KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI

CREDIT RISK ASSESSEMENT: A CASE STUDY OF SOME SELECTED BANKS IN GHANA

BY

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DECLARATION

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I hereby declare that this submission is my own work towards the award of the M. Phil degree and that, to the best of my knowledge, it contains no material previously published by another person nor material which had been accepted for the award of any other degree of the university, except where due acknowledgment had been made in the text.

DEDICATION

I dedicate this project to my mother, Miss Elizabeth Apibil for all the support and encouragement through out this years and also to my siblings for their love ans support.

ABSTRACT

This study modeled the profitability of banks in relation to its internal and credit risk factors. A panel data regression approach was used with data consisting of financial statements and closing stock prices of five selected banks listed on the Ghana Stock Exchange Market. The internal factors considered were Capital adequacy, asset quality, efficiency and size, with the credit risk factors being GDP growth, inflation, private indebtedness and average exchange rate. The Fixed effect model was found to be the most appropriate model suitable for this data set based on the Hausman test. Which specified, the independent variables had a 0.78 efficiency of predicting profitability, with capital adequacy, asset quality , inflation and private indebtedness being significant in determining the profitability of banks. The second part of this study proceeded to measure credit risk of these same banks using the option pricing methodology, the default model of these banks were evaluated using Black-Scholes-Merton default probability.

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LIST OF ABBREVIATION

BOG ..... Bank of Ghana

SEC ..... Securities and Exchange Commission LSDV .....Least Square Dummy Variable BLUE ..... Best Linear Unbiased Estimator iid .....Idependent and Identically Distributed

GLS .....Generalised Least Square

SG-SSB .....Societe General Bank

HFC .....Home Finance Company Bank Limited

OLS ..... Ordinary Least Square Method

BSM .....Black-Scholes-Merton

FGLS .....Feasible Generalised Least Square

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CHAPTER 1

INTRODUCTION

This chapter presents the general and specific expectations of this study. It includes the background of the study, objectives of the study, statement of the research problem, the scope of the study, the organisation of the study, the significance of the study, the research questions, the method for the study and the limitations of the study.

1.1 BACKGROUND OF STUDY

The banking system plays a major role in the financial intermediation process of every economy making its efficiency and effectiveness an essential requirement towards ensuring stability and growth Halling and Hayden (2006). Diamond and Rajan (2001) assert that banks engage in valuable economic activities and have major primary concerns to address in order to ensure their survival and profitability. The significance of these institutions is considered as the blood artery of human body due to the function of pumping other institutions and organization capital resources for the development and economic growth (Bloomestein and Spencer, 1993). Commercial banks (CBs) are financial institutions as well as main financial information suppliers for any economy. They are especially important to emerging economies in which the borrowers find it hard to access capital market (Hawkins and Mihaljek, 2001) and (MorndragonVelez and Glen, 2011). It is proved that CBs with effective functions contribute to improve economic growth; meanwhile, ineffective ones prevent economic growth and even exacerbate the poverty, in literature (yun Liang and Reichert, 2012). Wetmore and Brick (2004) indicated that CBs may have to deal with three categories of risks, including financial risk (credit risk), operational risk, and strategic risk, and as a consequence, CBs' performance will be affected. According to

Altman and Saunders (1997), the influence of credit risk on CBs is relatively huge and severe in comparison with other factors, leading to the failure of the banks. Through years, the number of bank problems is significantly increasing in not only matured economies but emerging ones as well. Regarding credit issues, the weakness of credit risk management (CRM) is attributed as one main cause of banking trouble. Loans may contribute much to credit risk because the loans of the banks are often 10 or 15 times higher than banks' equity 2011)(Bessis, 2011). Accordingly, banks will have to deal with more difficulties due to such a small decline in loan quality only. The root of poor loan quality comes from the mechanism of information processing. According to the observations of Morndragon-Velez and Glen (2011), developing nations are now dealing with these issues at the acute level. Ghana is not an exception. These problems start from the stage of loan application, and then expand at the stages of loan approval, monitoring, and control when there is no existence of the guidelines of credit risk management regarding credit processing policies or procedures or these guidelines are weak or incomplete. Against this backdrop, this paper examines how credit risk affects a bank's profitability. The study employs panel regression analysis to investigate the relationship between credit risk factors and bank profitability as well as determining the probability of default of the banks using the MertonBlack-Scholes Model.

1.2 PROBLEM STATEMENT

The bank industry in Ghana has been dominated with both local and multinational foreign banks. This industry has became very competitive such that banks have been forced to give out a lot of packages and increase their efficiency in other to bring about a rise in their Profitability and market shares (Sharon, 2012) .Greater request for share holders value has lead most banking wanting to maximize their return on asset. This has resulted in banks finding means and ways of decreasing their operation cost. The best approach however should be used to make sure that banks continue

to enjoy their profitability and also ensure that, services offered by them are directly linked with the needs of their customers. This will lead to an increase in revenue, customer's loyalty and very long term profitability.

According to the bank theory, there are six (6) main types of risk which are linked with credit policies of banks and these are; credit risk (risk of repayment), interest risk, portfolio risk, operating risk, credit deficiency risk and trade union risk. However, the most vital of these risks, is the credit risk and therefore, it demands special attention and treatment.

Recent times in Ghana has witnessed a tense competition among banks for customer deposits characterised by regular advertisement in both the print and electronic media, attractive promotions and the employment of salesmen who sell to varied customers on daily basis the different banking products offered by them in their quest to maximize customer deposits (Gyamfi, 2012).

Nonetheless, on the asset side of the balance sheet, banks ensure the smooth flow of funds by lending to deficit spending units while providing liquidity to savers on the liability side. In addition, facilitating trade through the provision of payment and settlement systems, ensuring the productive investment of capital and the profitability of other varied functions according to Jenkison (2008) expose banks to a large number of risks which include liquidity risk, credit risk, foreign exchange risk, market risk, interest rate risk among others.

In recent times, banks' risk management has come under increasing scrutiny in both academia and practice (Amidu and Hinson, 2006). Banks have attempted to sell sophisticated credit risk management systems that can account for borrower risk and perhaps more importantly, the risk-reducing benefits of diversification across borrowers in a large portfolio. Said and Tumin (2011) advice that revising the determinants of the profitability of banks is an essential subject matter which could help in banks' appreciation of the contemporary conditions of the banking industry and the critical factors to be considered in fashioning out plans and policies towards improvement, profitability and mitigating credit risk.

Credit risk continues to be the major causes of serious banking problems in Ghana and the provision of credit remains the primary business of every bank in the country. For this reason, credit quality is considered a primary indicator of financial soundness and health of banks. Interests that are charged on loans and advances form sizeable part of banks' assets (Gyamfi, 2012). Default of loans and advances poses serious setbacks not only for borrowers and lenders but also to the entire economy (Amidu and Hinson, 2006) . Studies on banking crises all over the world has proven poor loans (asset quality) to be the key causes of bank failures. Staurt (2005) stressed that the spate of bad loans (non-performing loans) was as high as 35% in Nigerian Commercial Banks between 1999 and 2009.Umoh (1994) also pointed out that increasing level of non-performing loan rates in banks' books, poor loan processing, undue interference in the loan granting process, inadequate or absences of loan collaterals among other things, are linked with poor and ineffective credit risk management that negatively impact on banks profitability. As a result of the likely huge and widespread of economic impact in connection with banks failure, the management of credit risk is a topic of great importance since the core activity of every bank is credit financing.

In Ghana, it has been noticed that financial management concentrates more generally on profitability in short term, with a few care on adverse risk on the quality of asset that has more effective impact on long run of the financial services. As such, it is important to understand the credit risk determinant which affects some of these banking industries, who play an essential role in the stability of the economy

This thesis aims at assessing the credit risk of these banking industry in relation to their profitability and probability of default.

1.3 OBJECTIVES

The study is aimed at achieving these objectives

- The main aim is to identify and analyse the internal and external factors affecting the profitability of the banking industry in Ghana, using a longitudinal data approach.

- The probability of defaults of these selected Banks listed on the stock exchange market will be determined using Black-Scholes-Merton's model.

In attaining the research objectives, the following two specific research questions are formulated:

1. What are some of the internal and external factors affecting the profitability of the banking industry in Ghana.
2. How is credit risk modeled or quantified?

1.4 METHODOLOGY

The data type for this study will be mainly secondary, comprising financial statements of some selected banks listed on the Ghana stock exchange market for a period of five years. The data will be taken from December 2009 to December 2013 from Annual Report Ghana and the Ghana Stock Exchange market of which the researcher will do more research on producing a model for the external and internal factors affecting credit risk, and calculations the probability of defaults of these selected Banks. These companies are selected because they have complete data and also follow within the time horizon for the study.

Longitudinal data analysis requires the collection of a series of observations on across section component, over a long period of time. This makes it easier to identify effects that are usually not easily observed in a normal time series analysis. Longitudinal data analysis is usually differentiated from a time series or cross sectional regression by the subscript. Usually in panel data regression, a double subscript is attached to each variable. The general form of the panel data model can be specified compactly as:

$$\gamma_{it} = \alpha + \beta x_{it} + e_{it}$$

where: i = Cross- sectional dimension,t =time series dimension, γ_{it} = the dependant variable in the model, α =Constant overtime t,x_{it} =Contains the set of independent variables in the model and e =error term

Ordinary least square provides a consistent and efficient estimator of α and β The black Scholes Merton's model is revealed to be a powerful method to value complex debt issue on a firm. The black Scholes formulation gives the value equity today as

$$E_0 = V_0N(d_1) - Be^{-rt}N(d_2)$$

$$d_1 = \frac{In\frac{V_0}{D} + (r + \sigma_2)}{\sigma^2\sqrt{T}} \quad \text{whereand } d_1 = d_1 - \sigma_v \sqrt{T}$$

Where, V_0 = Value of the firm's assets today,E_0 =Value of companies equity Today, D =Debt repayment due at time T and σ_v =Volatility of asset

1.5 JUSTIFICATION

The research work is justified and significant because of the important role financial banks plays in Ghana. It is in the light of the above that a study of this nature seeks to analyse the impact of credit risk factors on the profitability of banks as well as determine the probability of default of these banks.The final report of this study would provide :

1. key stakeholders in the banking industry with vital information that will enhance decision making and policy directions.
2. It will also serve as knowledge on how the Macroeconomic conditions has to adjusted in other to reduce the number of non performing loans
3.

