Impact of credit risk management on the profitability of the Irish banks

Niharika Kamala Prasad Jaiswal

MSc in Management

National College of Ireland

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Abstract

The objective of the study is to examine the impact of credit risk management on the profitability of the Irish banks. The sample of this study consists of 4 Irish banks: Allied Irish Bank, Bank of Ireland, Permanent tsb and Ulster Bank. Profitability is measured by Return on Equity (ROE) and credit risk is measured by Capital Adequacy Ratio (CAR) and Non-performing loans (NPL).

The financial ratios were calculated by the author from the annual financial reports of the banks for 11 years (2008 - 2018), which includes both the period of global economic crisis and recovery. The data has been analyzed through regression analysis for understanding the relation between credit risk management, NPL and CAR (independent variables) and profitability, ROE (dependent variable). The models are developed by making three variations in the data set: removing an outlier, lagging the dependent variable by one period and lagging the dependent variable with an outlier removed. A non-linear trendline is also examined for relevant models. Since, the data has both crisis and recovery period, a dummy variable is included. A qualitative variable called "economic condition" is introduced where "0" indicates crisis (2008-2012) and "1" denotes recovery (2013-2018).

The quality of the data set is also checked through diagnostic testing. The testing includes Autocorrelation and Heteroscedasticity. A test for Multicollinearity is also undertaken. Along with these, significance testing is also done.

The findings from the study tells that there is negative association of NPL with ROE and positive relationship between CAR and ROE. It is also observed that there is also a positive relationship between economic condition and the profitability of the Irish banks. The data doesn't show evidence of Multicollinearity and Autocorrelation, but there is some evidence of the presence of Heteroscedasticity in the data.

Also, the study addresses the identified gap in the literature.

Key words: Non-performing loans, Capital Adequacy Ratio, Return on Equity, Credit risk management, Profitability, Regression

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List of Abbreviations:

BCBS = Basel Committee on Banking Supervision

CAMEL = Capital Adequacy Ratio, Asset Quality, Management, Earnings, Liquidity

CAR = Capital Adequacy Ratio

Df = Degree of freedom

DPS = Dividends Per Share

D-W score = Durbin-Watson Score

EPS = Earnings Per Share

MBR = Market to Book Ratio

NAMA = National Asset Management Agency

NIM = Net Interest Margin

NPA = Non-performing Assets

NPL = Non-performing loans

PL = Performing loans

R = correlation coefficient

R^2 = R squared

ROA= Return on Assets

ROAE = Return on Average Equity

ROCE = Return on Capital Employed

ROE = Return on Equity

ROTA = Return on Total Assets

SPSS= Statistical Package for the Social Sciences

X = Independent variable

Y = Dependent variable

ρ (rho) = Population correlation coefficient

Chapter 1: Introduction:

Banks are one of the important parts of a country's economy but at the same time there are many risks which are involved in the banking sector. Al-Tamimi and Al-Mazrooei (2007) states that "*banking is a business of risk*." The multiple risks which are involved are market risk, liquidity risk, credit risk and interest rate risk (Al-Tamimi and Al-Mazrooei, 2007). Tehulu (2014) tells that there are internal and external factors like economic condition and inefficiency of management that contributes in rise of different risks. But, credit risk is one of the most crucial one. In spite of having different risks which are related to profitability, credit risk stands at the top (Islam *et al.*, 2019). According to Gizaw *et al.,* (2015), credit risk management decides the performance of the banks and shows how successful it is. In 2008 the global financial crisis has affected most of the countries around the world, out of which the most affected sector was banking sector. Hence, the need for effective credit risk management arises. In response to the financial crisis, Basel Committee on Banking Supervision (BCBS) has made new regulations for banks' equity capital and liquidity (Abbas *et al*., 2019). According to Ali and Dhiman (2019) when the borrower is unable to fulfil the commitments made to banks related to lending, credit risk arises. Zribi and Younes (2011) state that the risk is high especially in developing countries whose economy is weaker as compared to the developed countries. Therefore, effective credit risk management becomes crucial for such countries. As per Richard *et al.,* (2008) efficient credit risk management system reduces the credit risk.

This research is based on Ireland as it is considered to have a developed economy and made a successful recovery from the economic crash. Also, it became a good example of managing the crisis successfully. According to Schoenmaker (2015), from the start of crash, Central Bank of Ireland and Department of Finance were in action to stabilise the conditions in Irish banks. It was possibly due to policy lessons which includes the establishment of National Asset Management Agency (NAMA) by the Department of Finance in 2009. NAMA is a bad asset agency which deals with these bad assets of the Irish banks. From the assessment done by European Central Bank, two Irish banks which are, Bank of Ireland and Allied Irish Bank showed good results whereas Permanent tsb suffered with shortage in capital (Schoenmaker, 2015). The competition in giving out loans increased as foreign banks entered in Ireland and the country saw an increase in domestic

finance (Regling and Watson, 2010). But, the fact cannot be denied that due to global crash, Ireland faced a severe banking crisis after the burst of property bubble also, policies and factors associated with the market contributed in rise of the crisis (Schoenmaker, 2015). As per Regling and Watson (2010) from the report published, it is clear that risk management and governance of the banks were weak.

