Innovations

Loan and Portfolio Management with Linear Programming for Risk-Averse Investors

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Abstract

Investors are risk averse and are interested in minimizing investment cost to maximize returns. This study aims to demonstrate mathematical evidence using quantitative research design, stratified sampling to minimize loan and portfolio management cost for risk averse investors. We used the period of 2017-2021 financial ratios on a panel data of 10 firms derived from a population of 15 actively quoted credit and finance firms to build a linear programming model. This study reviewed that the application of linear programming on loan and portfolio management cost would yield an approximate optimal result. The results also show that risk averse investors would accept investment with low variance between expected cost of investment and returns. The results of this study do not reconfirm the validity of the efficient portfolio theories, Markowitz and modern portfolio theories, but align only to the field of operations research to validate investors' interest on cost minimization and maximization of expected return for any given level of portfolio risk. The LINDO output result shows that 357.7000 value would be minimized for risk averse investors used in the study. Also, the result shows a reduced cost for NPL and PL of 22382.90 and 53444.44 respectively. No reduced cost for credit risk as the linear programming model was modeled with some assumptions to accommodate risk averse investors interest. The study therefore recommends quantitative and programming skills for researchers in financial institutions to build optimal portfolio models.

Keywords: 1.*Loan, 2.Portfolio Management, 3.Linear Programming, 4.Risk-averse investors, 5.operations research*

Contribution/Originality:

This study contributes to the existing literature in portfolio theory by providing innovative ideas that loan and portfolio model could be optimized using linear programming. The originality of this study is the mathematical techniques applied, the use of financial ratios as proxies for loan and portfolio management on a LINDO software. The innovative ideas of this study has never been done by any researcher on loan and portfolio optimization.

1.1 Introduction

The number of credit financing firms in Nigeria engaging in loan disbursement through financial technological applications grew by 15% over a five-year period (Ajala, 2022). Expansion in business indicates that investors maximized return. Due to economic uncertainty, global warming, and high rate of inflation in most countries in the world and risk-return trade off, it is generally assumed thatmost investors are risk averse. However, researchers in

the field of economic, finance, and operations research were shocked about the great inflow of firms into credit financing businesses in a country that is saddled with economic uncertainty and high risk of financing businesses and a period of global economic recession. Any question that arises, maybe is, are loan and portfolio management businesses profitable and lucrative? Whatever the answer may be is what this study is aimed at investigating; if risk averse investors are comfortable with their funds in credit finance firms in a period of global risk and economic down turn.

Minimizing the cost of loan portfolio in any credit finance firms is essential and most times the use of financial statement is essential to minimize the cost as minimizing of cost sometimes maybe the variance between the expected cost and return of investment. As credit financing firms craves for expansion from profit generated through loan disbursement and return portfolio investment and management, it becomes paramount for the firms to create appropriate models to minimize cost in the period of economic uncertainty. Due to the complexity in optimizing linear programming model for portfolio management in credit financing or financial institutions, there is a need to identify the various parameters and assumptions that are tailored towards building a linear programming model for loan portfolio management. In this study, we assumed that a mathematical programming model with the capacity for optimizing and planning loan portfolio management is required to minimize financing cost and deliver optimal return for risk averse investors.

In operations research, researchers assumed that modelling a problem in a period of economic uncertainty call for the application of a model that can absorb the uncertainty. In finance and investment, modeling a portfolio calls for assets allocation based on the correlation of assets. Building portfolio models also calls for testing portfolio efficient frontiers, Markowitz and the modern portfolio theories, etc. Any portfolio in the field of finance and investment is regarded as the conventional theory of portfolio management which this study over looked. This study failed to test and support any theory in portfolio management in the field of finance but rather placed emphasis on mathematical models in the field of operations research. Many existing research and literature findings corroborate conventional portfolio management models. In this study, we proposed a linear programming model as an alternativeto the convention model to optimize loan and portfolio management cost for risk averse investors in credit financing firms. In this study, we do not account for steps in finance in building an efficient portfolio rather we supported techniques in the field of operations research in modelling an optimal portfolio using linear programming method.

