrap confidence intervals are similar for a given index. However, a clear pattern of the mutual position of bootstrap confidence intervals of different types is visible here, i.e. for a given index the percentile confidence interval has the lowest both lower and upper bounds, while the bootstrap-t confidence interval has the largest upper bound. This regularity is observed in all the cases.

The lower bounds of bootstrap-t confidence intervals range from 1.2966 for WIG-real estate up to 3.3013 for WIG-mining. The corresponding numbers for percentile confidence intervals are 1.2741 (WIG-real estate) and 3.2458 (WIG-mining) while for BC_a confidence intervals the

range is from 1.2956 (WIG-real estate) to 3.2937 (WIG-mining). The upper bounds of bootstrap-t confidence intervals range from 1.663 for WIG-real estate up to 4.1422 for WIG-oil&gas. The range for percentile confidence intervals is 1.6049–3.9687, while for BC_a confidence intervals the range is 1.6388–4.066 (in both cases the minimal result refers to WIG-real estate and the maximal result is due to WIG-oil&gas).

From the investor's point of view, the location of the confidence intervals for TailVaR of WIG-real estate seems to be the most favourable, followed by WIG-banking, WIG-construction, WIG-IT, WIG-media, WIG-food, and WIG-telecom. In turn, at the bottom of the ranking are: WIG-chemical, WIG-energy, WIG-mining, WIG-clothes, and WIG-oil&gas.

The results suggest that the real estate sector tends to be the most advantageous from the viewpoint of an investor opting for sectoral investment strategies and focusing on the Sharpe ratio and TailVaR in his or her investment decisions. The portfolio of WIG-real estate index comprises companies that are leading Polish residential and commercial real estate developers.

Table 1
Bootstrap confidence intervals for the Sharpe ratios

Index	Interval type		
	Bootstrap-t	Percentile	BC_a
WIG- automobiles&parts	(-0.1244, 0.0364)	(-0.1278, 0.0300)	(-0.1245, 0.0344)
WIG-banking	(-0.0516, 0.1043)	(-0.0510, 0.1048)	(-0.0506, 0.1055)
WIG-chemical	(-0.1065, 0.0415)	(-0.1085, 0.0445)	(-0.1077, 0.0462)
WIG-clothes	(-0.0705, 0.0885)	(-0.0739, 0.0860)	(-0.0689, 0.0884)
WIG-construction	(-0.1448, 0.0214)	(-0.1343, 0.0263)	(-0.1378, 0.0225)
WIG-energy	(-0.0936, 0.0643)	(-0.0993, 0.0591)	(-0.0951, 0.0627)
WIG-food	(-0.1231, 0.0388)	(-0.1270, 0.0358)	(-0.1271, 0.0352)
WIG-IT	(-0.0683, 0.0894)	(-0.0657, 0.0914)	(-0.0655, 0.0917)
WIG-media	(-0.0596, 0.1039)	(-0.0621, 0.1009)	(-0.0580, 0.1041)
WIG-mining	(-0.0786, 0.0812)	(-0.0805, 0.0784)	(-0.0793, 0.0796)
WIG-oil&gas	(-0.0643, 0.0959)	(-0.0635, 0.0941)	(-0.0621, 0.0957)
WIG- pharmaceuticals	(-0.0758, 0.0797)	(-0.0778, 0.0774)	(-0.0812, 0.0760)
WIG-real estate	(-0.0400, 0.1216)	(-0.0393, 0.1193)	(-0.0403, 0.1186)
WIG-telecom	(-0.0546, 0.0980)	(-0.0590, 0.0943)	(-0.0599, 0.0929)

Source: Authors' calculations based on data provided by Stooq.pl

Table 2
Bootstrap confidence intervals for the TailVaR (in %)

Index	Interval type		
	Bootstrap-t	Percentile	BC_a
WIG-automobiles&parts	(2.3443, 3.7028)	(2.2700, 3.3284)	(2.3716, 3.6442)
WIG-banking	(2.2398, 2.8714)	(2.2019, 2.7603)	(2.2498, 2.8217)
WIG-chemical	(3.0226, 3.8796)	(2.9956, 3.7765)	(3.0496, 3.8501)
WIG-clothes	(3.0152, 3.6273)	(2.9645, 3.5496)	(3.0159, 3.6052)
WIG-construction	(2.0220, 2.5556)	(1.9822, 2.4642)	(2.0237, 2.5164)
WIG-energy	(3.1658, 4.0965)	(3.0961, 3.9571)	(3.1633, 4.0541)
WIG-food	(1.8576, 2.4104)	(1.8395, 2.3396)	(1.8699, 2.3845)
WIG-IT	(2.0403, 2.6405)	(1.9959, 2.5603)	(2.0477, 2.6145)
WIG-media	(1.9022, 2.7181)	(1.8626, 2.5051)	(1.9174, 2.6335)
WIG-mining	(3.3013, 3.9116)	(3.2458, 3.8214)	(3.2937, 3.8949)
WIG-oil&gas	(3.2130, 4.1422)	(3.1552, 3.9687)	(3.2223, 4.0660)
WIG- pharmaceuticals	(2.7954, 3.5016)	(2.7257, 3.3880)	(2.7789, 3.4405)
WIG-real estate	(1.2966, 1.6630)	(1.2741, 1.6049)	(1.2956, 1.6388)
WIG-telecom	(2.2661, 2.9437)	(2.2256, 2.8545)	(2.2770, 2.9072)

Source: Authors' calculations based on data provided by Stooq.pl

6. CONCLUSIONS

The main goal of this paper was to demonstrate how to use an alternative approach, i.e., bootstrap methods, to evaluate investment effectiveness and risk based on confidence intervals for the Sharpe ratio and TailVaR. We assumed that returns are i.i.d. The aim of the paper was achieved over two stages. First, the construction and properties of three types of bootstrap confidence intervals were discussed. Then, we demonstrated how to use them in practice for assessing an investment opportunity.

The results of the research can serve as a reference for other researchers investigating methods of estimating various investment effectiveness and risk measures. What is more, the results of the analysis of the bootstrap confidence intervals for the Sharpe ratios and TailVaR of the Warsaw Stock Exchange sectoral indices deliver a clear assessment of their performance, which can be useful for all the researchers and practitioners interested in the Polish capital market performance and investment strategies.

To sum up, the implicit advantage of using bootstrap confidence intervals (non-parametric bootstrap) is that it does not require making any assumptions about the shape of the distribution, and thus the universality of the approach.

On the other hand, the approach presented in this paper requires i.i.d. assumption. Moreover, in general the bootstrap method is computationally expensive.

The considerations presented in this paper can serve as a starting point for further analysis on the theoretical basis and practical possibilities of using bootstrap methods in assessing the effectiveness and risk of investment opportunities. The analysis can by expanded to other types of effectiveness and risk measures, as well as point estimation.

References

Auer B.R., Schuhmacher F. (2013) Robust Evidence on the Similarity of Sharpe Ratio and Drawdown-based Hedge Fund Performance Rankings. *Journal of International Financial Markets, Institutions and Money* 24, pp. 153–165. https://doi.org/10.1016/j.intfin.2012.11.010.

Chaudhry A., Johnson H.L. (2008) The Efficacy of the Sortino Ratio and Other Benchmarked Performance Measures Under Skewed Return Distributions. *Australian Journal of Management* 32, pp. 485–502. https://doi.org/10.1177/031289620803200306.

Cont R. (2001) Empirical Properties of Asset Returns: Stylized Facts and Statistical Issues. *Quantitative Finance* 1, pp. 223–236. https://doi.org/10.1080/713665670.

Davison A.C., Hinkley D.V. (1997) *Bootstrap Methods and Their Application*. Cambridge: Cambridge University Press.