1.6 THESIS ORGANIZATION

This study is organised into five (5) chapters and other minor sections. Chapter one (1), gives readers what to expect in this study. It provides a description of the background of the study, statement of the research problem, the primary and specific objectives of the study, the research questions, the significance of the study, the research methodology, organisation of the study and the limitations of the study. Chapter two (2) discusses the literature review which focuses on the works of other researchers that are related to this study. Chapter three (3) also discusses the researcher's systematic procedures for achieving the objectives of the study. Chapter four (4) present the processing and analysis of data which will be collected for this study based on the objectives and research questions. Lastly, Chapter five (5) gives the summary of findings, conclusions and recommendations of the study.

1.7 LIMITATION OF THE STUDY

Research, no matter how it is well conducted and constructed, has limitations. This study is not an exception. This study was challenged with data that was very difficult to come by. Methodologically, the researcher was faced with inadequate literature sources since there is a wide knowledge gap in the topic under study in Ghana.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter presents some related literature on credit risk . Again studies by other researchers on proposed credit risk models and their practical application in real life situations are presented.

2.2 DEFINITION OF RISK

Risk is inherent in all activities. It is a normal condition of existence. The concept of risk management has expanded from its origins in the insurance industry in the last few decades (Richardo, 2004). It has extended into the fields of investment finance, medicine, environmental management, space science, and meteorology. Risks are usually defined by the adverse impact on profitability of several distinct sources of uncertainty (Richardo, 2004). Risk can be classified into systematic and unsystematic risk (Al-Timimi and Al-Mazrooei, 2007). Systematic risk refers to a risk inherent to the entire system or entire market. It is sometimes called market risk, systemic risk or un-diversification risk cannot be avoided through diversification. Contrary, Unsystematic risk is associated with individual assets and hence can be avoided through diversification. It is also termed as specific risk, residual risk or diversifiable risk, (Al-Timimi and Al-Mazrooei, 2007). Risk has also been defined as the potential for a negative future reality that may or may not happen. Risk can be explained with two characteristics of a possible negative future event: probability of occurrence (whether something will happen), and consequences of occurrence (how catastrophic if it happens). However, risk can also be split into two categories; (i) pure or systematic risk and (ii) unsystematic risk.Pure risks or systematic risks cannot be influenced by

the manager and are independent of business decisions. On the other hand, unsystematic risks are the result of managerial decision-making and can either have a negative or a positive outcome.

2.3 RISK MANAGEMENT

Risk management is primarily concerned with reducing earnings volatility and avoiding large losses. In a proper risk management process, one needs to identify the risk, measure and quantify the risk and develop strategies to manage the risk . The highest concern in risk management are the most risky products. The prior concern for the risk management are those products that can cause the highest losses: high exposures with high default risk. The lowest priorities have low exposures with low risk. The key risk management functions are:

RISK ANALYSIS

The risk management analyzes the risks of transactions that the bank takes because of its business: credit, market and operational risks. It surveys whether the risks are in line with the risk appetite the banks wants to take. It further informs the front office on the risk it takes on transactions and whether the bank is sufficiently rewarded for it.

RISK MONITORING AND REPORTING

The risk of existing positions is continuously monitored.Individual transactions may became more risky,especially on longer maturities or because of important changes in the financial market, or microeconomic environment.The risk department also monitor the risk position of the banks at the level of different portfolio and on the level of the whole bank.it monitors whether the Banks risk profile evolve as expected.

2.4 CREDIT RISK

This risk is associated with almost every banking activity (Muzicek, 2010). There is a certain chance that the client will not repay the loan provided by the bank and the agreed interest and charges. According to the Basel (1999), credit risk is defined as "the potential that a bank borrower or counterparty will fail to meet its obligations in accordance with agreed term". TheMonetoryAuthorityofSingapore (2006) has also defined it to be the "risk arising from the uncertainty of an obligor's ability to perform its contractual obligations", where the term "obligor" refers to any party that has either direct or indirect obligations under the contract. According to Gestel and Baesens (2009),Credit risk occurs when the counter party is unable to pay or cannot pay on time.In most cases, the obligator is in a financial distressed situation and may be facing bankruptcy procedures or can also refuse to comply with its debts service obligations (Gestel and Baesens, 2009).Technically, default results from a misunderstanding because of the flaws in the information system. Gestel and Baesens (2009) further suggest that a credit loss occur when the bank invest in debt of a high quality borrower of which the risk profile has deteriorated. In the case of liquidation,the price at which the debt is sold on the market is lower than the price at which the debt was bought by the bank, which makes a net loss.In the case of a default,the lost of the bank is not necessarily high.The loss in the case of default depends on the percentage that one can recover from the defaulted counterpart and the total exposure to the counterpart. The recovery depends on the presence of collateral and guarantees. A good risk management tries to avoid large exposures on high-risk counterparts.

2.5 CATEGORIES OF CREDIT RISK

To gain a better understanding on the nature of credit risk, it is necessary to identify the categories of credit risks (Zhao, 2007). Concerning the categorizing of credit risk, different authors have expressed various criteria. For example, Henne (2003) points out that the three main types of credit risk are consumer risk, corporate risk and

sovereign or country risk, while Culp and Neves (1998) consider default risk and resale risk to be the two types of credit risk. (Horcher, 2005) also defines six types of credit risk, including default risk, counterparty pre-settlement risk, counterparty settlement risk, legal risk, country or sovereign risk and concentration risk.

2.5.1 DEFAULT RISK (PD)

According to Horcher (2005),traditional credit risk relates to the default on payment,especially on lending or sales.Hence ,default risk is the probability that a default event occurs (Gestel and Baesens, 2009).This probability is called the probability of default (PD) and has values between 0 and 1.There are many definitions of a default event.The most common definition of a default event ia a payment delayed of at least 3 months (Gestel and Baesens, 2009).The default risk depends on so many factors (Muzicek, 2010). Counter party with a weak financial situation,high debt burden,low and unstable income has a higher default probability.

2.5.2 LOSS RISK (LGD)

The loss given risk determines the lost as a fraction of exposure in the case of default (Gestel and Baesens, 2009).In Basal II ,this terminology is known as the lost given default.In the case of no loan, the LGD is equal to zero.When one loses the full exposure amount, the LGD is equal to 100 percent. A negative LGD indicates a profit (e.g due to penalty fee and interest rate) in some cases, the LGD can be above 100 percent, e.g due to litigation cost and almost zero recovery from the default counter party. both lost given rate and the default recovery sum up to one.

2.5.3 COUNTRY RISK

Country risk arises due to the impact of deteriorating foreign economic, social and political conditions on overseas transactions and sovereign risk refers to the possibility that governments may enforce their authority to declare debt to external

lenders void or modify the movements of profits, interest and capital under some economic or political pressure Casu et al. (2006).

2.6 SOURCES OF CREDIT RISK

There are two main sources of credit risk factors. These are external and internal risk factors. The risk factors are discussed below as follows:

2.6.1 EXTERNAL SOURCES

ECONOMIC CONDITIONS

Change in national income and unemployment will have impact on credit risk through change in business cycle, exchange rate, interest rate, credit availability and credit quality. Liquidity crunch or financial problems has the ability to impact borrowers' ability to fulfill their obligation. In addition legal and regulatory change could cause financial institutions to change how they oversee a transaction, as well as the quality and ability of debt collection.

COMPETITION

Competition among financial institutions in terms of growth, profitability and the desire to be a market leader have the ability to cause financial institutions to lower their standards or improperly price their loan products. This result in higher cost of increasing non- performing loans.

2.6.2 INTERNAL SOURCES

UNDERWRITTING STANDARDS

This is a process to determine what type of, to whom, for what purpose and when credit should be granted. Proper credit approval process should comprise proper guidelines on both form and methodology in evaluating borrowers' credit worthiness,

setting up of credit line and interest rate appropriate to borrowers' risk and credits. Lenient credit underwriting can incur losses to financial institutions especially when debt repayment cannot be demanded or collateral cannot be seized in time. Many credit risks arise from deficiency in underwriting standards and credit monitoring.

COMPETENCE OF STAFF

Credit officers without the necessary expertise in the activities they are responsible for, be it credits, investment, management of problem assets or new products, can lead to poor lending practice, ineffective administration, and eventually, loss to financial institutions.

INAPPROPRIATE ASSESSEMENT OF CREDIT QUALITY

This problem may result from competitive pressure and credit growth as they tend to put a time constraint on getting accurate data. Moreover, rapid growth and entry into new markets can tempt the management to lend without sufficient financial and economic analysis. To facilitate quicker decision making, management may support credit decisions by using simple indicators of credit quality such as borrowers' characteristics, current and expected value of collateral or support of a parent company or affiliated companies.

LENDING IN EXCESS

Lending in excess of the minimum required imposes risk. Lending in excess of borrowers' ability to repay will result in problem loans.

2.7 OVERVIEW OF THE BANKING INDUSTRY IN GHANA

Ghana's banking industry has became very modernised and vibrant in these past few years, against the series of financial and reputational damages faced from economic

recession and government debt in the 1980's and 90s (George and BobMiller, 2007).As a result of this rapid growth, the central bank has disclosed its intension of making Ghana the Financial Hub of West African Sub Region (Sharon, 2012).

This industry is fairly saturated and comprises of 27 universal banks, 137 rural and community banks, 58 non financial institutions including financial houses.The regulatory body strengthen recently its supervision of non financial institution and it lead to the closure of some financial institutions which did not meet the requirement. The bank of Ghana recently raised the minimum capital requirement for new commercial banks to GHS 120M, (PriceWater, 2014). The industry grew by 32% from GHS25,755m in 2012 to GHS34,296m in 2013. The growth was attributable to a 30% increase in deposits and borrowings.Loans and advancement remain the most significant component of the industries operating asset and accounting for 43% of its asset.This has not changed from the prior year because of the limited opportunities for banks to extend credit to customers.The general industry perception is that, the risk profile of customers has not improve. This condition has been aggravated by the unfavorable economic conditions which is creating constraints for profitable business.

2.8 THE REGULATORY ENVIROMENT

BANK OF GHANA

On the 4th March 1957, just two days before the declaration of political independence, the Bank of Ghana was formally established by the Bank of Ghana Ordinance (No. 34) of 1957, passed by the British Parliament.

The Bank of Ghana has the Authority to regulate and supervise all the banking and non banking financial businesses with the main aim of achieving an effective and sound banking for the benefits of depositors, customers and the economy of Ghana, (BOG, 2011). The legal and regulatory frame work in which the banks, non banking institutions together with forex bureau are operated in Ghana include :

1. Bank of Ghana Act 2002,(Act 612)
2. Banking Act,2004 (Act 673)
3. Non Banking Financial Institution Act 2008(Act 774)
4. Bank of Ghana Notice /Directives/Circulars Regulation

The duties of the Bank of Ghana is to be responsible for ensuring stability in the financial system this is to make sure it acts us a facilitator for creating wealth, economic growth and development.

