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Effect of Financial Innovation on Credit Risk A Case Study of Non-Performing Loan Ratio of Commercial Banks in Kenya

Stephen Ndegwa Nderitu[1], Dr. Gordon Opuodho[2]

[1,2] School of Business, College of Human Resource and Development, Jomo Kenyatta University of Agriculture and Technology, Kenya

[1]ORCID ID: 0009-0004-0869-1050

[2]ORCID: 0009-0007-9560-2117

ABSTRACT: Financial innovation is a process with no certainty thus the need for it to be introduced to the market as the diminishment of costs and the reduction of chance exposure as part of a financial function. Credit risk the probability of the expected pay back on a speculation or lending will differ from expectations. The aim of the study was to establish the effect of financial innovation mainly Mobile money innovation and Internet banking innovation have on Non-performing loan ratio as a credit risk of commercial banks in Kenya, focusing on the operational main forty two commercial banks that were registered from 2013 to 2022 that were the target group that formed the unit of examination.

Secondary data was utilized from the readily available data from yearly distributed monetary reports, Central Bank of Kenya (CBK). From the research findings Mobile money innovation and Internet banking innovation had a positive influence on non-performing loan ratio of commercial banks in Kenya.

Literature on the association of innovation and credit risk is available. Researchers from different backgrounds and areas have vastly examined the vast aspects of innovation and credit risk. But most fail to elaborate or indicate and are focused on innovation and credit risk as dependent variables and also the influence innovation has on credit risk.

The implications of the study on theory, policy and practice. The research findings add to the solidification of the present body of literature by affirming that organizational resources influence credit risk of commercial banks.

1.0 INTRODUCTION

Financial innovation is a vital component of modern finance. Organizations generate various commodities in order to meet demands. A continuous procedure where unused and existing money related items, administrations and strategies are created and modernized items are revised to be able to cater to the ever-changing money related environment. Financial innovation is a process with no certainty thus the need for it to be introduced to the market as the diminishment of costs and the reduction of chance exposure as part of a financial function. Mainly a result of technological improvement and continuous growth is in inevitable as competition and the quantity of financial institutions increases while developments in the form of making payments have begun to provide near replacement for paper money, in this way influencing an important function of banking (Mbogoh, 2013). Over the years, commercial banks have faced many challenges due to various reasons; the main problems of principal financing are still directly related to the credit structure of borrowers, limited risk management or lack of attention to other business-related methods and conditions. The decision to extend a loan is based on the borrower's characteristics and a good review of the loan, which is usually reviewed at the time it is written (Central Bank of Kenya, 2017).

Lenders must undertake to seek and request additional information beyond that given by the borrower and other significant data from mediators such as company loans and credit counseling agencies. Kenyan commercial banks have developed various ways to incorporate risk factors into their decision-making processes, they can do many things, from simple methods such as using studies or informal methods, to complex methods that require the use of computer simulations. When determining the proportion of credit hazard, the bank ought to collect all the data about its customers, this information will show the borrower (in this case the bank) the analysis of the probability that the person who owes will not be able to bear and utilize the credit. This is a recipe in determining the price of the loan (Nader, 2011). Credit risk the probability of the expected pay back on a speculation or lending will differ from expectations. It is also known as misplacement arising from debtors' unwillingness or inability to settle their debts in its entirety and when expected. The principal starting points are: limited capacity, unsuitable lending policies, variable charges, bad governance, insufficient policies, limited resources and revenue, low interest rates, many bank licenses, bad credit assessments, central government intervention and banks that have little or no supervision (Baesens, 2016). Commercial banks are for profit-

seeking businesses, operating in money. A financial institution dealing in money through accepting deposits from the general republic to hold in its custody for safe keeping. It also issues out credit, by giving out credit inform of loan advances from the funds collected as deposits (Xuemei Xie, 2019). They are usually categories based on their nature such as; Commercial banks, deposit taking institutions, savings based institutions, agricultural focused institutions, foreign exchange banks and other banks. Over the years, commercial banks have faced many challenges due to various reasons; the main problems of principal financing are still directly related to the credit structure of borrowers, limited risk management or lack of attention to other business-related methods and conditions. The decision to extend a loan is based on the borrower's characteristics and a good review of the loan, which is usually reviewed at the time it is written.

2.0 REVIEW OF LITERATURE

Under this section we focus on the premise that bring forth an understanding for the need of financial technology to financial performance. The theories adopted for the study include; Technology acceptance model and Resource based theory.