Efron B. (1979) Bootstrap Methods: Another Look at the Jacknife. *The Annals of Statistics* 7, pp. 1–26.

Efron B., Tibshirani R.J. (1998) *An Introduction to the Bootstrap*. Boca Raton: Chapman & Hall/CRC Press.

Fama E.F. (1965) The Behavior of Stock Market Prices. *Journal of Business* 38, pp. 34–105.

Hodges Ch.W., Taylor W.R.L., Yoder J.A. (1997) Stocks, Bonds, the Sharpe Ratio, and the Investment Horizon. *Financial Analysts Journal* 53, pp. 74–80. https://doi.org/10.2469/faj.v53.n6.2132.

Hull J.C. (2009) *Options, Futures, and Other Derivatives*. New Jersey, Upper Saddle River: Pearson Prentice Hall.

Jarno K. (2019) Bootstrap methods and their application to confidence intervals. Bachelor's thesis defended in Mathematics. Adam Mickiewicz University, Poznań.

Krzyśko M. (2004) Statystyka Matematyczna. Poznań: Wydawnictwo Naukowe UAM.

Ledoit O., Wolf M. (2008) Robust Performance Hypothesis Testing with the Sharpe Ratio. *Journal of Empirical Finance* 15, pp. 850–859. https://doi.org/10.1016/j.jempfin.2008.03.002.

Lin S.-K., Wang R.-H., Fuh C.-D. (2006) Risk Management for Linear and Non-Linear Assets: A Bootstrap Method with Importance Resampling to Evaluate Value-at-Risk. *Asia-Pacific Financial Markets* 13, pp. 261–295. https://doi.org/10.1007/s10690-007-9042-0.

Lo A.W. (2002) The Statistics of Sharpe Ratios. *Financial Analysts Journal* 58, pp. 36–52. https://doi.org/10.2469/faj.v58.n4.2453.

Mancini L., Trojani F. (2011) Robust Value at Risk Prediction. *Journal of Financial Econometrics*, 9, pp. 281–313. https://doi.org/10.1093/jjfinec/nbq035.

Mandelbrot B. (1963) The Variation of Certain Speculative Prices. *The Journal of Business*, 36 pp. 394–419. http://dx.doi.org/10.1086/294632.

Pilotte E.A., Sterbenz F.P. (2006) Sharpe and Treynor Ratios on Treasury Bonds. *The Journal of Business* 79, pp. 149–180. http://dx.doi.org/10.1086/497409.

Riondato M. (2018) *Sharpe Ratio: Estimation, Confidence Intervals, and Hypothesis Testing*. Two Sigma Technical Report 2018-001.

Rachev S.T., Menn Ch., Fabozzi F.J. (2005) *Fat-Tailed and Skewed Asset Return Distributions: Implications for Risk Management, Portfolio Selection, and Option Pricing*. New York: John Wiley & Sons.

Shao J., Tu D. (1995) *The Jackknife and Bootstrap*. New York: Springer-Verlag.

Sharpe W.F. (1966) Mutual Fund Performance. *The Journal of Business* 39, pp. 119–138. http://dx.doi.org/10.1086/294846.

Scherer B. (2004) An Alternative Route to Performance Hypothesis Testing. *Journal of Asset Management* 5, pp. 5–12. https://doi.org/10.1057/palgrave.jam.2240123.

bKash *vs.* Bank-led Option:
Factors Influencing Customer's Preferences
– Does it Warrant *Voluntary-Insurance*-Policy
for Rapid-growth Digital-banking
in Bangladesh-economy?

Akim M. Rahman[1]
Canadian University of Bangladesh, Dhaka, Bangladesh
Email: akim_rahman@hotmail.com
https://orcid.org/0000-0002-8162-555x

ABSTRACT

In today's *technology-driven* world-economy*,* banking-services have been modernized where customers compete for comparative time-saving-options. Bangladesh, a developing country, is no exception. Besides traditional banking, Agent-banking, bKash, Western-Union etc. serve new-way financial-services. But, in *21st-Century* business-mentality *era*, many factors are unpredictable. Strict laws & application can marginalize the magnitudes of *Perceived-risk* where developed countries are ahead of developing countries. But it does not guarantee risk-free digital-transaction where developing countries are vulnerable. It might have led a slower growth of digital-banking in countries like Bangladesh. Dealing with determinant *Perceived-risk*, current author proposed *Voluntary-Insurance* policy (Rahman, 2018) that deserves to be scrutinized. Using Factor Analysis and Hypothesis Testing on customers' opinions helps identifying factors that have undermined the growth-trend of bank-led digital. Attributes "Phone call confirmation" has influenced customer's preference using bKash. "No transaction fee" has influenced using bank-led digital. Addressing risk-factors, *Voluntary-Insurance* in place can ensure secured digital-banking that can enhance growth of usages digital-banking.

JEL Classification: C0, C1, C4, D0, D1, D9

Keywords: Bank-led digital, digital-transaction, bKash, *Voluntary Insurance*, digital-banking, percived risk-factor

1. INTRODUCTION

In today's world of *technology-driven society and human-connectivity era*, service sector has been expanded and modernized vigorously. Here people rationally behave without emotion. Thus an effective utilization of IT, *especially*, ICT advancement can play significant roles in

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market-competition on promoting new products of service-sector for sustained revenues. This new and increasing value is what will keep service-sector, *especially*, banking-sector is growing in many countries such as Bangladesh.

Underpinning the *motto*, financial, *especially*, banks sector is no exception where digitized or On-the-Go banking in multi-faucets is known to be the *latest* product (Tan and Teo, 2000). In this development, besides traditional banking, bKash, Ucash and Paypal, Western Union and business-cards etc. are few names that serve new way financial services globally. No matter whether customers use bKash or bank-led digital services, customers are competing for a comparative time-saving-option. On the same token, service-providers are competing for comparative option that can effectively marginalize its operating costs (Rahman, 2018).

With win-win prospect, the trend of digital-banking is currently growing faster than ever before in countries such as Bangladesh. Here bKash is dominating the trends, *despite* the fact there is a rapid growth of phone-facilitated-Internet usages with comparatively lower prices. Secondly, in-spite of ICT facilitations, bank-led digital banking has been increasing geometrically in developed countries. In *contrast*, bank-led users in developing countries such as Bangladesh have been moving cautiously and in slow phase where Agent-banking is the latest addition. This dual *dilemma* raises question: why so?

Answering the question posed, literature suggests that adaptation of On-the-Go banking has been a challenging issue for banks in many countries (Karjaluoto *et. al.*, 2002). Countless customers are not still using it due to important factors such as *lack of know-how* and *perceived risks involved* etc. (Rahman, 2018; Clemes *et al.*, 2012; Lee, 2009; Fichtenstein *et al.*, 2006). Findings identify the "perceived risk" as having significant and direct negative effects on customers' adaptation of On-the-Go banking (Lee, 2009; Kuisma, Laukkanen and Hiltunen, 2007; Polatoglu and Ekin; 2001; Tan and Teo, 2000).

Since we live in a world of business-mentality where many factors are often unpredictable, it is *palatable* saying – strict laws & its fullest application can marginalize the magnitudes of "perceived risk". On this matter, in today's world, developed countries are doing better and ahead of developing countries. But it does not guarantee an absolute risk-free On-the-Go banking even in developed countries. On risk issue, developing countries are vulnerable, which might have led a slower growth of bank-led On-the-Go banking in countries such as Bangladesh where mobile-led payment (bKash), is dominating trends of On-the-Go banking (Rahman, 2018).

In aim to deal with the determinant "perceived risk", current author has proposed in literature a proposal – *Voluntary Insurance* in banking services (Rahman, 2018). Under the proposal, bank will introduce "Voluntary Insurance" as a new product in digital-banking-services (Rahman, 2018) where customers will decide buying or not buying it. The proposal is deserved to be scrutinized empirically on how the customers feel about it.