The functions and responsibilities of the central bank as spelled out in Act 612 and Act 673 includes:

1. Regulating, supervising and giving directions to the banking industries as well us the credit system to aid in efficient operations of a safe and sound Banking industry.
2. They appoint an individual to serve the role of the head of Banking Supervision Department; This individual is appointed by the Board.
3. The central bank also considers and proposes reforms of laws relating to banking business.

SECURITY AND EXCHANGE COMMISSION (SEC)

The securities industry in Ghana is governed by the Securities Industry Law 1993, PNDCL333. The Securities Industry Law, among other things, brought about the establishment of the Securities and Exchange Commission (formerly Securities Regulatory Commission).The Function of the security and Exchange Commission are as fellows:

(a) Providing companies and the general public with guidance in interpreting the provision of the securities law, rules and regulations on the subject of securities and handling any investor.

(b) Licensing and regulating all market operators such as investment advisors, Dealers and their representatives , including the regulation of the Ghana stock exchange.

(c) Overseeing and regulating the fund management industry in Ghana and administering the securities law affecting collecting investment schemes such as unit trust and mutual funds.

(d) Overseeing the disclosure of material information to the investing public by companies ,including securities listed on the Ghana Stock Exchange.

(e) Performing post-prospectus checks on the utilization of funds collected through Public subscription.

2.9 RELATED WORKS BY OTHER RESEARCHERS ON CREDIT RISK

Jonathan (2012), used data to construct a logistic regression model to identify the important demographical characteristic related to credit risk of a Rural bank in Ghana. The logistic regression model was used to design a logic regression calculator to predict the probability of default in a rural bank.it was established that gender, age, number of dependants and loan amount were some of the factors affecting default. The model had 70% predicting power and a 70.5% accuracy rate of distinguishing between defaulters and non-defaulters.

Castro (2012) employed a longitudinal data approach to five selected countries experiencing the negative impact of economic and financial constraints. He concluded that, credit risk in the banking sector was affected significantly by macroeconomic factors. Credit risk went up with GDP growth. Also, share price index together with share price indices went down and roused when the unemployment rate, interest rate, and credit escalation increased. It was again observed that credit risk was

positively affected by an increase in the real exchange rate and there was a considerable rise in credit risk during the financial crisis period.

Foglia (2009), Analysis the quantitative techniques elaborated by some firms for stress testing credit risk. They emphasis was on the technique used to relate macroeconomic factors that influences stress with micro economic measures of credit risk. Basel II framework made stress testing credit risk one of its requirement and it is developed by making exact input from the economic cycle. His paper makes important recommendations on current progress in macro stress testing and specifies a number of problems encountered when using stress testing techniques.

Padron et al. (2005) contrasted the various parameters that influence the degree of indebtness of establishments using a longitudinal data approach. The parameters used were categories into size, generated resources, level of warrants, debt cost , growth opportunities and reputations and six hypothesis formulated. Their findings showed that, only reputation is categorically considered to be an explanatory variable of a firm's degree of debt. It also discovered that, the unique features of each firm remain constant over time.

Bharath and Shumway (2004), examined the contribution and Performance of the Merton's (1994) bond pricing default forecasting model performed against other models. The KMV Merton model performed slightly worst against a simpler similar alternative in terms of hazard model and out of sample forecast. They concluded that, the KMV Merton model did not provide a good statistic for the probability of defaults; it looked possible to produce such a sufficient statistic without working-out the simultaneous nonlinear equations required by the KMVMerton model.

Arminger et al. (1997) applied machine-learning techniques to construct nonlinear nonparametric forecasting models of consumer credit risk. By combining customer transactions and credit bureau data from January 2005 to April 2009 for a sample of a major commercial bank's customers, they were able to constructed out-of-sample forecasts that significantly improve the classification rates of credit-card-holder

delinquencies and defaults, with linear regression R2's of forecasted/realized delinquencies of 85%. Using conservative assumptions for the costs and benefits of cutting credit lines based on machine-learning forecasts, they estimated the cost savings to range from 6% to 25% of total losses. Moreover, the time-series patterns of estimated delinquency rates from this model over the course of the recent financial crisis suggests that aggregated consumer-credit risk analytics may have important applications in forecasting systemic risk.

Pierre et al. (2011) used dealer's quotes and transaction prices on industrial bonds to find out the factors that affect credit risk spread changes. They observed that, parameters that had to determine credit risk spread changes in theory had limited prediction power. The residuals produce in their regression were found to have high cross correlation. Their principal component dissection showed they were almost always affected by one identical factor. Their result suggested that monthly credit spread change are mainly affected by local supply and demand factors that are independent of both credit risk factors and accepted proxies for liquidities.

Du and Suo (2007) determined the extent to which the probability forecasting model on credit risk based on Merton's (1974) performed. Distance to default was studied as a sufficient statistical tool for equity market reports based on the credit worthiness of debt issuing firms.it was showed that, a simple reduced form outperformed the Merton (1974) for in sample fitting as well as out of sample forecasting. Credit risk scoring can be greatly enhanced by using the firm's equity value as an additional factor.it was concluded that distance to default did not best captures the firms credit quality report from the equity market.

Dionne et al. (2008) accessed how combining valuation by the structural model with the accounting model could improve forecasting of a company's probability of default. The mixture model proved to be better than other models. Precisely quantifying structural probability of default contributed greatly to forecasting default probabilities together with accounting and microeconomic factors as used in their

hybrid model. Result were achieved using the Merton's 1973, 1974 model together with default barrier model (Brockman & Turtle 2003), maximum likelihood method was also used to estimate the models parameters .

Oderda et al. (2003) produced a framework which determined the statistical importance of expected default occurrence computed by credit models. This frame work was used to investigate the attributes of two most popular models, namely the KMV credit monitor and Moody's risk calculator. Specific databases of expected default probability for both models were used to determine the consistency and timeliness of their forecasting. Cumulative accuracy profile (CAP) were introduced, that permitted them to observe in a single curve the fraction of firms that got grabbed by the model a year ahead. Miller information test were carried out to determine if more information was added by the model to the S & P rating. Results indicated that, the model added additional important information not catered for by rating alone.

Pires et al. (2013) studied the empirical determination of credit risk defaults swaps spread through a quintile regression analysis. In addition to conventional parameters such as implied volatility, put skewed, past stock returns, leverage, returns and rating. Results indicated that CDS premiums are strongly decided by CDS liquidity cost.it was also observed that, high volatile industries were most sensitive to change in the interpretive variables than low risk firms.

Altman et al. (2004) argues that the link between recovery rates has been conventionally abandoned by many credit risk modellers. Many modellers according to him concentrated on default risk and chose constant assumption, considering the recovery rate as a consistent parameters or a stochastic parameter unconventional of default. They presented a précised assessment of credit risk model elaborated in the past thirty years, treating recover rates and its relationship with probability of default of an obligatory.

Xiaolin et al., (2009) made do with a hybrid logic modelling method to forecast credit risk of some selected firms in china. To minimize the challenges mostly associated when dealing with correlation and multiple parameters of the financial indexes of the

selected firms as well as making sure some data were not lost; a factor assessment was introduced in the hybrid logic equation. A new modelling method was constructed; its parameters were drawn from the authentic financial indexes. Four out of the fifteen factors were chosen as proxies to the authentic financial indexes as explanatory parameters. It was observed that, the new method was reliable and presented a much more accurate forecasting method. Fisher (2014) generalizes Merton's asset valuation method to techniques of several financial companies in which a mixture of equity and liability ownership exist. Liabilities, included debts and derivatives were of dissimilar standing. He produced equations for determining the prices of equities and retrieval demand under no-arbitrage. An already functioning outcome and an exceptional outcome were shown. He provided illustrations and a method used for the simultaneous computation of all no-arbitrage prices.

Eisdorfer (2008) produces clues of risk-shifting behaviour in the investment outcomes of financially afflicted industries. He used a real options method to show that, shareholders' risk-shifting motivation can switch the habitual unfavourable link between volatility and investment. Two Algorithms that were dependant on risk-shifting behaviour were tested: (i) volatility has a positive impact on afflicted industries' investment; (ii) investments of afflicted industries bring about diminished value in times of high volatility. Empirical evidence using forty years of information backed each hypothesis. Again, he analysed the impact of each industries behaviour on risk shifting and quantified the cost of investment distortion.

Beaver (1967) and Altman (1968), developed univariate and multivariate models to predict business failures using a set of financial ratios. Beaver (1967) used a dichotomous classification test to determine the error rates a potential creditor would experience if he classified firms on the basis of individual financial ratios as failed or non-failed. He used a matched sample consisting of 158 firms (79 failed and 79 non-failed) and he analyzed 14 financial ratios. Altman (1968) used a multiple discriminant analysis technique (MDA) to solve the inconsistency problem linked to the Beaver's univariate analysis and to assess a more complete financial profile of

firms. His analysis drew on a matched sample containing 66 manufacturing firms (33 failed and 33 non-failed) that filed a bankruptcy petition during the period 1946-1965. Altman examined 22 potentially helpful financial ratios and ended up selecting five as providing in combination the best overall prediction of corporate bankruptcy. The variables were classified into five standard ratios categories, the variables were classified into five standard ratios categories, including liquidity, profitability, leverage, solvency and activity ratios. Tufano (1998) discusses the expenses of large companies risk management methods whose fundamentals make use of Cash flow hedging method. Cash flow hedging method according to him, gives companies the chance to prevent difficulties in costing extraneous financing by making their companies cash flow equivalent to their investment requirements. In instances of difficulties between management and shareholders, these hedging methods can be applied to decrease shareholders revenue, as the remove the important decisions or new methods that generate new external source of funding forced on management.

Eric and David (1999), investigated the part country risk plays in deciding the default risk of companies in emerging markets. They studied the relationship between secondary market spread of bonds issued by their governments in the past three and half years. Their result showed that market participation does not precisely fellow the "sovereign ceiling", which says that no companies is more creditworthy than its government. It was also found that spread of emerging market cooperates and government bonds were highly correlated.