2.1 Technology Acceptance Model

Formulated by (Davis 1989) applicable to model organizations for their usage and acceptance of technology, user's acceptance to automation and clear ease of utilization of such innovation. The Technology Acceptance Model (TAM) propose users are mainly influenced by a handful of factors when deciding whether to use and implementing a technology. The two main factors include the apparent convenience, that relates to how an organization perceive a particular system influencing performance and the seen ease of utilizing a specific innovation, a clear indication of how a user friendly system has influence to its adaptability. An improved and modified TAM by Adams, Nelson and Todd (1992) had an addition to the preexisting factors. Effectiveness as factor to consider, where the use of the technology had to be impactful. This model is appropriate for this study because it assumes that information use is based on the goals of behavior, and behavior is based on people's attitudes towards the introduction of the system, thereby influencing new adoption. Davis believes that a method is not the only thing that determines the use of a body, but also depends on the relationship of perceived importance and can be easily seen in the Technology Acceptance Model (TAM). Use. On the off chance that two frameworks have the same highlights, clients will discover the framework less demanding to utilize. (Dillon and Morris, 1996).

The Technology Acceptance Model is a factor by which the adaptation of innovation is used and accepted in organizations. How users relate to the unknown implementation of technology is key in its adaptation (Marangunić, 2015). The aim is to carry out a research to find out the innovation of day to day processes, therefore, it is important that Davis's (1989) research to approve his demonstrate appeared that the relationship between the ought to utilize data technology is stronger than the relationship between the seen ease of utilization of values. Based on his argument, we can assume that the most important thing for consumers is the importance of the product, this will determine the close connection among the usefulness of innovation and users.

Agreeing to the TAM, the seen value, seen ease of utilization, and perceived trust are key factors that affect customers' acceptance of mobile money innovation services. Perceived usefulness refers to the degree to which a person believes that using a mobile money innovation service will enhance their job performance or daily activities. Banks can increase customers' perceived usefulness by providing services that simplify the process of managing credit risk, such as real-time monitoring of account activity and automatic alerts for potential fraud. Seen ease of utilizing alludes to the degree to which an individual accepts that employing a mobile financial feature service is free of effort. Banks can increase customers' perceived ease of use by providing mobile money innovation services that are easy to navigate and use, and by providing clear instructions and tutorials. Perceived trust alludes to the degree to which an individual accepts that a mobile money innovation service is safe and secure (Nyaga, 2017). Banks can increase customers' perceived trust by providing mobile money innovation services that are secure, and by communicating transparently about the measures they take to protect customers' personal and financial information. By understanding how customers' acceptance of mobile money innovation services is related to the management of credit risk, financial institutions can design and implement mobile money innovation services that are more effective in reducing credit risk. Mobile money innovation processes such as cash collection with ease, quickly and safely, as safe as possible to both parties. Innovation entails the use of entirely new technology systems that make work easier. The worldly sort after Mobile money innovation processes that are acceptable regardless of the accounting principal being implemented lay a foundation for what is acceptable or not (Altamony, 2016). Adaptability to acceptable forms of payment that are available enables ease of carrying out an organizations transaction that involve purchase or sale (Kontio, 2014). The limitations that hinder most organizations from implementing any form of payment method is highly influenced with security access, stability and ease of carrying out transactions with a particular platform or the intermediary. Mobile money innovation transactions can be acceptable through the different organizations and enable payments through various means and to the desired designated platform, payments are easily verified from bank account and linked to specific customers and confirmed, making the whole process of purchase or sale quick and secure. Credit control through innovation is easily achieved where there is real time data on the transactions carried out and for how long (Ala, 2013).

2.2 The Diffusion of Innovation Theory (DOI)

Introduced in 1962 and modified by Rogers (1995) aimed at how, why and what impact inventive thoughts as well as advances improvement in an organization. Explains diffusion as the means to which knowledge spreads in an industry. The theory proposes, diffusion can be simply put as how new innovative ideas is shared among the users over time and how the spread of the new idea is highly influenced by time, means of communication, social structure and the innovative idea. In line with this theory, taking up innovation is influenced by five factors in regards to the underlying innovation itself. Perceived needfulness, similar needs, intricacy, and transparency implementing the technology (Rogers, 2014). Under the theory acceptors can be in categories first endorsers, early general, last mass and laggards. Diffusion which is spreading of the innovative idea takes part within sections of the population and the effect is generally everyone being part of the new innovative idea. In Kenyan organizations, not all adopt the innovations and those that implement do not do so simultaneously as per the hypothesis more often than not the trend-setters the quick adopters, prior standard, late standard and the slow pokes which a clear indication why organizations implement innovation ahead of others. This hypothesis is important to the research since, agreeing to this theory, ease of utilization is an imperative calculator within the utilization of advancement. No matter how good an innovation is, if it is difficult to use and learn, people will not accept it. But the most important thing is the results, when people begin to realize the benefits of innovation, they find it difficult to resist the use of these innovations (Mwinzi, 2014). The characteristics of innovation are the most important for diffusion theory. It includes the level of innovation, while some embrace development immediately, others take their time and proceed to utilize the previous innovations. The acceptance rate depends on many factors. If the innovation is evaluated negatively by different people, others will reject it or refuse to accept it.