Since bKash dominates the current trends of digital banking in Bangladesh, this *lesson-learnt* comparison study is used to scrutinize the proposal using opinion-survey of customers who are using On-the-Go banking in countries such as Bangladesh. It begins with carrying out factor-analysis of bKash and bank-led digital banking side-by-side. The findings of this study should be educational enhancing the growth of bank-led usage digital banking in world-economy country-wise such as Bangladesh, which can be an impetus for policy-adoption in a nation that wants to enjoy risk-free On-the-Go banking no matter where they reside.

2. LITERATURE REVIEW

In today's banking, beside traditional-banking along with digital-banking services, new financial institutions such as bKash, Western Union and Alternative Delivery Channel (ADC) products have rapidly been growing (Lallmahamood, 2007; Rahman, 2018). In this progression,

today we see only digital-banking branches with limited or full banking-services in many developed countries (Rahman, 2018; balance.com). In full service digital-banking branches, customers can meet all its needs just like any traditional banking setup. Developing these distributional channels in banking services is now crucial in reducing operating costs, improving competitiveness in financial market and retaining exiting & attracting new customers. However, with ICT advancement, banking services are now carried out in a multifaceted, competitive and rationality manner that is characterized by evolving many factors that are often unpredictable. It faces serious pitfalls being it riskiness. It has caused extracting various hidden charges in the name of e-banking service charges through many bank branches globally. As reported by newspaper: the Financial Express (2016) banks sector in Bangladesh is no exception and is not free from this accusation of hidden or extra charges. Bangladesh Bank (BB) received 3,930 complaints from customers of the PCBs and non-banking financial institutions in FY 2015 against 4,476 in FY 2014. The highest numbers of complaints were received against PCBs that accounts 55.98 percent of total complaints (The Financial Express, 2016).

It is worthwhile noting that customers' accounts' money or deposits in bank accounts are insured by provisions in most developed and developing countries. However, customer's digital-services, transactions etc. are not covered. For example, customers' bank deposits are protected by Bank Deposit Insurance Act-2000 or Bank Amanat Bima Ain 2000 in Bangladesh. Under this act, all scheduled banks including foreign banks operating in Bangladesh are brought under the provision. But it does not cover perceived-risk evolved from On-the-Go banking system. This provision is very common and it is no different in banking system in other countries' either. On the same token, several empirical studies identify perceived risk as having a significant negative and direct effect on consumers' adoption of On-the-Go banking (Lee, 2009; Kuisma *et. al.* 2007; Polatoglu and Ekin; 2001; Tan and Teo, 2000). The security/privacy risk, as one of the main dimensions of perceived risk, appears to be the most inhibiting factor in the adoption of On-the-Go banking (Lee, 2009; Rotchanakitumnuai and Speece, 2003).

Addressing the *dilemma* in financial sector globally, the current author proposed in literature (Rahman, 2018) having "Voluntary Insurance" as a product of banking sector in operation. This addition to behavioral intention theories in literature, *especially*, literature in subject area of *entrepreneurship and innovation management* is now well recognized. But for policy-adoption purposes, policy-practitioners may prefer to know how bank-customers feel about it. Thus this study focuses on factor "perceived risk" and the policy-option "Voluntary Insurance" recommendation using opinion-survey of On-the-Go banking customers. Here Bangladesh-economy is chosen as a case study where its GDP is over 7.50 percent, which is one of the highest growth rates in world-economy for many years now.

3. OBJECTIVES OF THE STUDY

The primary objective of this study is to cross-examine current author's earlier proposal "Voluntary Insurance" (Rahman, 2018), using customer's opinions. The objectives are:
1. To identify & categorize feature / factor(s) that has impact on preferences using bKash or bank-led option when a customer faces decision choice in completion digital banking
2. To examine how the focal option influences customer's decision when customer faces bKash or bank-led option in completion digital banking needs
3. To examine how customers feel about having *voluntary insurance* policy in place for ensuring risk-free digital-banking in a nation's economy such as Bangladesh-economy.

4. ELABORATION OF CONCEPTS FOR BETTER UNDERSTANDING

4.1. On-the-Go or Digital-banking: What is it?

Bank-led payment or mobile-led payment or a combination of the two is known as "On-the-Go or digital banking in today's world-economy of business-mentality where people behave rationally without emotion. For further clarity, by using a computer or mobile device, On-the-Go banking involves managing bank accounts, transferring funds, depositing checks and paying bills etc. Most banks and credit unions, beside traditional services, let customers access their bank accounts *via* the internet. Online bank branch, on the other hand, is typically one that customer access only through the internet, which may facilitate all services or a part of it. On the same token, mobile banking typically operates across major mobile providers in a country through one of two ways: SMS messaging and Mobile Web. It is similar to online account access from a home-based computer or mobile-phone. This option allows for checking balances, bill payment and account transfers simply by logging into the user's account.

4.2. bKash, Ucash, Paypal and other alternate banking such as bank-card business etc.: Few names that help new way financial services

Like in many countries, today world-economy, *especially*, banks sector is operated providing services in multi-faucets meeting customers' needs. Besides bank branches, the *bKash, Ucash and Paypal and alternate banking such as card-business etc.* are the latest of the progression where customers use them for banking-services no matter where they reside. For example, bKash and many in Bangladesh act as a catalyst for economic development of unbanked population by providing banking-services.

Alternative delivery channel (ADC) in digital banking services

Beside this progression, at present, Bangladesh Bank (BB) has also undertaken a multi-faucet projects in building up modern payment automation infrastructure (Amin, 2018) where Bangladesh Automated Clearing House (BACH) is the *latest*. It has replaced traditional system of clearing bank drafts, checks, pay orders etc. with automated system. Under non-cash payment instruments various ATM cards as credit card, debit card transactions are popular, especially in the urban areas (BB, 2017). Currently, 51 banks are operating card business in Bangladesh. Here interbank ATM transactions of 49 banks and POS transactions of 39 banks are being routed through National Payment Switch Bangladesh (NPSB).

However, it is an undeniable fact that certain negative practices of digital-banking are committed by internet criminals and fraudsters due to the ignorance of both bankers and customers (Harris & Spencer, 2002). So security concern is one of the major obstacles in electronic banking (Feinman *et al.*, 1999). Cyber security, IP protection and real time payments will likely be the top risks. These are the common *scenarios* of banking sector in world-economy.

4.2.1. bKash: What is it? Why is it?

Bangladesh is a *three-tire*: rural, urban and city based country with 70% of its population resides in rural areas where the access to formal financial services is difficult. But these are the people who are in most need of such services, either for receiving funds from loved ones in distant locations. These people are needed a safe convenient and affordable means of transferring money to and from the cities to the villages. So Brac, the biggest NGO, has come up with the idea of mobile banking in *parallel* to bank-led digital-banking where less than 15% of Bangladeshis are

connected to the formal banking system. However, over 68% of the population of Bangladesh has mobile phones. Taking advantage of mobile-phone popularity & affordability, Brac introduced bKash Ltd. in year 2010.

The ultimate objective of bKash is to ensure access to a broader range of financial services for the people of Bangladesh. It has focused to serve low-income general people of the country by providing services that are reliable, convenient and affordable. Mobile banking is the perfect platform for Bangladesh to take financial services to the country's largely unbanked population in an efficient and low-cost manner. The most common product offerings of MFS includes account opening, cash-in, cash-out, money transfer, bill payment, salary disbursement, foreign remittance and the like. Underpinning the theme of *entrepreneurship and innovation management*, BB introduced efficient off-branch Mobile Financial Services (MFS) in 2011. Since then, MFS has seen exponential growth due to the proliferation of low-cost mobile phones and increasing network coverage throughout the country. However challenges such as digital literacy, limited competition and security concerns remain an issue in taking the next step towards greater financial inclusion (Fin Tech Magazine, 2017). In 2017 there were 58.6 million registered customers in total, however, only 23.1 million are active (Bangladesh Bank, 2017)

4.2.2. How does bKash work?

With service fees, bKash provides MFS allowing customers to send, receive, and pay money using their mobile phones or thru agents. Send and receive money, or make payments the fastest way. bKash enables customers to send money to anyone using an advanced technology available on his or her own mobile phone. The recipient can receive money instantly bKash agent or by having own bKash account. Even if customer does not have the required amount in his or her bKash account, someone else can easily send him or her amount in times of needs.