Huang and Chen (2002) investigates the stochastic volatility option pricing model of Hull and White [Journal of Finance 42 (1987) 281]. Their study evaluates the out-of-sample attainment of the pricing model used in determining the covered warrants sold on the Taiwan Stock Exchange (TSE). Warrant values from Hull and White's stochastic volatility model and those of Black–Scholes methods are compared with surveyed option premiums. Pricing bases related to warrant strike price, time to maturity, volatility, and risk-free interest rate are also used in their research. Empirical outcomes indicated that, HW method with implied volatility did better in forecasting

the warrant prices; showing that the pricing model incorporated with stochastic volatility parameters can revamp the pricing of warrants. In addition, pricing lapses are logically linked to the degree to which the warrants are are making-money, and the riskiness of the underlying assets. Xiao et al. (2012) raises concern with the issues arising when allocating prices in an equity warrant in a mixed fraction Brownian invariant. Using a pseudo conditional expectation and frontier transform, they postulate a new method for pricing equity warrant. A mix exceptional Algorithm founded on the bases of genetic Algorithm is used in resolving a non linear optimization problem.

'Zhang et al. (2009) formulates an equity warrant estimation method under fractional Brownian motion, The European option estimation method was analysed using a simpler approach and a warrant pricing method was suggested and expanded to enclose equity warrant of stocks producing dividend. Changdian warrant in china's stock market was used for illustrations and the results obtained were noticed to be more accurate than the classical methods.

Gourieroux et al. (2003) argue continuous time affine models have not experienced the normal accomplishment with practioners and regulators. They attribute this to its shortfall in flexibility which implies poor fit, in comparison with more adhoc methods designed by industry. They produce a discrete time affine study of credit risk explaining how distinct type of variables can be used to apprehend distinctly the term structure of defaults correlation, of default heterogeneity, of correlation between default and loss given default was developed. These model, was used in deriving credit Var and numerous decomposition of the spread for cooperate bonds or first to default basket.

Morris and Shin (2009) elaborate and compare the particular measures used by establishments for credit risk. Risk arising from bankruptcy is a conditional probability of default resulting from depreciation of resource quality if no short term creditors exist. Total credit risk according to them is defined as the probability of default resulting from short term or asset bankruptcy. Liquidity is noted to be the difference

resulting from the two risk sources. They discuss the different effect each risk sources had on balance sheet component. A formula for liquidity risk is provided and it is shown that, a reduction liquidity ratio, an upward movement in outside option and an upward movement in fundamental risk ratio is a measure of export variation in the asset of a portfolio.

? trace the evolution of credit risk estimation information over the last two decades. Firstly, the development of information on credit risk estimation and portfolio is outlined and a new method formulated compassing mortality risk schemes in quantifying risk and returns on loans and bonds. Their new method proves to be good in evaluating risk returns on instruments of portfolios of credit risks and exposing debt instruments.

Abor (2005) investigates the link between capital structure and returns of enlisted companies on Ghana's stock exchange market over a five year range. Regression method is applied in evaluating the functions that links returns on equity (ROE) with capital structure. His research indicated a positive link between the ratio of short term debt to total asset and ROE, a negative link exist between ratio of total asset and ROE.

Yamanaka et al. (2011) present an intensity based credit rating migration model and execute empirical analyses on forecasting the number of downgrades in some credit portfolios. The framework of the method has it basis on so-called topdown approach. First of all, they model economy-wide rating migration intensity with a self-exciting stochastic process. Secondly, the downgrade intensity for the essential sub-portfolio with some attrition model specified by the distribution of credit ratings in the sub-portfolio is characterized. Their results of empirical analyses indicate that their method is to some extent consistent with downgrade data of Japanese from in a sample period.

Asanuma (2011) analyze the credit market and the effect of the monetary policy during an economic depression. He derived the credit rationing that would take place in the case of economic depression. The remarkable feature of his model was that the estimation of rationing can be arrived at in spite of the exclusion of the asymmetric

information assumption. In his model, the role of the expectation of the commercial bank is significant. The rationing result came from the different formalization of the commercial bank from mainstream theories. Because people accepted the debt the commercial bank issues, there was no need for it to have any deposits before it made loans. In contrast to the mainstream theories, the commercial bank did not face any physical constraint, i.e. the deposits it held. Deposits were generated by lending. This was found to be the special feature of the commercial bank. Although the Central Bank was introduced, and it implemented the monetary policy by manipulating the base rate to steer the economy, it has not always been effective.

Hao and Dong (2013) uses the k-nearest neighbour (K-NN) algorithm and random forest method to deal with imbalance data set the first one was called the preliminary classifier, contracted using k- mean clustering algorithm. The second classifier was contracted using random forest. The proposed approaches were applied to the credit risk assessment problems in small companies and compared to methods based on the k nearest algorithm. It was observed that the proposed approach has higher ability to identify the insolvent customers of the minority class.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In this chapter, discuss basic concepts on regression, linear regression and panel regression are discussed. The researcher will also take a look at Credit risk management and Black- Scholes - Mertons approach of determining default probability.

3.2 REGRESSION ANALYSIS

Sykes (2011) defines Regression analysis as a unique way of analysing multivariate data in which several type of measurement are taken from each individual of interest. We identify one measurement as response, or dependant; our interest is in making statement about this measurement, controlling for the other variables. Regression is basically used to analyse data from a cross section of subjects. In regression analysis, the researcher usually wants to find the relationship between entities. This could be the effect of study hours on the grade point of students in a school or the effects of working hours on income earning in a given community. To do this, the researcher collects data on the subject of interest and use regression analysis to determine the quantitative effect of the independent variable on the dependant entities. The researcher usually finds out the statistical significances of the quantified relation, that is how closer the estimated values are to the true values. Several form of regression analysis exist with the commonest being simple regression.

3.3 PANEL DATA REGRESSION

Panel data represents a marriage between time series and regression analysis , longitudinal data set are usually repeated cross-sections over a period of time, this

implies space as well as time dimensions will exist. This usually requires the researcher to move beyond simple descriptive patterns of variables and makes it easier to identify effects that are not easily observed in a normal time series analysis or cross sectional data analysis. Longitudinal data analysis is differentiated from a time series or cross sectional regression by the subscript.In panel data regression, a double subscript is attached to each variable. According to Hsiao (2003) panel data analysis permits:

- The researcher to use a huge number of data source , this increases the degree of freedom and reduces the collinearity among the independent variables and therefore helps improve the efficiency of the estimates .
- Allows for the construction and testing of complicated models that time series and cross sectional data cannot handle.
- It avoids bias from unobserved heterogeneity

3.3.1 APPROACHES TO PANEL DATA ANALYSIS

CHANGE SCORE MODELS

This is the simplest form of modelling in panel data analysis; it is used in predicting change and its response between two points. This permits the researcher to analysis whether change over a given period of time is linked or related to a fixed characteristic of individuals and defined by the equation:

$Y_{i2} - y_{i1} = \beta_o + \beta_1 x_{i1} + \ldots + \beta_p x_{ip} + e_i$ Where, y_{i1} and Y_{i2} represents the response individual i at time period 1 and 2 respectively x_{it} and x_{ip} represents the values taken by the covariate predictor and

e_i is the error term.

The instances where the term y_{i1} is not considered as predictor in the model , is defined as the unconditional change score model,this allow us use the cross sectional method in panel data to model the differences in Y with the ordinary lease square

method (OLS).The disadvantage of this method include: The change is always considered to be independent of the response at the first time period of the predictor value. An alternative to this form is the conditional change model, where the response at the first time is made used of as a predictor model

$$Y_{i2} - y_{i1} = \beta_o + \beta_1 x_{i1} + \ldots + (\beta_{p+1} - 1) y_{i1} + e$$

This method of panel data analysis is often limited to two waves of data set.

FIXED EFFECT MODELS

The fixed model is represented by the equation:

$$Y_{i,t} = \alpha_i + \beta X_{it} + \varepsilon_{it}$$

$$X_{it} = 1 + k$$

In the fixed mode, α_i for $i = 1,\ldots n$ are unknown constants included in the noise parameter.

ASSUMPTIONS

1. ε_{it} are i.i.d cross variables and time dated with $E[\varepsilon_{i,t}] = 0$ and $V[\varepsilon_{it}] = \sigma^2$ for all i and t
2. The regressor variable X_{it} is independent of $\varepsilon_{j,s}$ for all i,j and t,s

These assumptions means the time-variant errors are conditionally homoskedastic and serially uncorrelated.The fixed effects models are usually referred to as models where we allow for arbitrary correlation between the unobserved individual effect α_i and the observed explanatory variable X_{it} (Wooldridge, 2002). Assumption one puts out the strict exogeneity , with assumption two needed for the optimality of OLS.

The fixed effect model in its compact form is written us:

$$y_i = S_T \alpha_i + X_i\beta + \varepsilon_i$$

Where $y_i = T \times 1$ $X_i = T \times K$ $y_i = (y_{i1},\ldots,y_{it})$ and $S_T = (1,1)$ is a is a T- dimensional vector of ones

$$y = (I_n \otimes S_T)\alpha + X\beta + \varepsilon \equiv W\gamma + \varepsilon \quad (3.1)$$

Where,

$y = nT \times 1, (I_n \otimes S_T)\alpha \equiv D$ and $X = nT \times k, y = (y_1', \ldots, y_n')', \alpha = (\alpha_\prime, \ldots, \alpha_n)'$ and $W = [D,X]$

Equation (3.1) can be written explicitly as

$y_{2,T}$ = 1 $x_{2,T}'$ β $\varepsilon_{2,T}$

$y_{n,}$.........

1

... ... 1

1...

$\alpha_{...n}$

$x x_{n,T}' {}'_{n,}$.........

1

$\varepsilon \varepsilon_{n,T n,}$.........

1

$y_{n,T}$

LEAST SQUARE DUMMY VARIABLES (LSDV) ESTIMATOR

Using the ordinary least square method to determine the statistically significance of the fixed effect models, we first of all have to partition the regression to get the equation below

$$\hat{\beta} = (X'M_D X)^{-1} X'M_D y = \left(\sum_i X_i' M_T X_i\right)^{-1} \sum_i X_i' M_T y_i \quad (3.2)$$

Where $M_D = I_{nT} - D(D,D)^{-1}D' = I_n \bigotimes M_T,\ M_T = I_T - \frac{1}{T}S_T S_T'$

To interpret the LSDV estimator, you will have to consider data in difference from time means.

$$y_{i,t} - \bar{y}_{i.} = (x_{i,t} - \bar{x}_{i.})\beta' + \varepsilon_{i,t} - \bar{\varepsilon}_{i.} \tag{3.3}$$

Where

$$\bar{y}_{i.} \equiv \frac{1}{T}\sum_i Y_{i,t}$$

$$\bar{x}_{i.} \equiv \frac{1}{T}\sum_i x_{i,t}$$

$$\hat{\beta} = \left[\sum_i \sum_i (x_{i,t} - \bar{x}_{i.})(x_{i,t} - \bar{x}_{i.})'\right]^{-1} \sum_i \sum_i (x_{i,t} - \bar{x}_{i.})(y_{i,t} - \bar{y}_{i.}) \tag{3.4}$$

Estimators for the fixed effect then becomes $\bar{\alpha} = \bar{y}_i - \bar{x}_i\hat{\beta}$

We obtain unbiased and consistent estimators using OLS, provided assumption one is obeyed.