The diffusion of innovation suggests that the selection of modern thoughts, items, or technologies spreads gradually through a population. In the context of internet banking innovation and managing credit risk, this theory can be applied to the process of banks and other financial institutions adopting and implementing new technologies and strategies for managing credit risk (Baesens, 2016). As more and more banks adopt these new technologies and strategies, the overall risk management practices in the industry will improve, leading to a reduction in credit risk for all institutions. Additionally, with the rise of internet banking innovation, customers can access banking services from anywhere and the credit chance administration can be done by the bank in genuine time which can raise the proficiency of credit chance administration.

Internet Banking Innovation entails the use of internet to simplify the generally accepted banking process, enabling individuals and organizations to focus keenly on their sole purpose of achieving set goal and objectives (DeYoung.R, 2015). Adoption of internet banking innovation transactions between organizations inform of EFT and also among individuals, financial institutions even to customers, thus a payment from a verified customer from a financial institution is immediately verified enabling ease of payment and revenue collection even eliminating erroneous payments, fraudulent transactions and even ease of refunds upon erroneous payments. Implementation of the Internet Banking Innovation enables the ease of amendments if need arises (Koch, 2011). Access control ensures selective restriction to a physical location or in a business its resources generally referred as authorization. Usually carried out through a three process stages, initiated by identity, the identities of the users are well known and documented, followed by authenticity, where the identity of the user is counter checked and compared to the collected data base and lastly authorization, if everything checks out then the permission is granted to the user to access the required resources. This ensures mitigation of misuse of an organization funds and limiting of relevant information to the right individuals. Fraud detection and mitigation is easily achieved and maintained in limiting asset misuse (Dunk, 2011).

The Effects of Financial Innovations on Credit Risk Management of Commercial Banks in Kenya by Maina Joseph Irungu 2014. This research using the data of 43 commercial banks in Kenya. Secondary information for the period between 2003 -2013 from financial product reports and risk guides from selected commercial banks. Credit risk management measures include: Non-Performing Loans Ratio (NPLR). Information were examined through multiple regression. Results were obtained using (SPSS version 18). In the research, three independent variables was used. As a result of the study, financial innovation was found to have a positive impact on credit risk management of banks. Among banking technology are institutional innovations. These results are championed by the coefficient of resolution, it shows: that 40.4% of the change in the bank's non-performing loan ratio is explained by the bank's financial innovation. The impact of bank financial technology its impact on earning is also significant ($p<0.001$), confirming the relationship mentioned above. This means that the impact is not random. This study has greatly aided the current study in guiding the research in what to expect in the findings, however it is keen on the association of credit risk management and was also carried more than a decade ago.

(Waweru, 2012) Did a research about the effects of financial innovations on risk management among commercial banks in Kenya, Auxiliary information gathered from hazard manual, monetary items report and inspected monetary account of eighteen commercial banks chosen to speak to the forty three commercial banks in Kenya. Information was examined utilizing SPSS through relationship investigation, relapse investigation and autocorrelation strategies were utilized to analyze the information. The think about concluded that monetary advancements have uncovered commercial banks in Kenya to different dangers counting credit hazard, all these dangers ought to in this manner illuminate generally chance administration of the education through a reasonable chance list

figure at any one period. The analyst prescribes more strong chance moderation hones and arrangements to guarantee that all components of chance are captured within the hazard list variables of commercial banks. On the other hand mobile banking had a negative relationship to real time gross settlements with the risk governance system.