1.2 Literature

Kitaka, (2016) states that the rate at which Microfinance Institution is diminishing in wealth attesting to the high cost of loan management and inappropriate modeling for loan portfolio management is alarming and continuity in that process may be alarming in the long run for such financial institutions if not appropriately checked by the financial regulator. However, Okoye and Agwu (2017) critically assessed the effects of credit management on bank's performance in Nigeria and concluded that there is little evidence concerning the correlation between loan portfolio management and bank performance in Nigeria given banks unique nature of providing services to the unbanked population and eradicating poverty. Ozili (2015) stated that banks in both developed and developing countries adjust the degree of loan loss reserves and loan growth to reduce the size of nonperforming loan and with such action the modeling of portfolio may produce an inconsistent outcome. Sarah (2020) used qualitative method and regression to measure the contribution of loan portfolio management on banks performance in Kigali-Rwanda. The results show that the risk attached to loan portfolio management is shifted to insurance companies. However, the work of Beck, Asli, and Ross (2006) concluded that commercial banks are adopting a conventional system of shifting risk relating to loan to insurance companies while the insurance companies issued bonds transferring the risk to investors. Muiru, Oluoch and Ajang (2018) stated that an efficient modeling of loan portfolio will significantly affects returns on investment and return on assets in microfinance institutions in Kenya while Muhammed (2020) looked at the impact of appropriate modeling of logistic problem using discrete data and a linear programming model for South Africa companies listed in the capital market and found out that linear programming

model is essential for finding optimal cost in logistic and supply analysis. Irrespective of the method of analysis used by any of the researchers, the objective tailored toward one direction of cost minimization.Andersen Akinlo and Mofoluwaso (2014) opined that research is needed to solve the debates between the banks transferring loan risk from the balance sheet to insurance and risk management institution would only provide short run solutions. Schularick and Taylor (2009) perceived that banks could apply strategies in sharing and distributing loan risk, the assumption is that credit risk can be segmented and transferred in parts by purchasing credit risk protection with the aim of minimizing the risk exposure. Alternatively, it could be selling options or any other derivative instruments that captured the loan risk. Ngozi (2018) examined a comparative analysis on the effect of non-performing loan on operating national and international banks financial performance in Nigeria using the Generalized Methods of Moments (GMM). The study tested the risk and return trade as well as the efficient market theory and the results show that in the long run, international banks could accommodate the negative effects of non-performing loans while national banks could not.Buddhi (2017) stated that credit portfolio management refers to the process of building a series of investments based upon credit relationships and managing the risks involved with these investments.Freshia and Pauline (2016) stated that the use of linear optimization model to model health cost yielded valid conclusions for problems related to cost minimization. Williams, Abiola and Ojikutu(2021) used linear programming model to investigate the effectiveness of cost minimization and they found out that linear programming model minimizes cost if the constraint variables are accurately measured. Arora (2015) found out that the pattern of calculating the parameters in linear programming models differ from researchers to researchers in any field of study. Ali and Ishtiaq (2018) stated that minimization or maximization of portfolio parameters are based on assumptions and data availability. James and John (2021) opined that the use of transportation and linear programming model in management sciences to solve problem relating to cost would yield the same result while the work of Samad and Irfan (2017) used linear programming model to solve the problem of cost minimization on medical supply and found out that linear programming gives an optimal solution. Johnson and Udoh (2021) stated that non-performing loan and performing loans data are essential in building a linear programming model as the continuity of financial institutions is dependent on the profit and revenue generated.

Uwuigbe (2013) stated that the cost incurred in loan management and processes form an essential part of the financial statement of any financial institution. It is obvious that Loan portfolio management is made up of some stages, the first stage is the loan portfolio planning, thereafter the customer screening and credit risk control (Adeusi, Akeke, Adebisi&Oladunjoye, 2014). An interesting knowledge acquired from the study of loan and portfolio management is the ability to ascertain mathematically the relationship between risk and return. In Nigeria, financial institutions such as the deposit money banks are increasingly measuring the performance of loan portfolios by their risk adjusted returns (Adegbie&Adebanjo, 2020). On the whole, loan portfolio management is linked with the building of a portfolio of assets (stocks, derivatives, or bonds, or even real estate) with the goal of maximizing the expected returns and minimizing the risk.Detragiache and Gupta (2006), Martinez-Miera and Repullo (2010) and Bertay, Demirguc-kunt and Huizinga (2013) corroborates and concluded that the non-performing loans (NPL) have different effect on banking stability attesting to differences in researchers assumptions, market risk differences, strategies applied by individual risk management department, capital structure and the sources of the banks as well as the supervisory and regulatory effect of country to country.