FINITE SAMPLE PROPERTIES OF THE LSDV ESTIMATORS

With standard results from OLS, The two assumptions for the fixed effect models are considered to be strictly exogenous with spherical errors. Thus,

$E[\varepsilon/X] = 0$,and $V[\varepsilon/X] = \sigma^2 I_{nT}$

if assumptions two is not obeyed,serial correlation will be faced between the errors in the first differencing and the regressors.

$$W = [DX] \tag{3.5}$$

is a matrix with full column rank,for the matrix to be satisfied it becomes compulsory for the regressor X not to have time-invariant variables. Considering the assumptions for the fixed effect model and equation 3.4,The optimal estimator in this case is the generalized least squares (GLS) estimator, $\hat{\beta}$ is considered to be blue with variance:

$$V[\hat{\beta}/X] = \sigma^2[X'M_DX]^{-1} = \sigma^2\left[\sum_i\sum_t (x_{i,t} - \bar{x}_{i.})(x_{i,t} - \bar{x}_{i.})'\right]^{-1} \quad (3.6)$$

The unbiased estimator of σ^2considering the residual$\hat{\varepsilon}_{i,t} = y_{i,t} - \hat{\alpha} - x'_{i,t}\hat{\beta}$ becomes,

$$\hat{\alpha}_2 = \frac{1}{n(T-1)-K}\sum_i\sum_t \hat{\varepsilon}_{i,t}$$

Large sample properties of the LSDV estimators is considered when the assumption of serial correlation and homoskedasticity are violated and when there would be inconsistent standard errors subsequent to estimation. This often depends on the following asymptotic properties

1. $n \to \infty$
2. n is fixed and $T \to \infty$
3. $n, T \to \infty$

Considering assumption one under standard regular conditions,

$$P\lim_{n\to\infty}\frac{1}{T}\sum_i X_i' M_T X_t \equiv Q$$

is positive definite

$$p\lim_{n\to\infty}\frac{1}{n}\sum_i X_i' M_T \varepsilon_i = E[X' M_T \varepsilon_i] = 0$$

As stated in the first two assumptions made above

$$\frac{1}{n}\sum_i X_i' M_T \varepsilon_i \xrightarrow{d} N(0, \sigma^2 Q)$$

We then have,

$$\hat{\beta} - \beta = \left(\frac{1}{n}\sum_i X_i' M_T X_i\right)^{-1}\frac{1}{\sqrt{n}}\sum_i X_T' \varepsilon_i$$

The LSDV estimator is deduced to be consistent and asymptotically normal using the equation :

$$\sqrt{n}(\hat{\beta} - \beta) \xrightarrow{d} (0, \sigma^2 Q^{-1})$$

Asymptotically valid standard errors and confidence intervals without assuming normalities of the errors are calculated using the equation :

$$\widehat{AsVar}(\hat{\beta}) = \hat{\sigma}^2 \left[\sum_i \sum_t (x_{i,t} - \bar{x}_{i.})(x_{i,t} - \bar{x}_{i.})' \right]^{-1}$$

INDIVIDUAL AND TIME FIXED EFFECT

This model is modelled in such a way that it will include both individual and time effect.

$$y_{i,t} = c + \alpha_i + f_t + x_{i,t}'\beta + \varepsilon_{i,t}$$

To, avoid the dummy variable trap, we usually exclude the effect for one individual $\alpha_i = 0$ and one time date $f_t = 0$ and include the constant c.

To eliminate both the individual and time effect, the transformation below is used.

$$y_{i,t} - \bar{y}_{i.} - \bar{y}_{.t} + \bar{y}_{..} = (x_{i,t} - \bar{x}_{i.} - \bar{x}_{.t} + \bar{x}_{..})'\beta + \varepsilon_{i,t} - \bar{\varepsilon}_{i.} - \bar{\varepsilon}_{.t} + \bar{\varepsilon}_{..} \quad (3.7)$$

Where:

$$\bar{y}_{.t} = \frac{1}{n} \sum_i y_{i,t}$$

$$\bar{y}_{..} = \frac{1}{nT} \sum_i \sum_t y_{i,t}$$

To obtain the LSDV estimator of β , pooled regression is applied on the equation above.

RANDOM EFFECTS MODEL

According to the Economic and Council (2006), often our interest is in measuring change over a period of time. This requires treating the repeated measure of interest as a sample of observation from a continuous development process.

For example, let consider the weight of new born taken each month in a year. We might prefer to analyse these observation as indication of an underlying developing

pattern. We might expect the overall sequence to be positively and linear since weight of newborns increase steadily in the first year. Again, we might also expect some individual differences in the overall weight trend since some newborns will naturally gain more weight faster than others. This will further ascend our interest to look more into the characteristics of each individual newborn connected with variability in growth. Random effect models are mostly used to address issues of this nature. Random effect models allow the researcher to model each individual path that evolves with time. In the random effects model, the α_i are not estimated directly, but are rather assumed to follow a specied probability distribution.

The random model in its simplest form is expressed as:

$$y_{i,t} = \alpha + x_i^{'}\beta + \varepsilon_{i,t} \equiv z_{i,t}^{'}\gamma + \varepsilon_{i,t}$$

The error part of the equation becomes:

$$\varepsilon_{i,t} = u_i + v_{i,t}$$

ASSUMPTIONS

1. the individual errors u_i should be i.i.d across individuals with $E[u_i] = 0$ and $V[u_i] = \sigma^2$ for all i
2. The errors v_{it}, should be i.i.d across individual and time dates $E[v_{it}] = 0$ and $V[v_{i,t}] = \sigma_v^2$ for all i in t
3. The error u_i and $v_{j,t}$ are independent , for all i,j and t
4. The regressor $x_{i,t}$ is independent of errors u_i and $V_{j,s}$ for all i,j and t,s

The Random effect in it compact form is written us :

$$Y = S_{Tn}\alpha + X\beta + \varepsilon \equiv z_\gamma + \varepsilon$$

$Y = nT \times 1, E[\varepsilon_l] = 0$

$$\begin{pmatrix} \sigma_v 2 + \sigma_u 2 & \sigma_u^2 & \cdots \\ \sigma_u^2 & \vdots & \sigma_u^2 \quad \sigma_v^2 + \sigma_u^2 \end{pmatrix}$$

$$\sigma u2 \; \sigma v2 + \sigma u2 \; \sigma u2 \; \Omega \equiv \begin{matrix} \cdots & \cdots \\ \cdots & \end{matrix}$$

$$V[\varepsilon] = I_n \otimes \Omega \equiv V$$

Using the random effect estimator on equation 3.7 we obtain the equation below

$$\gamma\hat{} = (Z_0 V^{-1} Z)^{-1} Z_0 V^{-1} y = (\mathrm{X} Z_{i0} \Omega^{-1} Z_l) \mathrm{X} Z_0 \tau \Omega^{-1} y_i \qquad (3.8)$$

$i \qquad i$

we proceed to use spectra decomposition to invert Ω to enable us get the equation below.

$$\Omega = \sigma_v^2 I_T + (T\sigma_u^2)\frac{1}{T} S_T S_T' = \sigma_v^2 (I_T - \frac{1}{T} S_T S_T') + (T\sigma_u^2 + \sigma_v^2 \frac{1}{T} S_T S_T') = \lambda_1 M_T + \lambda_2 (I_T - M_T)$$

$\lambda_i \equiv \sigma^2$ and $\lambda^2 \equiv T\sigma_u^2 + \sigma_v^2, \; \Omega^{-1} = \lambda_1^{-1} M_T + \lambda_2^{-1} (I_T - M_T)$

We assume M_T is decomposed ,hence

$$V^{-1} = \lambda_1^{-1} I_n \otimes M_T + \lambda_2^{-1} \otimes (I_T - M_\mathrm{T}) = \lambda_1^{-1} M_D + \lambda_2^{-1} (I_{nT} - M_D)$$

INTERPERATION WITHIN AND BETWEEN COVARIATION

Using partition for the GLS regression, the random effect estimator for the sub vector β becomes,

$$\beta\hat{} = (X_0 M_V X)^{-1} X_0 M_v y$$

,

$$M_v = V^{-1} - V^{-1}S_{nT}(S_{nT}^{'}V^{-1}S_{nT})^{-1}S_{nT}^{'}V^{-1}$$

using

$$V^{-1}S_{nT} = \lambda_2^{-1}S_{nT}$$

, we can rewrite

$$M_v = \lambda^{-1}M_D + \lambda_2^{-1}M_B$$

With

$$M_D = I_n \otimes (I_n - \frac{1}{T}S_T S_T^{'})$$

and

$$M_B = I_n \otimes \frac{1}{T}S_T S_T^{'} - 1\frac{1}{nT}S_{nT}S_{nT}^{'}$$

Then,

$$\hat{\beta} = (\lambda_1^{-1}X^{'}M_D X + \lambda_2^{-1}X^{'}M_B X)^{-1}(\lambda^{-1}X^{'}M_D y + \lambda_2^{-1}X^{'}M_B y) \quad (3.9)$$

with

$$X^{'}M_D X = \sum_i \sum_t (x_{i,t} - \bar{x}_{i.})(x_{i,t} - \bar{x}_{i.})^{'}$$

$$X^{'}M_D y = \sum_i \sum_t (x_{i,t} - \bar{x}_{i.})(y_{i,t} - \bar{y}_{i.})$$

$$\frac{1}{T}X^{'}M_B y = \sum_i (\bar{x}_{i.} - x_{..})(\bar{y}_{i.} - \bar{y}_{..})$$

$$\frac{1}{T}X^{'}M_B X = \sum_i (\bar{x}_{i.} - \bar{x}_{..}) - (\bar{x}_{i.} - \bar{x}_{..})^{'}$$

These are the variation and co variation between individuals. The random effect estimator is blue under assumptions 1 and 4 with variance. The properties mentioned above critically depends on strict exogeneity of the regressors,(Galgliardini, 2013).

$$E[\varepsilon_i/X_i] = 0 \quad (3.10)$$

Strict exogeneity as indicated in the above equation is a very strong assumption. It fails when the regressor $x_{i,t}$ are correlated with the individual specific effects $u_{i,t}$.