3.0 METHODOLOGY

Where distribution of the population is accessible and not too large, using the whole part of the study. The research employed census survey to identify the population to involve in the study which is beneficial for an intensive coverage of the population and a reliable data as all items are included. According to (Oso, 2011) a collection of all inhabitant of a population that could potentially make up the sample. The study guided by secondary information mainly the use of yearly financial reports, publications from the managing authorities and also the government from the implementation of innovation in managing daily duties. (Cooper Donald, 2003)

3.1 Normality Test

Assumption under regression is where variables are casually spread and non-casually spread variables, largely out of place or with enormous outliers are able to distort the significance test and relationship. A visual observation of data plots or skews provides information of normality. Outliers can be easily observed when inspecting frequency or histograms distributions. The removal of outliers may minimize the opportunity of Type I and Type II errors and raise the precision of approximation but complicate the understanding of the results (Fox, 2015).

3.2 Linearity Test

A linear relationship in nature can only be accurately estimated through a standard multiple regression on the association among endogenous variables and exogenous variables. Occurrence of a nonlinear relation is common and to examine the analysis for nonlinearity is essential. If no linear relationship, the outcome of the analysis underestimates the connection of the variables. Underestimation has risks: a high possibility for a Type II error in the case of an independent variable and high risk of Type I errors in multiple regression, also referred as overestimation on the independent variables that have a common variance. Detecting nonlinearity can be done by using the nonlinear regression option accessible in statistical packages or the use of previous research carried out and theories to guide current analysis (Osborne, 2002).

3.3 Homoscedasticity

Homoscedasticity is when all the independent variables have the same variance of error and heteroscedasticity occurs when at different figures of the exogenous factor the deviation of error differs which has low effect on significance test. A Type I error may occur in the presence of heteroscedasticity causing a significant distortion in findings of the study and a weak analysis evident by visual examination of a tabulated standardized remainders.

3.4 Multicollinearity

Presumption by Multiple Linear Regression is that there's no multicollinearity inside the data. Multicollinearity happens when the exogenous factors are as well profoundly connected with each other. Multicollinearity may be checked through Relationship framework computing a framework of Pearson's bivariate for the relationship between all independent factors, the magnitude of the correlation coefficient must be less than 0.80. 2) Variance Inflation Factor (VIF) the VIF of direct regression represents the extent to which variation in repeated measurements is exaggerated due to multicollinearity. VIF values greater than ten indicate multicollinearity could be a concern. Presence of multicollinearity in the data, ordering will include centering the data, subtract the average score from each perception for each autonomous variable. In any case, the best ranging is to distinguish the variables affecting multicollinearity matters (i.e., relationships or VIF figures) and removing such variables from the regression.

3.5 Cointegration Test

Cointegration is information testing that finds in the event that there's a relationship between two or more time-related arrangement. A time-related arrangement is a few information focuses where one estimation is time. The essential utilize of cointegration is to decide whether you'll be able perform a regression on two or more factors (Kumar, 2018). Cointegration can decrease the plausibility that factors have a relationship that looks correlated but isn't. Cointegration could be a method used to test the relationship between two or more non-stationary time arrangement within the long run or for an indicated period. The strategy makes a difference distinguish long-run parameters or balance for two or more factors. In expansion, it makes a difference in choosing the scenarios wherein two or more stationary time arrangement are cointegrated so that they cannot leave much from the equilibrium within the long run.

3.6 Granger Causality Test

The Granger causality test could be a quantifiable speculation examination for choosing whether one time course of action is important in deciding another, ordinarily, regressions reflect relationships, that causality may well test this by examining the

ability to predict the long-term value of one period using the early figures of another period. Utilizing the term causality alone could be a misnomer, as is way greatly portrayed rather than examining X affects Y, the Granger causality examines why X figures Y. A pattern arrangement X is believed to Granger-cause Y if illustrated, ordinarily by way of an arrangement of t-tests and F-tests on slacked values of X, X values give factually critical data approximately future values of Y.