1.3Methodology

Risk averse investors' interest in investment decision is minimized cost and maximum return. This interest of the risk averse investors align with the minimization objective of alinear programming model.15 actively quoted firms in credit finance business on a consecutive 5 years periods (2017-2021) were used as the population of the study. Based on the paucity of data, 10 firms were selected based on convenience sampling as the study sample size. Panel financial ratios of 50 observations derived from 10 firms for five years were used to build a linear programming modelthat optimizes loan and portfolio management for risk averse investors using techniques only from the field of operations researchto attain the study set objectives. We justified the validity of the linear programming model with

other literature in finance, economics and operations research before its final adoption in the study model and analysis.

Table 1: Variables, Description, Measurement and Sources

Variables	Description	Measurement	Source
Return on Asset	Measures the return on profitability from portfolio investment and total assets	Returns divided by total assets	machameratios.company.site
Non-Performing Loan (NPL)	Measures the amount of funds within the financial system that are not performing.	Gross value of the non-performing loan divided by total value of the loan portfolio.	Computed using data from machameratios.company.site
Performing Loan (PL)	Measures the amount of loan actively generating interest within the financial system.	Current performing loan to deposit	Authors' computation using data for machameratios.company.site
Credit Risk (CR)	Measure the risk of non-performing loans.	NPL divided by total loans	Authors' computation using data for machameratios.company.site
ANPL, APL, ACR	Measure the averages	Each variable divided by the period under study (5years)	Authors' computation using data for machameratios.company.site

Source: Researchers compilation

Table 2: Objective and Constraints Variables

Scope	Credit Risk Variables			Return on Portfolio Management (ROA)
2017	NPL_{11}	PL_{12}	CR_{13}	ROA_1
2018	NPL_{21}	PL_{22}	CR_{23}	ROA_2
2019	NPL_{31}	PL_{32}	CR_{33}	ROA_3
2020	NPL_{41}	PL_{42}	CR_{43}	ROA_4
2021	NPL_{51}	PL_{52}	CR_{53}	ROA_5
Objective Function	ANPL	APL	ACR	Loan/ROA

Source: Researchers, 2022

Minimize loan portfolio cost (C) = $NPL_{11} + PL_{12} + CR_{13} + NPL_{21} + PL_{22} + CR_{23} + NPL_{31} + PL_{32} + CR_{33} + NPL_{41} + PL_{42} + CR_{43} + NPL_{51} + PL_{52} + CR_{53}$

Subject to the constraints:

$$NPL_{11} + PL_{12} + CR_{13} \geq ROA_1$$

$$NPL_{21} + PL_{22} + CR_{23} \geq ROA_2$$

$$NPL_{31} + PL_{32} + CR_{33} \geq ROA_3$$

$$NPL_{41} + PL_{42} + CR_{43} \geq ROA_4$$

$$NPL_{51} + PL_{52} + CR_{53} \geq ROA_5$$

$NPL_{11} + NPL_{21} + NPL_{31} + NPL_{41} + NPL_{51} \geq$ RNPL

$$PL_{12} + PL_{22} + PL_{32} + PL_{42} + PL_{52} \geq RPL$$

$CR_{13} + CR_{23} + CR_{33} + CR_{43} + CR_{53} \geq$ RCR

$NPL, PL, CR, ROA, ANPL, APL, ACR_{ij} \geq 0$ i=1,2,3.. j=1,2,3..

Standardized Linear Programming Model

MIN. C= $\beta_1\lambda_1 + \beta_2\lambda_2 + \beta_3\lambda_3$.....objective function

Subject to the constraints:

$\beta_{11}\lambda_1 + \beta_{12}\lambda_2 + \beta_{13}\lambda_3 \geq C_{vd1}$.....2017

$\beta_{21}\lambda_1 + \beta_{22}\lambda_2 + \beta_{23}\lambda_3 \geq C_{vd2}$.....2018

$\beta_{31}\lambda_1 + \beta_{32}\lambda_2 + \beta_{33}\lambda_3 \geq C_{vd3}$.....2019

$\beta_{41}\lambda_1 + \beta_{42}\lambda_2 + \beta_{43}\lambda_3 \geq C_{vd4}$.....2020

$\beta_{51}\lambda_1 + \beta_{52}\lambda_2 + \beta_{53}\lambda_3 \geq C_{vd5}$.....2021