FGLS ESTIMATOR

this estimator is used when $n \to \infty$, and T is fixed, or when $n,T \to \infty$ and are biased in finite sample. Consistent estimates of σ_u^2 and σ_v^2, or its equivalence of λ_1 and λ_2 are given by:

$$E[\varepsilon_i' M_T \varepsilon_i] = tr(M_T E(\varepsilon_i \varepsilon_i')) = tr(M_T \Omega) = \lambda_1 M_T = \lambda_1 (T-1)$$

$$E[\varepsilon_i'(I_T - M_T)\varepsilon_I] = \lambda_2 tr(I_T - M_T) = \lambda_2$$

The estimators are deduced based on the GLS residuals :

$$\hat{\varepsilon}_i = y_i - z_i \hat{\gamma}$$

$$\hat{\lambda}_1 = \frac{1}{n}\frac{1}{T-1}\sum_i \hat{\varepsilon}_i' M_T \varepsilon^i = \frac{1}{n(T-1)}\sum_i \sum_t (\hat{\varepsilon}_{i,t} - \bar{\varepsilon}_{i.})^2$$

$$\hat{\lambda}_2 = \frac{1}{n}\sum_i \hat{\varepsilon}_i'(I_T - M_T)\hat{\varepsilon}_i = T\frac{1}{n}\sum_i \hat{\varepsilon}_i^2$$

The FGLS Estimator is defined :

$$\hat{\Omega}^{-1} = \hat{\lambda}_i^{-1} M_T + \hat{\lambda}_2^{-1}(I_T - M_T)$$

The estimator $\hat{\lambda}_1$ and $\hat{\lambda}_2$ can be used to generate the error variance $\hat{\sigma}_u^2$ and $\hat{\sigma}_v^2$ by solving the equation $\hat{\lambda}_1 = \hat{\sigma}_v^2, \hat{\lambda}_2 = T\hat{\sigma}_u^2 + \hat{\sigma}_v^2$

Where,

$$\hat{\sigma}_v^2 = \lambda_1$$

$$\hat{\sigma}_v^2 = \frac{1}{T}(\hat{\lambda}_2 - \hat{\lambda}_1)$$

3.4 CREDIT RISK MODELLING

According to Andersen et al. (2009) credit risk can be defined as the probability of a loss due to the failure of a counterpart to honour the financial obligation .credit risk is found in all financial firms. Credit losses distributions are usually complicated .credit risk is usually associated with probability of default which means failure to honour a financial obligatio (Giesecke, 2002). The three major factors affecting credit risk Include:

1. probability of default
2. The lost given default,computed as one minus the recovery rate when default occurs
3. finally the exposure of default.

To compute for default probability, we have to estimate

1. A model quantifying an investors uncertainty or risk
2. A model for the available historical data set and how it changes with time
3. A model defining the default event.

In addition to the above mentioned, we will need to model the risk free interest, the recovery rate upon default as well as a model of the premium investors require as compensation for bearing systematic credit risk. Credit risk is categorized into credit risk management and Analysis of credit risk securities.

3.4.1 STRUCTURAL/ FIRMVALUE MODEL

These models are derived from Merton's (1974). this model postulates the mechanism for the default of a firm in terms of the link between the firms asset and liabilities within a given time frame.

3.4.2 REDUCED FORM MODELS

In these models, the precise mechanism leading to default of any firm is left unspecified. However, the time to default is usually modeled as a non-negative random variable with its distribution depending on economic covariate.

3.4.3 MACROECONOMIC MODEL

Among macroeconomic models, Credit Portfolio View is most widely used, a model proposed by McKinsey. It is a multi-factor model based on the casual observation that default and migration probabilities are linked to the economy (Couchy et al., 2011). The model measures only default risk, and the times series of default rates per industry sector are required as the most important data input for simulating macroeconomics scenarios, which are used for estimating the conditional distribution of default probabilities for individual credits.

3.4.4 ACTUARIAL MODEL

Actuarial models predict the loan loss distribution with the help of statistical techniques. In the model, borrowers are allocated among country-industry segments and default of individual loans is assumed to follow a Poisson process. The development of a loan is understood as that either the obligor pays the amount due or the loan defaults, and no profits or losses from rating migrations have to be considered. As concluded by Gundlach and Lehrbass (2004), the attractiveness of Credit Risk are that it is more intuitive and better suited to practical needs. There is no requirement to provide the complete cash flow vector for each loan or to update spread curves for each rating class on regular basis.

BLACK-SCHOLES-MERTON APPROACH

Black Scholes and Merton's method of determining the default of a firm was introduced by the prize winners Black, Scholes (1973)and Merton (1973),(Mcneil et al., 2005).

According to them, the value of a firm denoted by V_T is assumed to fellow a certain stochastic process, at time t. This firm is financed by debt B_t and equity S_t. The value of the firm at time $t = 0$ is given by the equation : $V_t = S_t + B_t$, $0 \leq t \leq T$

At maturity T, two events are likely to happen

1. $V_T > B$ The firms value becames greater than the liability, the bond holder receives payment B and the share holder is also entitled: $V_T - B$,Hence default does not occur.The value of the firms equity at maturity can be said to be equal to the payoff of an European call option,with the given European call option written us :

$$S_T = Max(V_T - B, 0) = (V_T - B)^T \quad (3.11)$$

2. $V_T \leq B$, this indicates that the value of the firms asset at maturity,T becomes lower than its liabilities. The share holders will then exercise their right of limited liability and give out the firm to the bondholders who will then liquidate and share the proceeds.The share holders are entitled to nothing, $B_T = V_T, S_T = 0$.The value of this firms asset at maturity is considered to be the nominal value of the firms debt minus the payoff of an European put option exercised on V_T with the exercise price being equal to B.

In actual world happening, or in physical probability measures, the value of the firm's asset is assumed to follow a log normal process or the black Scholes diffusion model given us:

$$dV_t = \mu_A d_t + \sigma_A dz_t \quad (3.12)$$

where : $\mu_A \in R$=Instantaneous growth rate, $\sigma_A > 0$ = Volatility of the firm's asset, Z_t=standard Brownian motion.

The firm's equity value is taken as a call option on the firms underlying asset and is expressed through the black Scholes option pricing as:

$$V_{E,T} = V_{A,T} N(d_1) - Be^{-rT} N(d_2)$$

Where,

$$d_1 = \frac{In(\frac{V_A}{B})) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

$$d_2 = \frac{In(\frac{V_A}{B})+)(r - \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

r =Risk free interest rate, N(.) =cumulative probability function for normal standard distribution $V_A - V_B$ = current value of debt.

The default probability is given as :

$P_{def} = P(V_{A,T} \leq B)\ In(V_{A,T}) + (\mu_A - \sigma_{A2})T + \sigma_A Z_t$

Were v_A = is the current value of asset

$$P(V_T \leq B) = P(InV_T \leq InB) = N\left[-\frac{In\frac{V_A}{B} + (\mu_A - \frac{\sigma_A^2}{2})T}{\sigma_A\sqrt{T}}\right] \quad (3.13)$$

3.4.5 ESTIMATION OF PARAMETERS FOR THE BLACK – SCHOLES-MERTONS MODEL

1. V_A is observable from the market and can be computed using the accounting principle as :

$$V_A = E + B$$

if the number of share holders and share prices are known,the value of the firms asset can be expressed as

$$V_A = nS_0 + B$$

2. B is observable in the market and can be computed from the accounting principle given in the equation above.

3. Expected profit ratio of the asset μ_v is equal to the risk free interest rate, this is assumed to take the value of the one year treasury bill rate in the country.

4. Volatility of Equity,σ_E is the only parameter that is not observable in the market, it is computed by using the historical volatility approach method.the length of the period in this work is assumed to be 60 days,The rolling day formula is used to achieve each days volatility forecast :

$$\hat{\sigma}^2_{t+1} = \frac{1}{n-1}\sum_{i=t-n}^{t}(R_i - \bar{R})$$

Where,

$$R_i = In(\frac{S_i}{S_{i-1}})$$

,

$$\bar{R} = \frac{1}{n}\sum_{t}^{i=t-n} R_i$$

The Rolling volatility is annualized by multiplying the actual trading days in a year to the variance,

$$\sigma^2 = \sigma^{\wedge 2}\mathrm{p} numberoftradingdaysinayear$$

5. Volatility of the asset σ_v this is assumed to follow an Ito lemme process given below

$$\sigma_V = (\frac{E}{V})(\frac{\delta V}{\delta E})\sigma_E$$

$$\sigma_V = \Big(\frac{E}{V}\Big)\Big(\frac{1}{N(d_1)}\Big)\sigma_E$$

CHAPTER 4

ANALYSIS AND DISCUSSIONS OF RESULTS

4.1 INTRODUCTION

This chapter discusses data analysis and interpretation of results.

4.2 DATA

The data type for this study will be mainly a secondary data comprising of financial statements and the closing stock prices of five selected banks listed on the Ghana stock exchange market for a period of five years. The banks used for the study includes Cal, Ecobank, UT, HFC and SG-SSB bank. The time frame for the data is from 2009-2013,the data is acquired from Annual Report Ghana and the Ghana stock exchange market.

Table 4.1: LIST OF THE DEPENDANT AND INDEPENDENT VARIABLES

Variable	Independent (Internal factors)	Null Hypothesis
Capital Adequacy	CA =total equity /total asset	+
Asset Quality	AQ = total loan/Total asset	+
Liquidity	LIQ= cash/Total Asset	-
Efficiency	EFF = Interest income/interest expensed	+
Size	SIZE= log of total asset	+
Variables	Independent Variable (External Factors or credit risk factors)	Hypothesis
Inflation	I = P0-P1/ P1 * 100%	-
GDP Growth	GDP = GDP 2- GDP 1/GDP 1	-
Private indebtness	P . IND= total gross loan/GDP	+
Average Exchange rate	EXC R= total exchange rate/n	-
	DEPENDANT VARIABLE	
Profitably	ROA =net income/total asset	
ε	Error term	

4.3 REGRESSION ANALYSIS

INDEPENDENT VARIABLE

These are classified into two main groups,the internal and external factors. The internal factors are based on banks specifics and usually affected by management decisions as well as their policy objectives.The external factors are based on macroeconomic factors, which are proven to be the main causes of credit risk experienced by the banking sector.