3.7 Autocorrelation Test

Autocorrelation investigation examines the correlation of the perceptions between the diverse focuses and hence looks for a design or slant during arrangement. For illustration, the degree on diverse days are auto related. Comparable to relationship, autocorrelation can be productive or unproductive It spans from -1 (superbly negative autocorrelation) to 1 (superbly positive autocorrelation). Positive autocorrelation implies increment watched in a time interim leading to a balanced increment within the slacked time interim. The outline of temperature talked approximately over outlines a positive autocorrelation. The temperature of the day is prone to move up when it has been extending and prone to move down when it's been decreasing in the midst of the past days. The discernments with positive autocorrelation could be tabulated into a smooth twist. Inclusion of a backslide line, it can be observed that a positive mistake is taken after by another, where a negative mistake is taken after by another. On the other hand, negative autocorrelation speaks to that the increment watched in a time interim leads to a corresponding diminish within the slacked time interim. By tabulating the perceptions from a regression stroke, it appears that a correct mistake would be taken after by a wrong one and bad habit. Autocorrelation connected to distinctive figures of time holes, which are referred to as lag. Lag 1 autocorrelation examines the relationship among the perceptions that are once separated. For instance, to memorize the relationship across the degree of temperatures of a day and then comparing that day within the following month, a lag thirty autocorrelation ought to be utilized. The Durbin-Watson measurement is mainly utilized to examine autocorrelation. When connected to an information set by measurable computer program. Durbin-Watson test results range from zero to four. A result near two implies an awfully small degree of autocorrelation. A result near to zero proposes a more grounded positive autocorrelation, and a result near four illustrates a more grounded negative autocorrelation. Examination for autocorrelation is essential when testing a set of chronicle information. For instance, within the value advertise, the securities costs of a single day could be exceedingly related to costs of a different day. In any case, it gives small data for measurable information investigation and cannot share the real execution of the security. Subsequently, it is fundamental to examine for autocorrelation of verifiable costs to recognize the degree cost alteration is just a trend or influenced by other components. In fund, a standard way to dispose of the effect of autocorrelation is to utilize rate changes in resource costs rather than verifiable costs themselves.

3.8 Unit Root Test

Tests for stationarity in a time arrangement is referred to as Unit root tests. A time arrangement is stationary on the off chance that a shift in time does not affect an alteration within the shape of the distribution; are one cause for non-stationarity. These exams are well known for possessing low measurable control. There are many tests, in portion, where all have no difference the foremost control. The rationale behind the name unit root is since a fundamental degree, a handle can be composed as an arrangement of statements that only contain one word. There is a root for every monomial (Githakwa, 2011). Should one of these roots equal one, then it is a unit root. The existence of unit roots when analyzing time arrangement can lead to serious problems with your analysis, such as spurious relapses, where you may obtain tall r-squared figures even when the information is unrelated. Erratic behavior as a result of unsubstantiated suspicions for an investigation. For instance, t-ratios do not follow a t-distribution.

The study will use Non-Performing loan Ratio, a credit risk measure, as the endogenous variable as also used by Maina 2014. The exogenous variables will be Mobile money innovation and Internet banking innovation each as a ratio. According to research, the Autoregressive Distributed Lag cointegration modeling approach first put forth by (Nkoro, 2016) and later developed by (Kejriwal, 2010) is more reliable than earlier cointegration tests. Regarding the ARDL cointegration approach, there are various inclinations. To begin with, the ARDL approach does not require that each factor be a coordinate of an identical arrangement (Kline, 2011). Applying the process is independent of whether the fundamental regressors are partially coordinates, coordinates of order zero [I (0)], or coordinates of order one [I (1)]. The estimated value of the sample under consideration has no bearing on the ARDL method, either. With the ARDL technique, even modest test measures can yield reliable results. Thirdly, the ARDL strategy may produce meaningful T-statistics and feasible estimates of the long-run performance when some of the regressors are endogenous. As per (Kejriwal, 2010) the cointegration equation for the general ARDL model utilized in this investigation can be represented as follows.

$$\Delta \mathrm{NPLr}_t = a_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta \mathrm{NPLr}_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta \mathrm{M}_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta \mathrm{I}_{t-i} + \alpha_6 \Delta \mathrm{NPLr}_{t-i} + \alpha_7 \Delta \mathrm{M}_{t-i} + \alpha_8 \Delta \mathrm{I}_{t-i} + \mu_{1t}$$

Equation 3.1

Where:
NPLr = Non-Performing loans Ratio

M = Mobile Money Innovation
I = Internet Banking Innovation
$\alpha 0$, = respective constants;
$\alpha 1 - \alpha 4$ = respective short-run coefficients;
$\alpha 5 - \alpha 8$ = respective long-run coefficients;
Δ = difference operator;
n = lag length;
t = time period; and
μit = white-noise error terms.

4.0 RESULTS AND DISCUSSION

Information was collected from forty two commercial banks that were enlisted by 2022, gotten from banks establishing a result of 100%. The reaction rate outperforms the 70% suggested. Due to the Banking Act, 2010, necessity where commercial banks enrolled in Kenya, record yearly budgetary articulation to CBK. The research calculated the mean and the standard deviation of the rates from the gathered data and attained the average for each of the objective. The standard deviation measures how spread out the values in a dataset are from the average. It quantifies the amount of variation in the information. A low standard deviation implies the figures are near the average, less variability, a higher standard deviation suggests more variability.