There are numerous studies which has been carried out in this area by using the most popular indicators of credit risk management which are Non-performing loans (NPL), Capital Adequacy Ratio (CAR) with Return on Equity (ROE) being the indicator of profitability. Dimitrios *et al*., (2016) states that bad debts are also known as Non-performing loans. It occurs when borrower is unable to repay the loan and banks consider it to be non-performing when it due for more than 90 days. It measured as the ratio of Non-performing loans to total loans. Whereas, Capital Adequacy Ratio has its role for security of the banks and shows the image of banks and measure their strengths (Yahaya *et al*., 2016). Ünvan (2020) states that CAR reduces the operating loss of the banks and portrays the ability of the banks to finance the long-term expenditures, but most importantly it determines the rate of profitability which bank has established. It is measured as the ratio of bank's capital to risk weighted assets. The capital is divided as Tier 1 and Tier 2. Tier 1 capital consists of share capital, equity capital etc. whereas, Tier 2 capital has undisclosed amount or reserves which are not audited. On the other hand, risk weighted assets are the minimum capital which banks hold in order to reduce the risk of being unable to pay the debts. As profitability is considered as one of the most important criteria of measuring bank's performance, ROE is the main indicator as it shows the return received on the funds invested in the banks. Yousuf and Felföldi (2018) states that it is a major profitability ratio. This is measured in percentage by dividing the income by shareholder's equity. The study includes both, the period of economic crash and recovery and will use these indicators to understand the impact of credit risk management on the profitability of the Irish banks.

The paper is arranged in the manner that Chapter 2 will examine the available literature in this area. Chapter 3 will present the methodology used for this study followed by the chapter 4 which will have analysis and results. Chapter 5 will be discussion and the last

chapter i.e. Chapter 6 will include conclusions, limitations of the research and recommendations for the further development of the research.

Chapter 2: Literature Review:

Literature is a base of the research and it helps in understanding the different studies which has been done in the particular area. There are various studies conducted over time in different countries for understanding the impact of credit risk management on profitability hence, this chapter will review the work done in this field by other researchers along with different indicators used for measuring credit risk management and profitability and to understand the relationship between the two. It will also be interesting to see the various approaches undertaken by the authors. The variations can be seen in this chapter as different studies give different results in relation with most of the common indicators of credit risk management which are NPL and CAR. Theoretically, it is accepted that with an increase in Capital Adequacy Ratio, profitability of the banks also increases (Annor and Obeng, 2018). But, with Non-performing loans it is opposite to CAR as it has an inverse relationship with profitability as high NPLs tend to reduce the profitability of the banks (Vinh, 2017). Recently, NPL has received the attention and it is used by many authors in their study in this field (Kharabsheh, 2019). It is observed that the studies conducted in different countries sometimes do not have the results which are accepted theoretically as it showed the opposite results as well. This can be seen from the different studies which has been reviewed in this chapter.

2.1: Studies finding that CAR is positively associated with profitability:

There are studies conducted in this field which has an evidence of CAR being positively related to profitability which is consistent with the theoretical expectation. The evidences can be seen in this section. One of the studies which is done in India by Ali and Dhiman (2019) shows that Capital Adequacy Ratio (CAR) which is one of the common measurement of credit risk management is positively related to profitability (ROA) which is also supported by Gizaw *et al.,* (2015). Ali and Dhiman (2019) also suggests that indicators of credit risk management influences the performance of banks. The study in India considered time period of 8 years i.e. from 2010-2017 and used various indicators of credit risk management. Based on the total assets of 10 public sector banks of India, the panel regression analysis is undertaken where credit risk is measured by various indicators which are: Non-performing loan Ratio (NPLR), Capital Adequacy Ratio (CAR), Loan Loss Provision Ratio (LLPR), Asset Quality Ratio (AQ), Earning (E), Management (M)

and liquidity (L). When it comes to dependent variable, Return on Assets (ROA) is considered as the measure of profitability. It is one of the main indicators of the profitability as it shows the ability of the management to earn profits. If ROA is higher, it indicates higher profit of banks and shows that they are systematically managing its assets (Rahmadi *et al*., 2020). Additionally the results showed that Management and Earnings also have positive relation to profitability (ROA). On the other hand, Liquidity and Asset Quality Ratio are negatively related to profitability. The study done by Poudel (2012) in Nepal used ROE and CAR along with other indicators and resulting in significant relationship between profitability (ROE) and CAR as of Ali and Dhiman (2019).