CAPITAL ADEQUACY

This measure how banks respond to external shocks.The higher the capital adequacy, the lower the need for external funding from the banks,which results in higher profitability. Banks with high capital usually have little tendency of going bankrupt when faced with economical crisis, their high capital usually serves as cushion during economic crises.

ASSET QUALITY

Asset quality measures the general health trend of a banks credit and asset quality.It is also serves as a banks credit risk indicator,higher risk is most often associated with high rates of returns.This however could bring about a reduction in the asset of the bank.

LIQUIDITY

Liquidity is defined as cash over asset,a shortfall of this could result in the failure of a bank.Liquidity is often viewed with much concern by regulators of the banking industry,not holding enough liquidity to meet the demands of customers could lead to a run.On the other hand,holding too much physical cash could result in the reduction in income of any bank,physical cash is known to yield lower rate of return as compared to non physical cash.

EFFICIENCY

The main component includes the salaries of workers and the cost incurred by the banks from its administrative cost.It serves as a major factor in determining the efficiency of a bank on its profitability,its usually expected that a higher operating cost will result in lower profit.

SIZE

Larger banks have been found by researchers to be less exposed to bankruptcy; they are more diversified and are able to absorb shock than smaller banks. Bigger banks have a high ability to put more money into research and findings, invest in more human resources and technological advancement. They are also able to win bigger deals with big private and public investors. The size of a bank permits it to function with little capital and engage in more lending.

INFLATION

Inflation causes a currency to loose its worth,it is characterized by more money chasing goods and services. In a bid to resolve this, the central bank most often increases the interest rate to reduce the amount of money circulating in the system.Borrowing then becomes expensive with less money spend on investment and more of the profit given back to the bank as repayment of loans.this will result in more debtors defaulting.

GDP GROWTH

GDP measures the growth rate of a country. An increase in the economy is usually meet with a very low number of non performing loans.Loans are usually given out to only costumers and industries that have a considerable flow of income. As the economy keeps growing, loans are given out to less credit worthy costumers, and when the economy starts to experience a decrease, the numbers of nonperforming loans become high.

PRIVATE INDEBTEDNESS

An increase in the debt of investors will make them more prone to shocks, this shocks will negatively affect their cash inflow and will increase their probability of default to the banks.

AVERAGE EXCHANGE RATE

An increase in the Exchange rate wills means more money used in the importing of goods and services to the country. This will means a decrease in the cash flow of investors hence increasing their probability of default.

THE EMPIRICAL MODEL

$$Profitability = \alpha_0 + \sum_{i}^{n} (internalfactors)_{jk} + \sum_{k}^{k} (Externalfactors)_{k}$$

$$ROA = \alpha_o + \sum_{j}^{} (ExternalFactors)_{j} + \sum_{j}^{} (CreditRiskFactors)_{j}$$

$$ROA = \alpha_0 + \beta(CA_{it}) + \beta(AQ_{it}) + \beta(LIQit) + \beta(EFFit) + \beta(SIZEit) + \beta(Iit) + \beta(GDPit) + \beta(P.INPit) + \beta(EXC.Rit)$$

REGRESSION ANALYSIS AND DISCUSSION

This will concentrate more on the descriptive statistics of the chosen variables and then the panel data model.The Panel data will be explored for the presence of autocorrelation,serial correlation and hetroscedasticity.The coefficients of the unknown variables will be estimated using the Generalized Least Square Method, a method which becomes the best linear unbiased estimator where serial correlation and hetroscedasticity could be present.

DESCRIPTIVE ANALYSIS

Table 5.1 in the appendix consist of the descriptive analysis of the variables used in the panel data regression analysis.The parameters recorded in the table consist of the number of observations,mean,standard deviation,the maximum and minimum values of the observations between the period 2009-2013. From the table it is noticed that, capital adequacy has highest standard deviation, this means that, it has the largest significance over the period considered for the study.liquidity has the lowest standard with return on asset recording a minimum of 0.33,with a maximum of 6.24 and a mean value of 2.99 percent.

CORRELATION MATRIX

Correlation ranges between -1 and +1,it showed the relationship between the independent variables and the dependent variable and the strength of their relationships and the directions.correlation inform us if there is multicollinearity among the variables.Presence of multicollinearity will mean the variables are related it becomes difficult to tell which variable is influencing the dependent variable.Pearson product-moment correlation coefficient was used to produce the correlation coefficient matrix and the result is presented in table 5.2 of appendix A

TEST ON THE INDEPENDENT VARIABLES

The independent variables were subject to several tests to verify Heteroscedasticity, homoscedasticity, and autocorrelation to determine the most efficient estimators for the coefficients.

WOOLDRIGDE TEST

This test was carried out to determine the presence of autocorrelation,not considering this test usually leads to inefficient estimates and biased standard errors.the null hypothesis was formulated us no presence of serial correlation with

the alternative test being the presence of serial correlation. A P value of 0.006131 was recorded,hence we failed to reject the null hypothesis .This test was carried out with the R- software and the result recorded in the Table 5.3 of appendix A BREUSCH PAGAN TEST

This test is carried out to determine the presence of hetroscedastic errors, the absence of these implies homoscedastic errors. The test carried out yielded a PValue greater than 0.05, hence we failed to reject the null hypothesis.the result is recorded in 5.4 Appendix A

Table 4.2: DESCRIPTIVE STATISTICS FOR RESIDUALS OF FIXED EFFECT

Min.	1st Qu.	Median	3rd Qu.	Max.
-0.012900	-0.001880	0.000614	0.002490	0.009180

Table 4.3: REGRESSION RESULTS, FIXED EFFECTS MODELS

	Estimate	Std. Error	t-value	Pr(>|t|)
CA	3.7579e-01	9.7369e-02	3.8594	0.0026560
AQ	7.2002e-05	2.9459e-05	2.4441	0.0325841
LIQ	1.7434e-01	1.0004e-01	1.7427	0.1092387
EFF	-1.4552e-03	3.0245e-03	-0.4811	0.6398605
SIZE	-1.5167e-03	2.9472e-02	-0.0515	0.9598797
I	6.2969e-03	1.7622e-03	3.5733	0.0043698
GDP	-9.2956e-04	7.5778e -04	-1.2267	0.2455478
P.INDP	-1.9350e-03	4.2024e-04	-4.6045	0.0007594
E.R	-5.6526e-02	3.2602e-02	-1.7338	0.1108485

R-Squared : 0.78038,F-statistic: 4.34299 p-value: 0.012706

Table 4.4: DESCRIPTIVE ANALYSIS OF IDIOSYNCRATIC AND INDIVIDUAL EFFECTS

	var	std.dev	share
idiosyncratic	4.484e-05	6.696e-03	0.223
Individual	1.561e-04	1.249e-02	0.777

theta :0.7669

Table 4.5: REGRESSION RESULT, RANDOM EFFECT MODELS

	Estimate	Std. Error	t-value	Pr(>|t|)
Intercept	9.6425e-04	1.2651e-01	0.0076	0.9940192
CA	3.6222e-01	8.3967e-02	4.3138	0.0006145
AQ	5.3029e-05	1.6880e-05	3.1416	0.0067203
LIQ	1.6459e-01	9.1901e-02	1.7909	0.0934983
EFF	1.0135e-03	1.8824e-03	0.5384	0.5981838
SIZE	-3.3271e-03	1.6160e-02	-0.2059	0.8396443
I	5.9085e-03	1.3089e-03	4.5139	0.0004117
GDP	-8.3251e-04	6.4385e-04	-1.2930	0.2155650
P.INDP	-1.8053e-03	3.1837e-04	-5.6706	4.443e-05
E.R	-5.0412e-02	1.8561e-02	-2.7160	0.0159383

R-Square : 0.75327 F- statistic :5.08838 p-value :0.0028766

HAUSMAN TEST

To decide between fixed or random effects ,a Hausman test is run. the null hypothesis is that the preferred model is random effects vs. the alternative the fixed effects. This test is to check if the unique errors are correlated with the regressors.Hausman test : $chisq = 1.5725$, $df = 9$, $p - value = 0.9966$ The Hausman test gave a $p - value =$

0.9966 indicating the fixed effect model is appropriate for this study, The result is recorded in in table 5.5 of appendix A.

DISCUSSION OF REGRESSION RESULTS

Using the Fixed effects model, the overall model is efficient at 78.% with $p-value$ = 0.012706. Thus, the independent variables predict 0.78% probability of predicting the profitability of banks at $R - Squared$ = 0.78038. From the results presented in Table 4.3, inference can be made that capital adequacy is significant in predicting the profitability of banks at p-value = 0.0026560. Cet par, a unit increase in the capital adequacy of the banks will increase the profitability of banks by 3.7 whereas a decrease in a unit of the capital adequacy will cause the profitability of banks to decrease by 3.7 The researchers' alternative hypothesis that capital adequacy is Positively related to profitability is accepted as shown in table 5.6 of appendix B. Asset Quality has a significant impact on the profitability of banks. Cet par, a unit increase in the asset quality of banks increases the profitability of banks by 7.2 at $p - value$ = 0.0325841, the researcher hypothesis that capital adequacy is positively linked to the profitability of the bank is accepted as presented in table 5.6 of appendix B. Inflation is one of the most reliable factor that can influence profitability and significant at p = $value$ = 0.0043698. A unit increase in inflation will cause the profitability of a bank to increase by 6.2.The researchers Hypothesis that inflation is negatively profitability is rejected as shown in table 5.6 of appendix B.

Private indebtedness from the research is found to have a significant relationship with profitability, a unit increase in private debt will causes profitability to reduce by 1.93 unit. The earlier hypothesis that private indebtness is positively linked to the profitability of the bank is rejected as shown in table 5.6 of appendix B. The size of the banks, liquidity, efficiency, GDP and Exchange rates of the banks have no significant impact on the profitability of banks. From the result,the researchers hypothesis for Liquidity, efficiency,size are rejected and that of GDP and Average Exchange rate is accepted as shown in table 5.6 of appendix B.