Table 4.1 Descriptive Statistics

	Credit Risk	**Mobile Money**	**Internet Banking**
Mean	**0.0991**	**0.0833**	**0.0833**
Median	0.1093	0.0838	0.0834
Maximum	0.1473	0.1003	0.0899
Minimum	0.0344	0.0709	0.0747
Std. Dev.	**0.0369**	**0.0037**	**0.0030**
Skewness	**-0.4022**	**0.2047**	**-0.3611**
Kurtosis	**1.5907**	**7.2264**	**2.7144**
Jarque-Bera	**13.1649**	**90.1510**	**3.0152**
Probability	**0.0014**	**0.0000**	**0.2214**
Sum	11.8925	10.0000	10.0000
Sum Sq. Dev.	0.1623	0.0017	0.0011
Observations	120	120	120

(**Source:** calculated by the author)

As per table 4.1 above the results of Non-preforming loan ratio, the indicator for credit risk has an average of 0.0991 and a low standard deviation of 0.0369 a clear indication that the value of the data set is closely clustered around the mean. The distribution of non –performing loan ratio is close to symmetry with a negative value of -0.4022 slightly left skewed, where the skewness falls between -0.5 and 0.5. The kurtosis value of 1.5907 a clear indication of a normal tail distribution, but the high value of Jarque-Bera test of 13.1649 accompanied with a lower p-value of 0.0014 a contrary indication of the distribution deviating from normality. The mean mobile money innovation rate as per information was 0.0833 with very low standard deviation of 0.0037 indicating little dispersion of the values from the mean, with a near symmetrical distribution having a skewness positive value of 0.2047. The kurtosis value 7.2264 suggest a heavy tail more peaked compared to a normal distribution, also evident with a high Jarque-Bera value of 90.1510 and very low p-value of 0.0000. The mean internet banking innovation rate over the distribution of the data set was 0.0833 accompanied with a very low standard deviation of 0.0030 a show of small variation of the distribution values around the mean. With a slightly left skewed negative value of -0.3611.The kurtosis value of 2.7144 illustrates a near normal peaked tail distribution also with a low valued Jarque-Bera test value of 3.0152 not indicating a significant deviation from normality with a p-value of 0.2214.

Table 4.2 Linearity Test

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.083611	0.139401	0.599787	**0.5498**
Internet Banking Innovation	-0.178933	1.249492	-0.143204	**0.8864**
Mobile Money Innovation	0.186571	0.962741	0.193791	**0.8467**

R-squared	**0.000924**
Adjusted R-squared	**-0.033827**
Probability (F-statistic)	**0.998614**

(**Source:** calculated by the author)

Table 4.3 Breusch-Pagan-Godfrey test

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
Null hypothesis: Homoscedasticity			
F-statistic	**0.1341**	**Prob. F(4,155)**	**0.9695**
Observation*R-squared	**0.5572**	**Prob. Chi-Square(4)**	**0.9677**
Scaled explained SS	**0.1509**	**Prob. Chi-Square(4)**	**0.9973**

(**Source:** calculated by the author)

Table 4.4 Variance Inflation Factor Test

Variance Inflation Factor		
Variable	**Coefficient Variance**	**VIF**
Internet Financial Access Innovation	1.561231	**1.187897**
Mobile Financial Feature Innovation	0.926807	**1.092252**

(**Source:** calculated by the author)

Table 4.5 Granger Causality Test

Granger Causality test			
Null Hypothesis		**Null Hypothesis**	
IBI does not Granger cause NPLR	**0.4003**	NPLR does not Granger cause IBI	**0.4557**
MMI does not Granger cause NPLR	**0.6100**	NPLR does not Granger cause MMI	**0.6999**

(**Source:** calculated by the author)

Table 4.6 Durbin-Watson Test

The Durbin-Watson Test		
Model	D W	**Conclusion**
Financial Innovation on Credit Risk	**0.0118**	**Autocorrelation**

(**Source:** calculated by the author)

Table 4.7 Augmented Dickey Fuller Test

Unit root tests	**Level**			**1st difference**		
Variable	**C**	**C&T**		**C**	**C&T**	
Credit Risk	0.4707	0.9473	**Non-Stationary**	0.0000	0.0000	**Stationary**
Internet Banking Inn	0.0000	0.0000	**Stationary**	0.0000	0.0000	**Stationary**
Mobile Money Inn	0.0000	0.0002	**Stationary**	0.0002	0.0016	**Stationary**

(**Source:** calculated by the author)