$\beta_{ij} \geq 0$ i=1,2,3,4,5 j=1,2,3

Linear Programming Model for the Study

MIN. C= $\beta_1 ANPL + \beta_2 APL + \beta_3 ACR$ .....objective function

Subject to the constraints:

$$\beta_{11}NPL + \beta_{12}PL + \beta_{13}CR \geq ROA_{2017}$$

$$\beta_{21}NPL + \beta_{22}PL + \beta_{23}CR \geq ROA_{2018}$$

$$\beta_{31}NPL + \beta_{32}PL + \beta_{33}CR \geq ROA_{2019}$$

$$\beta_{41}NPL + \beta_{42}PL + \beta_{43}CR \geq ROA_{2020}$$

$$\beta_{51}NPL + \beta_{52}PL + \beta_{53}CR \geq ROA_{2021}$$

$\beta_{ij} \geq 0$ i=1,2,3,4,5 j=1,2,3

Table 3: Data Presentation

	NPL λ_1	PL λ_2	CR λ_3	ROA
2017	32620	63440	0.26	0.98
2018	32400	65100	4.44	2.56
2019	37100	83000	6.39	1.11
2020	28100	47000	6.76	0.96
2021	30801	123660	8.30	1.56
SUM (Σ)	$\Sigma\lambda_1$=161021	$\Sigma\lambda_2$=382200	$\Sigma\lambda_3$=26.15	ΣROA=7.17
Constraint Variables	β_{1J}	β_{2J}	β_{3J}	
2017	NPL $\lambda_1$2017/$\Sigma\lambda_1$=0.203	PL $\lambda_2$2017/$\Sigma\lambda_2$=0.166	CR $\lambda_3$2017/$\Sigma\lambda_3$=0.01	
2018	2018/$\Sigma\lambda_1$=0.201	2018/$\Sigma\lambda_2$=0.170	2018/$\Sigma\lambda_3$=0.17	
2019	2019/$\Sigma\lambda_1$=0.230	2019/$\Sigma\lambda_2$=0.217	2019/$\Sigma\lambda_3$=0.24	
2020	2020/$\Sigma\lambda_1$=0.175	2020/$\Sigma\lambda_2$=0.123	2020/$\Sigma\lambda_3$=0.26	
2021	2021/$\Sigma\lambda_1$=0.191	2021/$\Sigma\lambda_2$=0.323	2021/$\Sigma\lambda_3$=0.32	
OBJECTIVE VALUES	$\Sigma\lambda_1$/ ΣROA = 22457	$\Sigma\lambda_2$/ ΣROA =53505	$\Sigma\lambda_3$/ ΣROA =3.65	
CR	$= \frac{NON-PERFORMING\ LOANS}{TOTAL\ LOANS}$			

Source: Computation with Microsoft Excel.

From Table 3, we developed a Linear Programming Model

$$\text{MIN. C} = 22457NPL + 53505PL + 3.65CR$$

Subject to the constraints:

$$0.203NPL + 0.166PL + 0.01CR \geq 0.98$$

$$0.201NPL + 0.170PL + 0.17CR \geq 2.58$$

$$0.230NPL + 0.217PL + 0.24CR \geq 1.11$$

$$0.175NPL + 0.123PL + 0.26CR \geq 0.96$$

$$0.191NPL + 0.323PL + 0.32CR \geq 1.56$$

$$NPL, PL, CR \geq 0$$

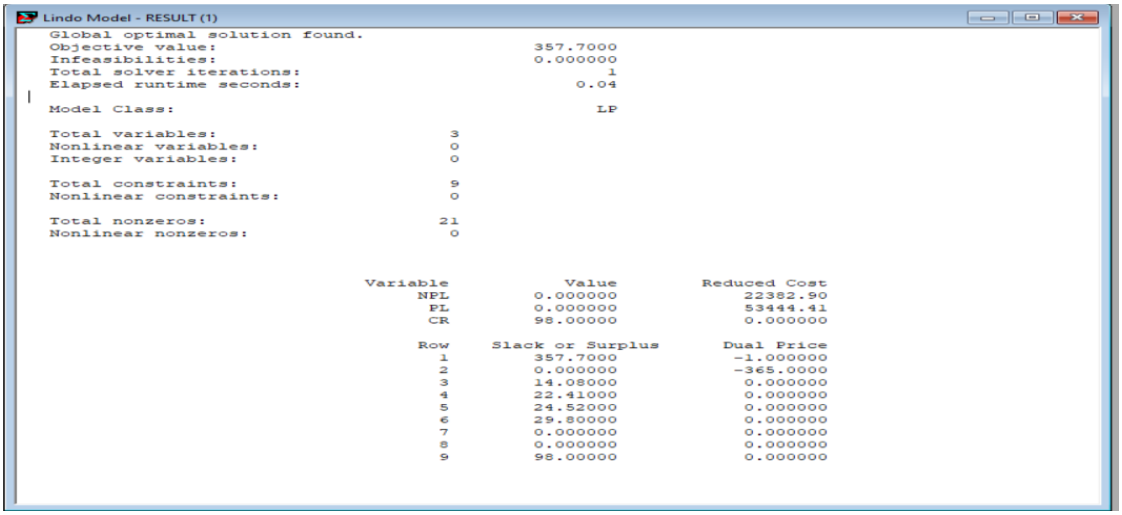
Table 4. Data Presentation in Linear Programming Format for Solver

DECISION VARIABLES	NPL	PL	CR			
Z				Objectives		
LOANS/RISK	22457	53505	3.65			
Constraint Variables						
model1	0.203	0.166	0.01		=>	0.98
model2	0.201	0.170	0.17		=>	2.58
model3	0.230	0.217	0.24		=>	1.11
model4	0.175	0.123	0.26		=>	0.96
model5	0.191	0.323	0.32		=>	1.56
Non-negative constraints						
NPL	1				>=	0
PL		1			>=	0
CR			1		>=	0

Source: computed

$$NPL, PL, CR \geq 0$$

Table 5 Linear Programming Output from LINDO



Global optimal solution found.
Objective value: 357.7000
Infeasibilities: 0.000000
Total solver iterations: 1
Elapsed runtime seconds: 0.05
Model Class: LP

Total variables: 3
Nonlinear variables: 0
Integer variables: 0
Total constraints: 9
Nonlinear constraints: 0
Total nonzeros: 21
Nonlinear nonzeros: 0

	Variable	Value	Reduced Cost
NPL		0.000000	22382.90
	PL	0.000000	0.000441
	CR	98.00000	0.000000

Row	Slack or Surplus	Dual Price
1	357.7000	-1.000000
2	0.000000	-365.0000
3	14.08000	0.000000
4	22.41000	0.000000
5	24.52000	0.000000
6	29.80000	0.000000
7	0.000000	0.000000
8	0.000000	0.000000
9	98.00000	0.000000

Source: LINDO Output, 2022

1.4 Discussions

Risk averse investors would accept any quantitative model that optimized cost and investment return at any one point. We tested the linear programming model to ascertain if loan and portfolio could be optimized for selected financial institutions in Nigeria. Our research results show that non-performing loans have a reduced cost value of 22382.90. The implication of this is that non-performing loan when optimized using linear programming model will minimize cost. The same goes for the performing loan as its value shows 0.000441. As the value approaches zero, indicating that the risk is low. The credit risk value shows 98.00000, indicating that no portfolio is void of risk. The objective value of 357.7000 confirmed that linear programming would yield value that maximized investor's wealth. The results of this study have been unsuccessful in validating theories in portfolio management and investment, especially the Markowitz theory and the modern theory of portfolio as this study aligned only with the methods of operations research. This study also failed to authenticate the effect loan has a security on portfolio management and various risk associated with loan and portfolio management. The results of this study are in line withBuddhi (2017), "who stated that linear programming model minimizes cost and maximizes returns". Freshia and Pauline (2016) stated that the use of linear optimization model to model health cost yield positive results. The study authenticates the work of Williams *et al*(2021) that linear programming model of minimization gives optimal results. Also, the results of the study corroborates with the work of Arora (2015)that the pattern of calculating the constraints parameters varies among researchers.The result of this study indirectly corroborate with the work of Ngozi (2018), Detragiache and Gupta (2006), Martinez-Miera and Repullo (2010) and Bertay, Demirguc-kunt and Huizinga (2013) that non-performing loans (NPL) affect financial performance in the long run by showing cost reduction.