4.4 MERTON- BLACK-SCHOLES MODEL

The equity holders of the banks are assumed to have a call option on the underlying asset of the firm with a strike price equal to the firms liability.Their limited liability gives them the right but not the obligation to pay off the debt holders and then be in-charge of the firms asset. At maturity,the equity holders will be expecting a payoff of the call option as:

$$E_T = Max(V_{A,T} - B, 0)$$

The debt holders of the banks are assumed to have a put option on the firms asset,They are considered to owe the banks until their debt obligations are honored. Failure of the equity holders to pay them off at maturity will make the equity holders exercise their limited Liability right and hand over the ownership of the banks to the debtors. The debtors will in turn liquidate the banks and share the proceeds. At maturity, the expected payoff is given as

$$E_T = Min(V_A, B) = B - (B - V_A)$$

ASSUMPTIONS

- No dividend is paid on the stock
- No arbitrage opportunity exist
- No transaction cost is incurred
- A perfect market is assumed.

Parameters for the black scholes is calculated and recorded in the Table below :

Table 4.6: PARAMETER FOR BLACK-SCHOLES-MERTON MODEL

BANK	YEAR	D	V_E	σ_V	σ_V	r
Bank 1	2009	393,456,000	57,014,000	0.000400641631	0.00316548629	0.2

	2010	423,232,000	76,519,000	0.001359334864	0.00887791212	0.1265
	2011	693,142,000	92,921,000	0.002555796028	0.02162069600	0.113
2	2009	182,780,000	205,413,000	0.000168799	0.001140751	0.2
	2010	1,293,583,000	227,646,000	0.00034169505	0.002283354	0.1265
	2011	1,869,584,000	262,599,000	0.00033934297	0.00275531	0.113
3	2009	226,227,169	32,058,246	0	0	0.2
	2010	291,635,679	69,775,606	0.00016474728	0.000853329	0.1265
	2011	356,915,855	74,009,334	0.00051110934	0.002975974	0.113
4	2009	468,172,432	108,521,954	0.002462386	0.013085317	0.2
	2010	569,668,320	116,244,343	0.001678952	0.009906841	0.1265
	2011	690,403,424	150,673,780	0.002762377	0.015419884	0.113

Using a maturity period of five years $T = 5$, the probability of default and expected equity value for each bank over a period of three years is determined and recorded in the table below. The expected stock price at maturity denoted by

$$E(S_0) = \frac{V_{E,5}}{Totalnumberofshareholders}$$

Table 4.7: RESULT FROM BLACK-SCHOLES-MERTONS MODEL

BANK	YEAR	BSM def	V_5	E_5	$E(S_0)$
1	2009	0	831,048,415.30	437,592,415.30	1.54
	2010	0	940,686,543.80	517,454,543.80	2.09
	2011	0	1,383,036,802	689,894,802.00	2.07
2	2009	0	3,773,499,806	3,590,719,806	48.95
	2010	0	2,863,425,286	1,569,842,286	20.68
	2011	0	3,740,227,122	1,870,643,122	22.72
3	2009	0	702,092,550	475,865,381	9.20
	2010	0	680,288,249	388,652,570	2.45
	2011	0	755,919,206	399,003,351	2.42

4	2009	0	1,567,617,870	1,099,445,438	4.55
	2010	0	1,203,212,457	633,544,137	3.48
	2011	0	1,583,168,434	892,765,010	2.78

DISCUSSION OF THE BLACK-SCHOLES-MERTON RESULTS

From the results recorded in table 4.7, each of the banks have $V_T > B$ at time $T = 5$, hence the probability that any of the banks will default on their debt obligation is virtually zero. E_T also measures the banks equity performance, with the expected stock prices being greater than the price at which the where purchased.This is an indication that, at time $T = 5$,any stock or equity holder who wants to exercise the call option will be in the money.

CHAPTER 5

SUMMARY,RECOMMENDATIONS AND CONCLUSION

5.1 INTRODUCTION

This chapter consist of the summary of the findings, recommendation and conclusions.

5.2 SUMMARY

The banking industry is a key sector in resource mobilization in Ghana.It has grown to form an integral part of the payment and resettlement system, a system very vital and key for the efficient functioning of our economy.

To became the financial Hub of west African sub region, good governance, macroeconomic stability, robust risk management strategies, safe banking system and support for the thriving bond market is required.

This study begins by examining some of the determinants of profitability for some selected banks in Ghana and then moves on to determine the probability of defaults of these banks as well as forecast the future stock prices of the chosen banks listed on the Ghana stock exchange market at a given period.

The determinants of banks profitability were categorized into two, the internal factors which consist mainly of bank specifics and the external factors which were primarily macroeconomic factors proven to be the main cause of credit risk in the banking system. Profitability was defined as return on asset and was the dependent variable in the study.The independent variables were made up of financial ratios namely capital adequacy, asset quality, Liquidity and Size with the macroeconomic variables made up of inflation, GDP growth, Private indebtedness and average Exchange rate. A longitudinal data approach was carried out on five banks over a period of 5 years starting from 2009-2015. Four out of the nine independent factors were found to be statistically significant in determining profitability of the banks.

Results from the Black-Scholes-Merton Model indicated that, each of the banks have $V_T > B$ at time $T = 5$, with virtually a zero probability of default on their debt obligation. E_T also measures the banks equity performance. at time $T = 5$, any equity holder who wants to exercise the Call option will be in the money. This serve as an indication that the stock of these banks are performing well on the stock exchange market.

5.3 CONCLUSION

Internal or bank specifics are factors that can be controlled by banks. The credit risk factors attributed to the macroeconomic conditions cannot be controlled by the banks, however banks can re strategies to exploit opportunities or mitigate threats from this Macro economic factors. The result suggest that high capital adequacy will lead to high profitability in banks and also have a positive impact on profitability. Asset quality which is an indication of the general health trend of a bank has a positive impact on the profitability of a bank. Banks with higher asset quality tend to enjoy

higher profitability. In other to increase the asset quality of the banks, these banks will need to seriously tackle credit risk,credit risks reduces the asset quality of banks. Inflation which general means more money chasing fewer goods is significant and has a positive impact on the profitability of banks contrary to the Researchers Hypothesis. Private indebtedness is also significant in measuring the profitability of a bank and has a negative impact on the profitability of banks. Liquidity, Efficiency , GDP Growth and Average Exchange rate were found to be insignificant in determining the profitability of banks.

Also the five selected banks have virtually a zero probability of default on their long term debt over a three year range. This is a good indication that, Ghana could realize its dream of becoming the financial hub of west African sub Region.

5.4 RECOMMENDATIONS

1. Banks should concentrate more on capital adequacy,this will serve as a cushion against external shocks and will result in higher profitability. It will also serve as cushion during economic hardships.

2. Banks should strictly adherence to the guide line in giving out credit, the should practice more robust risk management, this will reduce the number of defaulting customers and increase the asset quality of the banks.

3. Bank managers should probably study how to accurately predict the macroeconomic parameters to enable them adjust to their effect and also adjust their interest rate.

4. The Black -Scholes - Merton model, is a good model for determining the probability of default, It make use of two stake holders and also uses of historical data.This makes it a very good model for the banks, the banks should therefore considered using this methodology for credit risk management.

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CHAPTER 6

APPENDIX A

Table 6.1: DESCRIPTIVE ANALYSIS

Variable	Observation	Mean	Std Dev.	Min.	Max
ROA	25	0.02999	0.01261	0.00335	0.06244
CA	25	0.14688	0.03379	0.08589	0.21667
AQ	25	371.54620	337.54940	0.49620	838.85500
LIQ	25	0.10002	0.037118	0.00187	0.18519
EFF	25	3.3630	1.74675	1.5390	7.4310
SIZE	25	8.9350	0.3195	8.3260	9.6720
I	25	11.09	3.144662	8.58	15.97
GDP	25	4.1000	3.4469	4.10000	14.4
P.INDP	25	5.42949	11.671	0.00196	48.67667
E.R	25	1.41	0.2599359	1.41	2.07

Table 6.2: CORRELATION MATRIX

	ROA	CA	AQ	LIQ	EFF	SIZE	I	GDP	P.INDP	E.R
ROA	1									
CA	0.07869	1								
AQ	0.0464	-0.6803	1							
LIQ	-0.2089	0.49437	-0.6417	1						
EFF	0.1668	0.2935	-0.2967	0.5377	1					
SIZE	0.4826	-0.2988	0.5171	-0.1932	0.4652	1				
I	-0.1299	-0.1788	-0.2535	-0.2098	0.1206	0.0305	1			
GDP	-0.0243	0.0846	0.0536	0.4081	0.0349	-0.0875	-0.6719	1		
P.INDP	-0.4333	0.1856	-0.3425	0.0371	0.1951	-0.2956	0.6434	-0.4973	1	
E.R	0.01591	-0.1845	0.3273	-0.0049	0.2129	0.6096	0.04621	-0.0800	-0.4247	1

Table 6.3: WOOLDRIGE TEST FOR SERIAL CORRELATION

H_0	No presence of Serial correlation
H_1	Presence of serial correlation
Chisq	16.2633
df	5
P-value	0.008904

Table 6.4: BREUSCH PAGAN TEST FOR HETEROSKEDASTICITY

H_0	Presence of hetroscedasticity
H_1	Absence of Hetroscedasticity
BP	6.84
$P-Values$	0.6538

Table 6.5: HAUSMAN TEST RESULT

H_0	Random effect model
H_1	Fixed Effect Model
	1.5725
	0.9966

CHAPTER 7

APPENDIX B

This is APPENDIX B

Table 7.1: SUMMARY OF HYPOTHESIS TESTING

Variable	Null Hypothesis	Accept / Reject Hypothesis
Capital Adequacy	+	Accept
Asset Quality	+	Accept
Liquidity	-	Reject
Efficiency	+	Accept
Size	+	Reject
Inflation	-	reject
GDP Growth	-	Accept
Private indebtedness	+	Reject
Average Exchange rate	-	Accept

List of licensed banks in Ghana

Standard Chartered bank

Ghana Commercial Bank

SSG-SSB Limited

UT Bank Limited

The Royal Bank Ltd.

Unibank Ltd

National Investment Bank

Agriculture Development Bank

Prudential Bank Ltd

Merchant Bank (Ghana)Limited

Ecobank Ghana Limited

CAL Bank Limited HFC

Bank Limited

United Bank for africa (Ghana)Ltd

Stanbic Bank Ghana Ltd

Bank of Baroda (Ghana)Limited

Zenith Bank (Ghana)Limited

Guaranty Trust Bank (Bank)Limited

Fidelity Bank Limited

First Atlantic Bank Ltd

Bank of Africa (Gh)

Banque Schelo-saharienne pour

Access Bank (Ghana)Limited

Barclays Bank of Ghana Ltd

Energy Bank Of Ghana

International Commercial Bank Limited

First Capital Plus Bank Limited

ARB Apex bank limited

Citibank

Ghana International Bank plc

Ghana National Bank