Table 4.8 Auto Regressive Distributed Lag Dependent Variable: NPLR
Model selection method: Akaike info criterion (AIC)
Selected Model: ARDL(2, 0, 0, 0, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Credit Risk (-1)	0.71365	0.09323	7.65447	0.00000
Credit Risk (-2)	**0.27263**	0.09275	2.93954	**0.00400**
Mobile Money Innovation	**0.01159**	0.08571	0.13520	**0.89270**
Internet Banking Innovation	**0.02830**	0.11271	0.25106	**0.80230**
Constant	-0.05756	0.02104	-2.73537	0.00730
R-squared	**0.992440**			
Adjusted R-squared	**0.991720**			
Probability (F-statistic)	**0.000000**			

(Source: calculated by the author)

Table 4.9 Long Run ARDL results

Levels Equation				
Case 2: Restricted Constant and No Trend				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Mobile Money Inn	0.84412	6.24685	0.13513	**0.8928**
Internet Banking Inn	2.06125	8.32080	0.24772	**0.8048**
Constant	-4.19307	3.07037	-1.36566	**0.1750**
EC = NPLR - (0.8441*M +	**2.0612*IF -**	**4.1931)**		

(**Source:** calculated by the author**)**

Interpreting the results of the coefficients and their significance level, where the coefficients of mobile money innovation, internet banking innovation, are 0.84412 and 2.06125, respectively, the P- values of 0.8928 and 0.8048, which are all not statistically significant at 5% level. The coefficient indicates a positive relationship with Credit Risk (Non-performing Loan Ratio), but we cannot definitively establish a significant long-run relationship across mobile money innovation, internet banking innovation, and credit risk. Table below demonstrates the findings of cointegration with use of bounds test, which assesses whether the variables have a long-term relationship.

Table 4.10 F-Bound Test

F-Bounds Test		**Null Hypothesis:**	**No levels relationship**	
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
			Asymptotic: n=1000	
F-statistic	**3.863366**	10%	2.2	**3.09**
k	4	5%	2.56	**3.49**
		2.50%	2.88	**3.87**
		1%	3.29	**4.37**

(Source: calculated by the author)

The result of the F-bounds test statistic is 3.863366, which in comparison to the critical values at 5% significance level, the test statistic surpasses the upper limit bounds value of 3.49 and lower bounds of 2.56, and consequently, we determine that there is evidence of a long-term relationship between the variables and reject the H0 hypothesis, which states there is no level of relationship.

5.0 CONCLUSIONS

Through the use of the Autoregressive Distributed Lag method, the extent of the relationship between the variables was examined. The research data analysis revealed that the credit risk of Kenyan commercial banks was significantly impacted by innovations in mobile money innovation and internet banking innovation.

Based on the objective that aimed to establish the effect of mobile money innovation on credit risk, the results as per the descriptive statistics a low standard deviation a show of small variation of the data to the mean that is nearly normally distributed and diagnostic test gathered and analyzed for the specific period of the study, indicating clearly mobile money innovation had a positive statistical significance on credit risk measured by non-performing loan ratio of commercial banks in Kenya under this research. Secondly the objective that explored the effect of internet banking innovation on credit risk the results from the descriptive statistics clearly portray a low standard deviation an indicator of little deviation of the data from the mean that was also close to a normal distribution, the diagnostic test used to analyze the data for the study period, a clear indicator that internet banking innovation had a positive statistical significance on credit risk measured by non-performing loan ratio of commercial banks in Kenya.

6.0 LIMITATIONS AND FUTURE RESEARCH

The objective of the study was to determine the effect of financial innovation on credit risk of commercial banks in Kenya. Although the aim was attained but through limitations. One was that having the data of research being spread out through more than five years the number of commercially licensed Kenyan banks have undergone changes over time due to new entries and also others going into receivership altering the number of total licensed commercial banks in Kenya over time. The study's conclusions are only applicable to commercial banks in Kenya and where similar financial innovation was present across them all. The temporal scope of the study was constrained of innovation inception, implementation and to current use only.