The results obtained by Kitaka (2016) indicates that there was no appropriate model to test the optimality of loan and portfolio management in Microfinance Institution. Okoye and Agwu (2017) results show that credit management affect the modeling of bank's performance based on correlated evidence between loan portfolio management. The result of this study support the work of Ozili (2015) that the degree of loan loss reserves and loan growth reduced the size of nonperforming loan. The implication is that the availability of data may produce portfolio optimal results with inconsistency outcome. The results of this research also support the work of Muiru et al (2018), which showed that an efficient modelling of loan portfolio will significantly affect returns on investment and return on assets. The result of this study differ from the research of Muhammed (2020), who tested linear programming model on logistics problem and yielded optimal results. The results of this study using linear programming model is also supported by the empirical research of the work of Adeusi, et al(2014), Adegbie and Adebanjo(2020). Johnson and Udoh (2021) findings on the importance of non-performing and performing loans corroborates the findings of this study on the value of non-performing loan and performing loans. This study result partially supports the work of Sarah (2020), who used regression as a method of data analysis. It supports the work of Beck et al (2006), Akinlo and Mofoluwaso (2014), Schularick and Taylor (2009) on portfolio management but those not account for risk and its impact on portfolio modelling.

This study is indirectly in line with the work of Samad and Irfan (2017), which stated that investors portfolio are made up of bonds, stock, real estate investment and not association with loan and portfolio management. The research does not successfully confirm the efficient portfolio theory, Markowitz theory of portfolio management and other modern theories of portfolio management as it is tested by other researchers in the field of investment and portfolio theory. The results of this study are in line with the general theory of finance that investors' interest is to minimize the cost and maximize the return on investment.

1.5 Conclusion

The relevance and objective of linear programming is to minimize cost. We carried out a mathematical analysis and obtained data from the financial statement of the quoted firms made available by the Machameratios data base. It could be concluded that risk averse investors have a strong willingness for risk and cost minimization against the background of investment profit maximization, which reflects the interest of the risk averse investors and validate the finance investment theory. In as much as most risk averse portfolio in theory are made up of stock, bonds, derivatives, real estate etc, they are all tied to an element of risk in practical. The researchers view all elements within the financial institutions as the portfolio of the investors. Loan was considered as an element of portfolio for investors in credit financing firms. If the loan transform to be inactive or non-performing, a higher risk for the investor which may decline portfolio return. If the loan takes long and perform effectively, the certainty of the investor to receive return generated from the portfolio. Given the above analysis, we noted that the linear programming model would give the desired results tobuild an optimal model for loan and portfolio management cost in credit financing firms. In building a linear programming for the loan and portfolio management, we adopt mathematical assumptions to clean the panel data and best fit in the data to yield the expected results. The findings of this study corroborate the findings of other empirical work done in operations research that linear programming model is effective in minimizing cost. The study therefore recommends that financial institutions set up research department with persons skilled in mathematics and programming in modelling an efficient portfolio and vice-versa, achievingoptimal results for planning and policy implementation in credit and financing firms.

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Authors' Contributions: The first author conceptualized and analyzed the data while the second author reviews the literature and designed the study.

References

1. *Adegbie, F. &Adebanjo, S. F. (2020). Credit risk management and financial stability in quoted deposit money banks in Nigeria. European Journal of Accounting, Auditing and FinanceResearch (EJAAFR), 8(8): 1-20.*
2. *Adeusi, S. O., Akeke, N. I., Adebisi, O. S. &Oladunjoye, O. (2014). Risk Management and Financial Performance of Banks in Nigeria. European Journal of Business and Management, 6(31): 336-342.*
3. *Ajala, S. (2022). Managing Credit Financing Business in Nigeria. CBN Economic Reviews 21(4): 69-76.*