4.2.3. How secure is bKash in operation?

As a service-provider, bKash promises its user's benefits such as fast, affordable, secure, convenient and nationwide. On security issue, here every transaction is based on personal identification number (PIN) which is secured as claimed. By terms & conditions, any incorrect transactions in using bKash, all responsibilities lie with the customer or sender. This is because the customer himself or herself inputs the recipient's account number and amount of money and also s/he confirms the transaction by providing the PIN. Similarly, if customer uses agent-help transaction, bKash has no authority to reimburse the customer without any direction of the court, or the consent of the recipient. Service charges will be deducted from sender account balance. If a customer uses a bKash-agent, then cost can be paid instantly or it can be deducted from recipient's payment. Customer faces same *dilemma* in reality, if there is any *error* or misuse.

4.3. Perceived risks in digital-banking: What is it?

The concept of risk is organized around the idea that customer behavior involves risk in the sense that any customer action may produce consequences that they can not anticipate with anything approaching certainty (Bauer, 1967). Perceived risk is powerful in explaining a customer's behavior because customers are more often motivated to avoid mistakes than to maximize utility using digital-banking (Mitchell, 1999; Rahman, 2018). Risk is often present in choice situation as customers cannot always be certain that a planned uses of digital-banking will achieve satisfactory goals. Online shoppers perceive greater risk when paying Online bills even though goods are non-standardized and often sold without warranties (Zeithaml, 1981; Murray *et al.*, 1990). Underpinning today's reality, perceived risk is regarded as being a composite of

several categories of risk. Eight types or components of perceived risk in case of digital banking have been identified (Featherman and Pavlou, 2003; Lee 2009) in literature. They are

i) Security / privacy risk

It is a kind of threat where a fraud or hacker may get unauthorized access to online-bank user's account and acquire sensitive information such as username, password, credit card / debit card information etc. and misuse it. Overall, system reliability is an important.

ii) Financial risk

It is a kind of threat where monetary loss could take place due to transaction error or bank account misuse.

iii) Performance risk

It is a kind of annoying where unexpected breakdown or disconnection from the Internet can take place.

iv) Psychological risk

It is a kind of threat when something goes wrong with Internet banking transaction and customer feels frustrated. Also sometime customer feels shamed

v) Customer dispute

It refers to the possibility of getting into dispute with digital-service-providers or Online seller or with individual or group that has caused the problem. It may warrant legal cases.

vi) Social risk

It refers to the possibility that using Internet banking may result in the disapproval of one's family, friends or work group (Lee, 2009). It happens when family member or friend or work group signed on as the guarantor.

vii) Time risk

When using Internet and completing transaction takes unexpected longer time or server down, then customer become frustrated losses time. On scheduled payment issues, sometime customers are penalized for late transaction completion.

viii) Alternative delivery channels – Credit card or ATM card or Dual currency card or Cash by code or PIN fraud

5. VOLUNTARY INSURANCE IN DIGITAL-BANKING

Under Voluntary Insurance Program, customer's participation is absolutely voluntary and insurance will be attached to customer's account, if customer wants it. Under the program, the bank will take *extra* measures for ensuring risk-free on-the-go banking services. For example, ATM Card or Credit Cards can be protected by setting two identifications such as password and a finger-scan. Suppose, a customer wants to use ATM card where in order to access his account, the customer will have to use two identifications namely own setup password and previously chosen finger-scan say his thump or forefinger scan. Here finger scan in addition to password can be connected to the ATM system, which will make the on-the-go banking services to be enhanced secure. In aim to overcome the risk of heist or hacker's access to bank accounts, under the proposal, similar own set up identifications can be used. In global banking cases such as remittances, a third party can introduce the program and provide services so risk-free on-the-go or digital banking can be ensured.

Under the proposal, bank sector will introduce it as a product of bank-services. Transferring risk away from customer will benefit both PCBs and bank-customers. This product can attract new customers who were on the brink using digital banking but just felt it was too risky. This model can facilitate the parties involved for increasing usage of on-the-go banking-services while customers can maintain optimal utility of usages.

5.1. The economics of *Voluntary Insurance* in Digital-banking

It is clear now perceived-risk factor plays an influential role in setting the stage for the proposal, *Voluntary Insurance Option in On-the-Go banking services*. It is palatable to assume that On-the-Go banking-customers are risk-averse, *i.e.*, they prefer certainty to uncertainty when it come banking. Figure 2 illustrates the risk preferences of a risk-averse banking-customer.

In a world of uncertainty, a customer's actual utility that he receives from digital services will never fall on the TU (X) but rather on the chord (the bold line) as shown in Figure 1. X_g, in Fig. 1, represents a service outcome in which customer may use a certain level of service X while X_f represents a negative outcome in which customer may use less of service X. As long as there is a level of uncertainty that a customer may not use X_g units of service X, the utility that this customer receives will lie somewhere on the chord (the bold line) in figure 1. Here the chord represents expected utility (EU) of using service X, which lies in the concavity of the curve because it is the average probability that the customer will use service X or not. As a result, an individual will never receive TU (X_a) but rather EU (X_a).

Figure 1
Risk Aversion Scenario

⇨ Service X (Modern) (On-the-go banking)
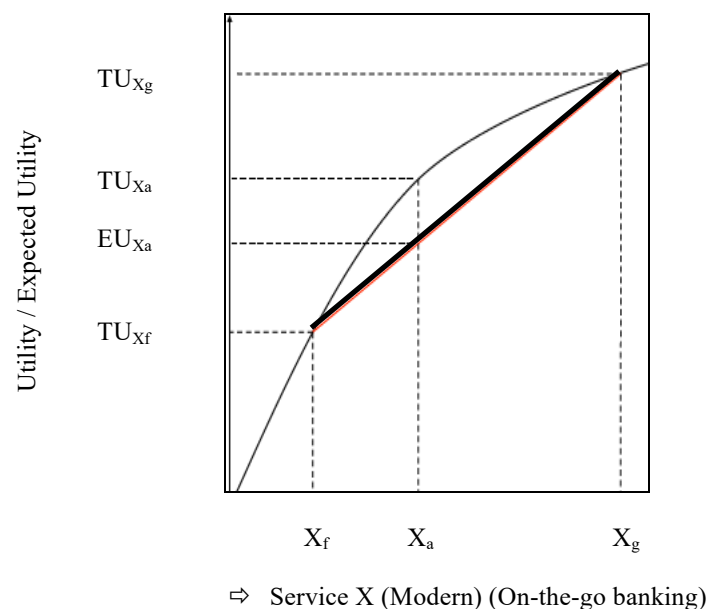
Source: (Rahman, 2018).

5.2. Why it is essential? Why now?

Some customers may not use the On-the-go banking-services simply because they do not want to or they are not obligated to do because of, I would say, inherent risk involvement using the services. This is *especially* true for the relatively new and older aged traditional minded customers. This is because they may not have skills in using the services that more young generation have. Secondly, the Financial Express (FE) (2016) reported in its news-page that there was a growing number of complaints relates to digital banking. It concluded that these complaints have been undermining the progression of digital banking and causing huge monetary losses and making the approach to be inefficient in operation. As a result, it is essential that a system be instituted that will give customers a sense of enhanced security for increased digital banking services. The fact is that insurance was developed as a way of transferring the risk away from its premium-payers. The primary goal of insurance is to provide the premium-payers with a sense of certainty, which is

almost always preferred to uncertainty. With the maxim of an insurance program, implementation of the proposed model: *voluntary insurance program* can ensure an enhanced security of digital banking services no matter what country or economic system we live in.