The study established findings that will enhance the understanding of influencers of credit risk on commercial banks in Kenya. The implications of the study on theory, policy and practice. The research findings add to the solidification of the present body of literature by affirming that organizational resources influence credit risk of commercial banks. Where all four independent variables; mobile financial feature innovation, internet financial access innovation, plastic card innovation and cheque truncation system have a positive influence on credit risk of commercial banks in Kenya, certain specific factors must be embraced. In mobile financial feature innovation mitigation of increase on credit risk by ensuring strict limitation on the value of credit limits per authorized users by their personal history of transactions also through strict adherence to validation of members through the credit reference bureau. Under internet financial access innovation creating of validating users across different platforms or banks to ensure proper confirmation of transactions limiting fraudulent activities online. Implementation of high standard systems to complement the introduction of the technology, information and education on the benefit of such technology should not be limited to users only but to all to limit exclusivity and ensure positive acceptance by all even non users and finally innovation should also be introduced fully to all financial institutions to ensure that even the non-bank financial institutions can fully adopt and implement innovations for better efficiency which is beneficial to members, the financial industry as well as the country as whole. Subsequent investigations in the same field should consider other forms of risks that hinder the operations of other businesses not limited to commercial banks as the effect may be different. Similar studies should also focus on other forms of performance rather than solely on financial performance. There is need for an extensive further studies to determine the extent to which the effect of innovation has from the period before the introduction of the innovation to present implantation.

REFERENCES

1) Ala, M. O. (2013). Influence of mobile banking on growth of Micro Finance Institutions in Kenya. *International Journal of Social Science and Entrepreneurship*, 1-18.
2) Altamony, H. A. (2016). The relationship between change management strategy and successful enterprise resource planning (ERP) implementations. *International Journal of Business Management and Economic Research*, 690-703.
3) Baesens, B. R. (2016). *Credit risk analytics: Measurement techniques, applications, and examples in SAS.* John Wiley & Sons.
4) Central Bank of Kenya. (2017). *Annual Report.* Nairobi: Central Bank of Kenya.
5) Cooper Donald, R. &. (2003). *Business research methods.* New York.
6) DeYoung.R. (2015). The Finanacial Performance of Pure Play Internet Banks. *Economic Perspectives*, 60-75.
7) Dunk, A. S. (2011). Product innovation, budgetary control, and the financial performance of firms. . *The British Accounting Review*,, 102-111.
8) Fox, J. (2015). *Applied regression analysis and generalized linear models.* Thousand Oaks: Sage Publications.
9) Githakwa, P. W. (2011). *The relationship between financial innovation and profitability of commercial banks in Kenya.* Nairobi: University of Nairobi.
10) Kejriwal, M. &. (2010). Testing for multiple structural changes in cointegrated regression models. *Journal of Business & Economic Statistics*, 503-522.
11) Kline, R. B. (2011). *Principles and Practice of Structural Equation Modeling. Third Edition.* New York: Guilford Press.
12) Koch, C. (2011). Enterprise Resource Planning: Information technology as a steamroller for management politics. *Journal of Organizational Change Management*, , 64-78.

13) Kontio, E. L.-L. (2014). Enterprise resource planning systems in healthcare: A qualitative revie. *International Journal of Information Systems in the Service Sector*, 36-50.
14) Kumar, R. (2018). Research methodology: A step-by-step guide for beginners. *Research methodology*, , 1-528.
15) Marangunić, N. G. (2015). Technology acceptance model: a literature review from 1986 to 2013. *Universal access in the information societ*, 81-95.
16) Mbogoh, G. M. (2013). *The effect of financial innovation on financial performance of insurance companies in Kenya.* Nairobi: University of Nairobi.
17) Mwinzi, D. M. (2014). *The effect of financial innovation on economic growth in Kenya* . Nairobi: University of Nairobi.
18) Nader, A. (2011). The effect of banking expansion on profit efficiency of Saudi banks. *International Conference on Business and Economic Research*, 6-12.
19) Nkoro, E. &. (2016). Autoregressive Distributed Lag (ARDL) cointegration technique: application and interpretation. *Journal of Statistical and Econometric methods*, 63-91.
20) Nyaga, K. M. (2017). *The impact of mobile money services on the performance of small and medium enterprises in an urban town in Kenya* . Nairobi: KCA University.
21) Osborne, J. W. (2002). Four assumptions of multiple regression that researchers should always test. *Practical Assessment, Research, and Evaluation*, 1-2.
22) Oso, W. Y. (2011). *Writing Research Proposal and Report: A Handbook for Beginning Researchers.* Nairobi: The Jomo Kenyatta Foundation.
23) Rogers, E. M. (2014). *Diffusion of innovations. In An integrated approach to communication theory and research.* Routledge.
24) Waweru, E. W. (2012). The Effect of Financial Innovations and Risk Management of Commercial Banks in Kenya. *School of Business, University of Nairobi.*
25) Xuemei Xie, J. H. (2019). Green process innovation, green product innovation, and corporate financial performance. *Journal of Business Research*, 697-706.