4. *Akinlo, O. &Mofoluwaso, E. (2014). Determinants of non-performing loans in Nigeria. IBFR Accounting and Taxation, 6(2): 21-28.*
5. *Akrani, G. (2011). What is portfolio management? Meaning and objectives. Kalyan City Life. kalyancity.blogspot.com.ng.*
6. *Ateya, M. (2020). Analyzing the Relationship Between Investment and Financial Performance of Industrial Companies Listed on the Amman Financial Market During the Period 2005–2018. Journal of Economics and Sustainable Development, 11(24): 57-69.*
7. *Balogun, I. O. (2013).Portfolio Management: An appraisal of insurance industry's investment profile under interest rate deregulation in Nigeria (1985 – 2007). International Journal of Business and Social Science, 4(1): 11-18.*
8. *Beck, T., Asli, D. & Ross L. (2006). Bank concentration, competition, and crises: first results. Journal of Banking and Finance, 30(5): 1581-1603.*
9. *Bertay, A. C. Demirgu c-Kunt, A. & Huizinga, H. (2013). Do we need big banks? Evidence on performance, strategy and market discipline. Journal of Financial Intermediation. 22(4): 532-558.*
10. *Bedford A. Fubara, B. A. and Agundu, P. U. (2003). Strategic Portfolio Management Model: Contemporary Imperatives for Quoted and Unquoted Companies in Nigeria. Journal of African Business. 4(1): 103-121*
11. *Detragiache, E. & Gupta, P. (2006). Foreign banks in emerging market crises: Evidence from Malaysia. Journal of financial stability, 2(1): 217-242.*
12. *Kenga, S. D., &Banafa, A. (2019). Effect of macroeconomic variables volatility on the financial performance of commercial banks listed at the Nairobi Securities Exchange. Global Scientific Journals, 7(10): 2320-9186.*
13. *Kiboi, T., &Bosire, M. (2022). Selected Investment Choices and Effect on Financial Performance of Insurance Companies in Kenya. International Journal of Economics, Business and Management Research, 6(4): 2456-7760.*
14. *Kimeu, F. M. (2015). The Effect of Portfolio Composition on Financial Performance of Investment Companies Listed in Nairobi Stock Exchange. Nairobi:University of Nairobi.*
15. *Lamichhane, P. (2021). Effect of Investment Diversification on financial performance of Nepalese Commercial Banks.*
16. *Makau, M., &Jagongo, A. (2018). The Impact of Portfolio Diversification on Financial Performance of Investment Firms Listed at Nairobi Securities Exchange, Kenya.International Journal of Management and Commerce Innovations, 5(2): 177-187.*
17. *Martinez-Miera, D. &Repullo, R. (2010). Does competition reduce the risk of bank failure? Review of Financial Studies, 23(10): 3638-3664.*
18. *Mohammed A. (2020), Transportation Modeling in Logistics. The South Africa Experience. Journal of Logistics and Transport, 12(3): 29-36.*
19. *Ngozi, V. T. (2018). Non-performing Loan and its Effects on Banking Stability: Evidence from National and International Licensed Banks in Nigeria. CBN Journal of Applied Statistics, 9(2): 43-74.*
20. *Nyaro, M. (2015). Relationship between portfolio holding and financial performance of insurance companies in Nairobi County. Doctoral dissertation, University of Nairobi.*
21. *Obiero, C. (2019). Effects of Portfolio Diversification on the Financial Performance of Investment Companies Listed at the Nairobi Securities Exchange. Doctoral dissertation, United States International University-Africa.*

22. *Okechukwu.E, U. &Egbo,D.E. (2017). Effect of Project Portfolio Management on the Performance of Business Organization in Enugu Nigeria:International Journal of Academic Research in Business and Social Science,7(9):591-604.*
23. *Sarah, M. (2020). Contribution of Loan Portfolio Management on Financial Performance of Commercial Banks in Rwanda A Case Study of Bank of Kigali-Rwanda. International Journal of Scientific and Research Publications, 10(6): 356-365.*
24. *Schularick, M. & Taylor, A. M. (2009). "Credit Booms Gone Bust. Monetary Policy, Leverage Cycles and Financial Crises, 1870-2008". National Bureau of Economic Research, Working Paper No 15512.*
25. *Semad B. and Irfan F. (2017). A Stochastic Programming Model for Decision-Making Concerning Medical Supply Location and Allocation in Disaster Management. Journal of Disaster Medicine and Public Health Preparedness. 11: 747-755.*
26. *Seetharaman, A., Indu, N., Nitin, P., & Amit, K. (2017). A Study of the Factors Affecting the Choice of Investment Portfolio by Individual Investors in Singapore. Accounting andFinance Journal, 6(3): 1927-5986.*
27. *Uwuigbe, A. (2013). Credit Risk Management and Financial Performance of Selected Banks in Nigeria. Police Economic Review, 1(1): 1-13.*
28. *Williams, H. T., Abiola B. &Ojikutu R.K (2021). Minimizing Healthcare Cost in Selected Tertiary Institutions in Nigeria. Journal of Innovations, 64(1): 544-554.*

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