Thus, as a foundation, the proposal is expected to be helping all users including new ones to achieve its optimal utilization, which will allow them to grow. On the same token, it can ensure a significant contribution to economic growth with win-win slogans of parties involved. The proposal facilitates a new product in market-system in world-economy where customers will have choices to purchase it or not when they open their bank accounts.

6. MOBILE-LED VS. BANK-LED TRANSACTIONS: A COMPARISON

A comparison between bKash option, *mobile-led transaction* and bank-led option, *bank-led transaction*, in digital banking services, is carried out to identify factors that has resulted a higher trend of usage of bKash than that of bank-led option in Bangladesh. More specifically, the outcome of this comparison is assumed to be served as a *lesson* or *lesson learnt* for better understanding of factors that has resulted a higher trend of bKash usage in Bangladesh.

Like bank-digital-services, bKash promises its users to make life easier & comfortable by offering attractive service-products. A customer can open bKash account for self-services whenever s/he wants it. *Alternatively*, customer can go to bKash-agent for services. In both cases, customer is charged service-fees for each transaction. Currently charging rate is TK 20.00 per TK 1000.00 no matter whether it self-service or bKash-agent services. However, in case of bank-led digital-services, customer is required to access by himself or herself, which requires some sort of proficiency using Internet where payment clearance can be time consuming. Here transaction is absolutely *free of charge*, which is different from bKash. In Bangladesh, bKash serves more than three crore customers. There are over two lacs bKash-agents located around Bangladesh. In comparison of usages, the trend of bKash is growing geometrically. However, trend of usage of bank-led option is growing *mathematically* – very slowly, despite the fact that bank sector promotes it desperately curtailing the magnitudes of its operating cost. This *dilemma* raises question: why so?

To answer the question posed, this section begins with comparing two options namely bKash and bank-led digital based on its attributes so that customer's preferences in choices can be understood. It can further be instrumental in diagnosis on the issue whether perceived-risk factor has overall played significantly undermining the growth of the trend of bank-led digital banking. Since both options have feature SMS, this study ignores using the SMS feature in aim to narrow down the size.

Also, in Table 1 A: indicates features of bKash and bank-led Digital where (+) sign indicates that corresponding feature positively influences customer's preference for the corresponding option. Conversely, (–) sign indicates corresponding feature negatively influences customer's preference for corresponding option. In comparison, features of bKash vs. bank-led Digital in Bangladesh-economy are spelled out in Table 1 where (+) sign indicates that the attribute positively influences customer's preference for the corresponding option. Conversely, (–) sign indicates that the attributes negatively influences customer's preference for the corresponding option.

Table 1
Attributes Comparison of bKash *vs.* bank-led Digital Banking

Determinants or features	bKash digital banking	Influence	Bank-led-digital	Influence
Transaction fees (TF)	Yes	(−)	No	(+)
Access Internet (AI)	Not necessary	(+)	Yes necessary	(−)
Know-how-skill (KS)	Very rare	(+)	Yes	(−)
Agent services (AS)	Yes (if needed)	(+)	No (if needed)	(−)
Bonus (Bo)	No	(−)	Yes	(+)
Ph-call-confirmation (PC)	Immediately, if wanted	(+)	Not immediately	(−)
Perceived risk	Very low	(+)	High	(−)
Security risk (SR)	No	(+)	Yes	(−)
Privacy risk (PR)	Yes (agent on Trans)	(−)	No	(+)
Financial risk (FR)	Unless sender's errors	(+)	Yes	(−)
Performance risk (P-R)	Very low	(+)	Yes net down	(−)
Psychological risk (PsR)	No	(+)	Yes	(−)
Social risk (SoR)	No	(+)	Yes	(−)
Knowledge required (KR)	Somewhat	(+)	Yes	(−)
Self image (SI)	Low	(−)	High	(+)

Source: Author's assessment & design.

7. METHODS AND DATA COLLECTION

The survey *questionnaire* in this study was designed to carry-out Factor Analysis and then develop Hypotheses and test them in choice problem: whether bKash or bank-led digital, when a customer is decided to go with On-the-Go banking. It is expected that the Factor Analysis identifies feature(s) of two options (bKash and bank-led) and then categorize its position for comparison based on its importance in customers' preferences. In Testing Section, hypotheses are developed and then used the collected data for statistical testing.

This study used both types of data, primary and secondary. The primary data was collected through a structured questionnaire. Whereas, secondary data was collected from books, textbooks, online articles, journals, etc. The number of participants in the survey was total 200 where all of them were users of On-the-Go banking – using either bKash or bank-led or both of the options. Participants were randomly chosen with the *criterion*: whether they use On-the-Go banking services. It was a face-to-face interview and the questionnaire was given to the intended participant who meets the *criterion*.

For Factor Analysis, Likert five – point scale was used with (1-Excellent, 2-Good, 3-Average, 4-Poor, 5-Very Poor) of each feature as identified above. Here data are separately tested for its appropriateness for factor analysis.

For hypothesis development & testing, respondents were informed that they would be presented alternatives and asked to indicate their preferences based on feature(s) of options. It was emphasized that there was no right or wrong answer. The researcher was interested only in "personal preference" of the participants. Then the scale that was later used for measuring the relative attractiveness of the alternatives was explained briefly.

7.1. Factor analysis

In comparative exploratory factor analysis, feature(s) that significantly contributes to the growth-trends of bKash and of bank-led digital-banking in Bangladesh-economy are identified. Here Factor Analysis is used as a technique to reduce number of features and then categorized based on its positions for both options. The statistical tools SPSS and Excel were used for data analysis.

In this analysis, number of features or factors is determined by Eigenvalues (E_v). If calculated $E_v > 1$, it considers the corresponding factor and if $E_v < 1$, corresponding factor is not considered. According to Variance Extraction Rule, it should be more than 0.7. If variance is less than 0.7, then we should not consider that a factor. The KMO and Bartlett's Test was used to check appropriateness of factor analysis, here results of reliability was considered bigger than 0.7. And Bartlett's Test of Sphericity was less than 0.05. The following table shows the KMO and Bartlett's Test conducted for the present study

Table 2
KMO and Barlett's Test

KMO and Barlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.88
Barlett's Test of Sphericity	Chi-square approx	1138.081
	df	36
	Significance	0.000

Source: Author's calculation.

According to results obtained from Table 2, KMO is 0.88 which is above the acceptable level, which approves the appropriateness of this analysis for the study (Kaiser, 1974).

Table 3
Total Variance where "Vari" and "Cum" denote variance and cumulative respectively

Total Variance Explained													
bKash digital							Bank-led digital						
Factor/feature	Initial Eigenvalues			Extraction sums of squared loadings			Factor/features	Initial Eigenvalues			Extraction sums of squared loadings		
	Total	% vari	% cum	Total	% vari	% cum		Total	% vari	% cum	Total	% vari	% cum
PC	1.991	22.127	22.127	1.991	22.127	22.127	TF	2.947	35.864	35.864	2.947	35.864	35.864
AS	1.448	16.090	38.217	1.448	16.090	38.217	Bo	1.210	14.725	50.589	1.210	14.725	50.589
KS	1.125	12.499	50.716	1.125	12.499	50.716	SI	1.00	12.169	62.578	1.00	12.169	62.578
AI	1.880	12.005	62.740	1.880	12.005	62.740	KS	0.661	8.044	70.802	0.661		
PR	0.970	10.783	73.523				AI	0.625	7.606	78.408	0.625		
SR	0.693	7.704	81.227				AS	0.525	6.389	84.797	0.525		
PsR	0.666	7.361	88.588				PR	0.456	5.549	90.346	0.456		
Bo	0.562	6.243	94.831				SR	0.432	5.257	95.603	0.432		
TF	0.465	5.169	100				PC	0.361	4.393	100	0.361		

Source: Author's calculation.

From Table 3, Total Variance, and the Rotated Component Matrix of two options, bKash and bank-led digital show the most important features in choice-decision corresponding to option(s). Loading factors show the importance of the specific feature(s) of the option(s) for the customers during their choice decision process. Eigenvalues show variance explained by that particular feature out of the total variance. From the commonality column, we can see that our first feature of bKash option explains 22.127% variance out of the total whereas first feature of bank-led option explains 35.864% variance of the total. For clarity, "phone call confirmation" is the most important factor in choice-decision of bKash. However, "no transaction fee" is the most important factor in case of bank-led option. Similarly, *factor to factor* comparison can be extended in aim to understand a customer's choice-decision when it comes bKash or bank-led.

7.2. Lessons *learnt*: can bKash shed lights for bank-led digital progression?

Using *factor to factor* comparison, it would not be overstated saying that security is undermining the trend-growth of bank-led option. On the same token, "transaction fees" most significantly discourages customer not to use bKash. On bank-led option, no facilitation of "phone call confirmation" most significantly discourages customer not to use bank-led. This *factor to factor* comparison can be extended using the calculated data statistics in Table 3.

8. CUSTOMER FACES A CHOICE-DECISION: WHETHER BKASH OR BANK-LED

Once consumer has decided to use On-the-Go banking, consumer then faces a choice-decision: bank-led or bKash for digital-banking in Bangladesh-economy. In classical preference theory, each consumer is assumed to have a well-defined preference order or utility function such that consumer selects from his or her choice set the alternative that offers the highest utility. Underpinning the theory, a group of researchers suggested that normatively equivalent procedures for assessing preferences lead to the same preference order (Tversky, Sattath, and Slovic, 1988). However, another group of researchers proposed "features that are unique to the focal option should also exert a greater influence on preferences" (Houston, Sherman, and Baker (1989). That is, when a person is comparing one alternative with another, the relative preference for the focal option depends on whether the focal option has "unique good features" or "unique bad features".

On the topic, literature further suggests that preferences are often sensitive to the particular task and context characteristics (Payne, Bettman, and Johnson 1992). In this line, in literature, Dhar and Simonson suggested, "attractiveness and choice probability of an alternative can be enhanced by making it the focus of a comparison (focal option) with a competing alternative" (Dhar & Simonson, 1992). For *clarity*, the choice probability can be influenced by alternative about which customers have information in memory.

This study uses Dhar & Simonson (Dhar & Simonson, 1992), proposition in case of a customer's preference between bKash and bank-led for digital banking services in Bangladesh-economy. Based on factor analysis (above), it first identifies "focal option" that makes distinct bKash or bank-led from one another when customer decided On-the-Go banking services.

Table 4
Feature(s) that can be considered as Focal in preferences of bKash or bank-led

Determinant(s) or feature(s)	bKash digital-banking	Bank-led digital-banking
Confirmed by phone (CP)	Immediately, if wanted	Not immediately even wanted
Transaction fees (TF)	Yes	No
Access Internet (AI)	Not necessary	Necessary
Agent services (AS)	Can be done by AS	Can't be done by AS
Perceived risk		
Security risk (SR)	No	Yes
Psychological risk (SR)	No	Yes
Social risk (SoR)	No	Yes

Sources: Author's assessment based on calculation using Factor Analysis.

In Table 4, seven factors are identified to be crucial, which can be used as "focal feature or factor" in this study. However, customers are likely to *contrast* the desirability of features of bKash as well as of bank-led services. In that case, "how much more or less attractive of bKash or bank-led" is not expected to have much impact on the comparison process (Alba, Hutchinson, and Lynch 1991). Thus, it can be predicted that changes of focal option in comparisons between bKash and bank-led digital with externally available descriptions will not influence relative preferences for these alternatives. Accordingly, descriptions of determinant AI and CP may not be effectively influencing relative preferences. Thus, AI and CP determinants of "focal option" are excluded in this study.

8.1. Hypothesis development and testing

Clarification in the above discussion leads to following hypotheses:

H_1: In a judgment task on whether bKash or bank-led, facilitation of immediate "phone call confirmation with recipient" addresses the issue of perceived risk in digital banking.

H_{1a}: An alternative that serves as the focal option in a comparison (as in H_1a) subsequently has a higher choice probability than it would have if the other alternative were the focal option.

H_2: In a judgment task on whether bKash or bank-led, "transaction can be completed by AS" in customer's memory tends to increase bKash's but to decrease bank-led's attractiveness.

H_3: In a judgment task on whether bKash or bank-led, "security risk" in customer's memory tends to increase bKash's but to decrease bank-led's attractiveness.

H_4: In a judgment task on whether bKash or bank-led, "psychological risk" in customer's memory tends to increase bKash's but to decrease bank-led's attractiveness.

H_5: In a judgment task on whether bKash or bank-led, "social risk" in customer's memory tends to increase bKash's but to decrease bank-led's attractiveness.

H_6: In a judgment task on whether bKash or bank-led, "transaction fees" in customer's memory tends to reduce bKash's but to increase bank-led's attractiveness.

H_7: In judgment task where insurance policy is subscribed by the user, "bank-led digital is insured" memory tends to reduce bKash but to increase bank-led's attractiveness.

As noted briefly in Methods & Data Collection Section, the respondents were further informed that they would be presented alternatives in different categories and asked to indicate their preferences. It was emphasized that there were no right or wrong answers and the researchers were interested only in the personal preferences of the participants. Then the scale that was later used for measuring the relative attractiveness of the alternatives was explained briefly.

Each choice problem presented two options that were identified by their names – bKash or bank-led digital. Here respondents were asked to assume they had to choose between two options. In this setup cost-incurs and quality of services of each option are comparable and known to the chooser. However, on perceived risk factor issue, choosers were expected to have information about the alternative in memory but probably no pre-formed preferences between them.

After reading each problem, subjects were asked the following question: "On the scale below, please indicate how much more or less attractive to you is [the focal option]? (circle the appropriate number)." Following Dunning and Parpal (1989), this study uses a 19-point scale from –9 to +9.

Figure 2
Example of a Focal Option Manipulation in preferences of bKash vs. bank-led

Using On-the-Go banking services, you have choices to use bKash or bank-led digital

1. On the scale below, please indicate how much more or less attractive to you is bKash?
   (Circle the appropriate number).

	bKash less attractive					**bKash more attractive**		
Much less			Slightly less			Slightly more		Much more
–9 –8 –7	–6	–5 –4 –3	–2 –1	0	1 2	3 4 5	6	7 8 9

2. How much more or less do you prefer to use bank-led digital?

	bKash less preferred					**bKash more preferred**		
Much less			Slightly less			Slightly more		Much more
–9 –8 –7	–6	–5 –4 –3	–2 –1	0	1 2	3 4 5	6	7 8 9

3. Assume that both are equally available to you, which one would you choose (Check one)

Bank-led digital   ( )   bKash   ( )

Source: Authors creation for hypothesis testing.

Above the left or right side of the scale (from –9 to –1 or from 1 to 9), the heading was "[focal option] less or more attractive," respectively. The identity of the focal option was manipulated between subjects, such that each option was the focus of the comparison in one version. The next item that responded was, "How much more or less do you prefer the [focal option]?" A scale similar to the attractiveness measure was used, with the headings "[focal option]" less or more preferred" above the scale. Finally, the two options were listed (in the same order in both conditions) and subjects were asked to indicate the one they would choose.

Table 5
Phone call confirmation and its effects in preferences of bKash vs. bank-led

Problem: bKash or bank-led for digital banking: **Phone call confirmation is Focal Option**				
	bKash is reference (n = 86)		bank-led is reference (n = 85)	
Average	3.3[a]	bKash more	1.3	bank-led digital more
Attractiveness	(0.51)		(0.6)	
Average	3.3[a]	bKash more	1.10	bank-led digital more
Preference	(0.54)		(0.62)	
Choice	67%	bKash	47%	bKash
	33%	bank-led digital	53%	bank-led digital

[a] The difference between conditions is statistically significant at the 0.05 level.

Source: Author's calculation.

Effect of focal option manipulation on preferences in memory-based comparison (Standard errors in parentheses).

Results

Results are summarized in Table 1. Consistent with H1, on facilitation phone call, tended to rate higher attractiveness and their preference for bKash that served as focal option. In accordance with these ratings and H_1a, each approach of On-the-Go banking services, a 20% (t = 2.7 and $p < .05$) greater share when it was the focal option than when the other approach was the focal option. A majority of subjects who received bKash approach preferred bKash, whereas a small majority of those with bank-led focus preferred bank-led digital.

Table 6
Transaction completed by AS and its effects in preferences of bKash vs. bank-led

Problem: bKash or bank-led for On-the-Go banking: **Completed by AS – Focal Option**				
	bKash is reference (n = 86)		bank-led is reference (n = 85)	
Average	4.5[a]	bKash more	0.5	bank-led digital more
Attractiveness	(0.52)		(0.69)	
Average	4.2[a]	bKash more	1.30	bank-led digital more
Preference	(0.71)		(0.62)	
Choice	78%	bKash	62%	bKash
	22%	bank-led digital	38%	bank-led digital

Source: Author's calculation.

Effect of focal option manipulation on preferences in memory-based comparison (Standard errors in parentheses).

Results

On transaction completed by AS, the focal option again influenced the ratings and choices 16% share increase, (t = 2.3, $p < .05$) as predicted.

Table 7
Security risk and its effects in preferences of bKash vs. bank-led

	Problem: bKash or bank-led for On-the-Go banking: **Security risk – Focal Option**			
	bKash is reference (n = 86)		bank-led is reference (n = 85)	
Average	0.2[a]	bKash more	2.9	bKash more
Attractiveness	(0.69)		(0.58)	
Average	0.1[a]	bKash more	2.9	bKash more
Preference	(0.68)		(0.61)	
Choice	52%	bKash	75%	bKash
	48%	bank-led digital	25%	bank-led digital

Source: Author's calculation.

Effect of focal option manipulation on preferences in memory-based comparison (Standard errors in parentheses)

Results

Similarly, in case of security risk, the focal option had a statistically significant effect on both the ratings and subsequent choices as hypothesized (27% share increase, $t = 3.4$, $p < .05$). Similar results can be seen in case of "psychological risk" (H_4) and "social risk" (H_5).

Table 8
Transaction fees and effects in preferences of bKash vs. bank-led in digital banking

	Problem: bKash or bank-led for On-the-Go banking: **Transaction Fees – Focal Option**			
	bank-led is reference (n = 86)		bKash is reference (n = 85)	
Average	3.49[a]	bank-led more	0.8	bank-led digital more
Attractiveness	(0.48)		(0.52)	
Average	3.7[a]	bank-led more	0.9	bank-led digital more
Preference	(0.60)		(0.54)	
Choice	72%	bank-led	61%	bank-led
	28%	bKash	39%	bKash

Source: Author's calculation.

Effect of focal option manipulation on preferences in memory-based comparison (Standard *errors* in parentheses)

Results

Finally, on transaction fees as focal, the effect of the focal option on the ratings, as predicted by H_6, was statistically significant and the effect on choice probability, 18%, was marginally significant ($r = 1.5$, $p < .10$). The transaction fees discourage using bKash in most cases.

Table 9
Insured bank-led digital banking and its effects in preferences of bKash vs. bank-led

	Problem: bKash or bank-led for On-the-Go banking: **bank-led is Insured – Focal Option**			
	bank-led is reference (n = 86)		bKash is reference (n = 85)	
Average	5.49[a]	bank-led more	0.8	bank-led digital more
Attractiveness	(0.78)		(0.28)	
Average	6.7[a]	bank-led more	0.9	bank-led digital more
Preference	(0.60)		(0.54)	
Choice	82%	bank-led	61%	bank-led
	18%	bKash	39%	bKash

Source: Author's calculation.

Effect of focal option manipulation on preferences in memory-based comparison (Standard errors in parentheses)

Results

This is the case where respondents were ensured that their bank-led digital is fully ensured. If anything goes wrong, it will be addressed by the insurance company to whom the customer is paying insurance premium through his or her bank account for secured digital banking. On bank-led is insured, the effect of the focal option on the ratings, as predicted by H_7, was statistically significant and effect on choice probability, 31%, was marginally significant ($r = 1.5$, $p < .10$).

9. GENERAL DISCUSSION

Customers of a product are assumed to have well-defined attitudes & preferences for alternatives offered to them. It is no different in case of preference for a product of bank-services namely b-Kash or bank-led option, when a bank-customer decides to go with On-the-Go banking in Bangladesh-economy. It is also well recognized that changing consumer's preference, marketers can employ various means of persuasion (Fishbein and Ajzen 1975; Petty, Cacioppo, and Schumann 1983). For example, in banking sector, banks may offer rebate or bonus for enhancing digital-banking. These together, it would not be overstated that customers' preferences are often fuzzy and uncertain (Payne *et. al.*, 1992), making them susceptible to various other influences. It is no exception in case of customer's preference for bKash or bank-led option in completion of digital-banking. So the proposed *Voluntary Insurance* policy in place can contribute significantly to the rapid-growth of bank-led or any other digital banking in Bangladesh-economy.

Table 1 show that bKash and bank-led options in digital banking services have its own distinct properties that distinguish one to other even though they both provide digital banking services. Since the growth of usages of bKash in Bangladesh-economy is growing faster than that of bank-led, this study first constructs a Comparison (Table 1) of the two based on its attributes and then classify these attributes based on customer's *priority* so that focal option can be identified.

In factor analysis, Table 3 and Table 5 clearly show that bKash secures the highest place in preferences when it come confirmation *via* phone call and know-how-skill, *in contrast*, the bank-led standouts with *last* position in preferences. On factors namely transaction fees, convenience for location, bonus for digital banking and self-image, bank-led secures the highest place in preferences, *in contrast*, bKash standouts with last position in preferences. On perceived risk

factor, both options play poorly where some cases bKash does better than that of bank-led. Despite having higher incurred-cost for using bKash, the bKash has been dominating the growth- trend in economy of Bangladesh for a while now. This is because it has facilitated the confirmation matter, i.e. security issue at least by placing phone call immediately. And the bank-led option has been suffering to grow faster than that of bKash even though it does not require any costs in operation.

In aim to verify the claim, a question relates to "Voluntary Insurance" was incorporated into the questionnaire where Voluntary Insurance as an attribute was used as a focal option. Here respondents were ensured that because of Voluntary Insurance in place, there is no risk at all where insurance company is obligated to take the burden to its fullest. The results indicate that shifting the focus of risk factor alternative to Voluntary Insurance can enhance alternative's perceived attractiveness. Here usage of bank-led over bKash option increases when customers face On-the-Go banking services in world-economy such as Bangladesh-economy.

If the proposed Voluntary Insurance policy were in place, then the user of On-the-Go banking service would have secured the perceived risk, which would have been stored in memory but had no pre-formed preferences between them. The result in Table 9 clearly shows that after assuring securities in multi-faucets in digital banking, the focal option had statistically significant effect on both the ratings and subsequent choices as hypothesized.

10. CONCLUSION

In today's *technology-driven* world-economy*,* service sector, like many others, banking-sector has been expanded and modernized. On the same token, customers are competing for a comparative time-saving-option that can effectively marginalize its operating costs no matter where they reside. Bangladesh-economy is no exception where besides traditional banking, bKash, Ucash and Paypal, Western Union etc. are few names that serve new way financial services globally. Like in many countries, since many factors are often unpredictable, it is *palatable* saying – strict laws & its fullest application can marginalize the magnitudes of "perceived risk". On this matter, in today's world, developed countries are doing better and ahead of developing countries. But it does not guarantee an absolute risk-free On-the-Go banking even in developed countries. On risk issue, developing countries are vulnerable, which might have led a slower growth of bank-led On-the-Go banking in countries such as Bangladesh where mobile-led payment (bKash), is dominating trends of On-the-Go banking (Rahman, 2018). In aim to deal with the determinant "perceived risk", current author has proposed in literature a proposal – *Voluntary Insurance* in banking services (Rahman, 2018), which deserves to be scrutinized and this study takes on the challenge. Using Factor Analysis, Hypothesis Development & Testing where growth-trend of bKash helps to single-out factors that have undermined the growth-trend of bank-led digital banking."Phone call confirmation" has influenced customer's preference using bKash, on the other hand, the features, "no transaction fee" has influenced positively using bank-led On-the-Go banking. Finally, findings indicate that shifting the focus of risk factor alternative to Voluntary Insurance can enhance alternative's perceived attractiveness. Here usage of bank-led over bKash option increases when customers face On-the-Go banking services in world-economy such as Bangladesh-economy. If the proposed Voluntary Insurance policy were in place, then the user of On-the-Go banking service would have secured the perceived risk, which would have been stored in memory but had no pre-formed preferences between them. It further ensures that after assuring securities in multi-faucets of digital banking, voluntary insurance policy in place can significantly affect the rating & subsequent choices in digital banking services.

References

Alba J.W., Hutchinson J.W. and Lynch J.G. Jr. (1991) *Memory and Decision Making*, in Handbook of Consumer Behavior, T. Robertson and H. Kassarjian, eds. New York: Prentice-Hall, Inc., 1–49.

Amin R. (2018), Alternative Delivery Channels of Islami Bank Bangladesh Lld.: Usage, Challenges & Prospects, *Journal of Islamic Economics, Banking and Finance*, Vol. 14, No. 1.

Aldrich J. (2006) Eigenvalue, eigenfunction, eigenvector, and related terms (http://jeff560.tripod.com/e.html), in J. Miller (ed.), *Earliest Known Uses of Some of the Words of Mathematics* (http://jeff560.tripod.com/e.html), retrieved 2006-08-22.

Bangladesh Bank (2017) *Payment & settlement systems, Annual Report* 2015–2016, pp. 114–122.

Bauer R.A. (1967) Consumer behavior as risk taking, in D.F. Cox (ed.), *Risk taking & information handling in consumer behavior*, Boston: Harvard University Press, pp. 23–33.

Clemes M., Gan Ch. and Li Yan Zheng (2007) Customer switching behavior in the New Zealand banking industry, *Banks and Bank Systems*, 2 (4).

Dhar R. and Simonson I. (1992) The Effect of the Focus of Comparison on Consumer Preferences, *Journal of Marketing Research*, Vol. XXIX (November 1992), pp. 430–440.

Donnelly J.H. and George W.R. (eds), *Marketing of Service, Proceeding Series. Chicago*, III: American Marketing Association, pp. 186–190.

Featherman M.S. and Pavlou P.A. (2003) Predicting e-services adoption: a perceived risk facets perspective, *International Journal of Human-Computer Studies*, 59 (4), pp. 451–474.

Fishbein M. and Ajzen I. (1975) *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research. Reading*', MA: Addison-Wesley Publishing Company.

Islami Bank Bangladesh Limited (2017) *Business plan 2017 for ADC products*, *The Business Development Conference*, Younus Auditorium of Islami Bank Tower, Dhaka, pp. 222–227.

Kaiser H. (1974) An index of factor simplicity', *Psychometrika* 39: 31–36.

Karjaluoto H. and Matila M. (2002) Consumer beliefs and reactions to a new delivery channel, *Journal of Financial Services Marketing*, 6 (4), pp. 346–361; DOI: 10.1057/palgrave.fsm.4770064

Kuisma T. *et. al.* (2007) Mapping the reasons for resistance to Internet banking: a means-end approach, *International Journal of Information Management*, 27 (2), pp. 75–85.

Lallmahamood M. (2007) An examination of individual's perceived security & privacy of internet in Malaysia and the influence on their intention to use E-Commerce: Using an extension of technology acceptance model', *Journal of Internet Banking and Commerce*, 12 (3), pp. 1–26.

Lee M.C. (2009) Factors influencing the adoption of internet banking: an integration of TAM and TPB with perceived risk and perceived benefit', *Electronic Commerce Research and Applications*, 8 (3), pp. 130–141.

Mitchell V.W. (1999) Consumer perceived risk: conceptualisations and models, *European Journal of Marketing*, 33 (1/2), pp. 163–195.

Murray K.B. and Schlacter J.L. (1990) The impact of services versus goods on consumers' assessment of perceived risk and variability, *Journal of the Academy of Marketing Science*, 18 (1), pp. 51–65.

Payne J.W., Bettman J.R. and Johnson E.J. (1992) Behavioral Decision Research: A Constructive Processing Perspective, *Annual Review of Psychology*, 43.

Petty R.E., Cacioppo J.T. and Schumann D. (1983) Central and Peripheral Routes to Advertising Effectiveness: The Moderating Role of Involvement, *Journal of Consumer Research*, 10 (September), 134–148.

Polatoglu V.N. and Ekin S. (2001) An empirical investigation of the Turkish consumers' acceptance of Internet banking services', *The International Journal of Bank Marketing*, 19 (4/5), pp. 156–165.

Rahman A. (2018) Voluntary Insurance for Ensuring Risk-free On-the-Go Banking Services in Market Competition for Bangladesh*, The Journal of Asian Finance, Economics and Business*, Vol. 5, No. 1, ISSN: 2288-4637, Boston University (USA); DOI:10.13106/jafeb.2018.vol5.no1.29

Rotchanakitmnuai S. and Speece M. (2003) Barriers to Internet banking adoption: a qualitative study among corporate customers in Thailand, *International Journal of Bank Marketing*, 21 (6/7); DOI.org/10.1108/02652320510612483

Varma V. (2016) *Payment ecosystem in Bangladesh: Challenges and opportunities*, Retrieved from http://www. thedailystar.net/round-tables/payment-ecosystembangladesh-challenges

Tan M. and Teo T. (2000) Factors influencing the adoption of Internet Banking, *Journal of the Association for Information System*, 1 (5), pp. 1–42.

The Financial Express (2016) *Combating Online Frauds and Security Threats in Banks*, The Financial Express, e-paper, Bangladesh, Retrieved December 2, 2019 from https://thefinancialexpress.com.bd/ views/ combating-online-frauds-and-security-threats-in-banks

Tversky S.S. and Slovic P. (1988) Contingent Weighting in Judgment and Choice, *Psychological Review*, 95 (July), 371–384.
Zeithaml V.A. (1981) *How consumer evaluation processes differ between goods and services*, in Donnelly J.H. and George W.R. (eds.), American Marketing Association, Chicago, IL.

www.bb.org.bd, Financial Stability Report (2017) Issue 8 – Bangladesh Bank
www.fintechbd.com An Exploration of the Booming Mobile Banking Market in Bangladesh, March 19, 2017
Wikipedia Eigenvalues and eigenvectors