However, the study conducted by Islam *et al.,* (2019) on commercial banks of Bangladesh has used additional profitability indicators which are Return on Equity (ROE) and Market to Book Ratio (MBR) along with Return on Assets (ROA). From the data analysis done for 10 years (2006-2015), the results from several diagnostic tests and fixed effect model with Driscoll –Kraay standard error, proved the theoretical expectation of CAR with profitability to be correct. Because the results showed that Capital Adequacy Ratio (CAR) which is credit risk management indicator has positive relationship with profitability. In addition to this, Annor and Obeng (2018) also found the significant positive relationship with Capital Adequacy Ratio. Thus, being consistent with theory behind relation of CAR and profitability of the banks. It is also seen by Mushtaq *et al.,* (2015) who conducted a study on Pakistan from 2007-2012 on 14 commercial banks by using regression analysis that CAR is having positive impact on the performance of the banks because CAR for this time period was above the set level under Basel II.

Asllanaj and Nuhiu (2018) conducted a study in Kosovo and saw the same results with CAR. But the study used CAMEL indicators which included Capital Adequacy Ratio, Return on Average Assets (ROAA), Net Interest Margin (NIM), Management efficiency and Liquidity. These were used for analyzing the data from the year 2008 - 2012 and considered as independent variables. The analysis is done statistically hence, multiple regression analysis is used. But, to know the real relationship between the variables, correlation coefficient is also used to find if there is a linear relationship between dependent and independent variables. The study used Return on Average Equity (ROAE) as a measurement of performance which is the dependent variable. From the results it is

seen that CAMEL indicators have a strong impact on performance. The time period considered for the research tells that Capital Adequacy, Net Interest Margin (NIM) and Liquidity shows stronger relationship with financial performance of the banks (Asllanaj and Nuhiu, 2018). This study also proves the theoretical expectation of profitability with Capital Adequacy to be true. Also, the study conducted in Kosovo has a strong conclusion and recommends that CAMEL indicators can also be considered in the banking system for accessing and rating the credit risk management. Which indeed can be used by the banks for accessing the credit risk management.

Abiola and Olausi (2014) conducted a study from 2005-2011 in Nigeria and found that Capital Adequacy Ratio shows positive relationship with profitability and being consistent with the theoretical expectation but according to them, it is not a significant relationship. Whereas, Ogboi and Unuafe (2013) also conducted the study in same country, Nigeria from 2005-2009 for 6 banks and found the significant positive relationship between CAR and profitability. Both the studies are done using panel regression approach. But, Abiola and Olausi (2014) used ROA and ROE as a profitability indicator whereas Ogboi and Unuafe (2013) used only ROA as an indicator of profitability and makes an additional finding from the research that loans and advances given to the customers certainly reduces the profitability of the banks.

From this section, it is evident that studies done in different countries used different methodology but showed the results which are theoretically accepted. But there are studies which shows the opposite relation of CAR with profitability and this can be seen in the next part.

2.2: Studies finding that CAR is negatively related to profitability:

In 2018, Yousuf and Felföldi conducted a study on 6 commercial private banks of Syria, in normal (peace) conditions from the year 2007 till 2011, to know the effect of credit risk management and profitability. The study is yet simple but strong as it has used one of the major indicators of credit risk, CAR and profitability (ROE). The results obtained from regression and correlation is quite surprising and different with the other studies discussed. Because according to the author, credit risk management is less responsible for the bank's profitability (only 19%). It is also observed that the results contradict with the theoretical expectation as author concludes that CAR effects negatively on ROE for the

considered time period of the study. Gizaw *et al., (*2015) saw the same result when it comes to profitability as it also concludes that CAR is having negative association with ROE.

Another major indicator of credit risk management i.e. Non-performing Loan is expected to have a negative relationship with profitability and the following section will inspect the studies which are consistent with the theoretical expectation.

2.3: Studies finding that NPL is negatively associated with profitability:

This section will discuss the studies in which the result is being consistent with Non-performing loans and profitability. NPL is negatively related to profitability (ROA) is shown in the study conducted by Serwadda (2018) on banks in Uganda. The research consists of 20 commercial banks from 2006-2015 which has the time of both global financial crash and recovery. With statistically analyzing the data using regression, descriptive statistics and correlation, the results exhibit that NPL is impacting the performance of the banks inversely and 22% decrease in profitability is seen when NPL rises by 1%. Serwadda (2018) agrees with the result by Islam *et al.,* (2019) as the author also found that Non-performing loans ratio (NPLR) is negatively associated with profitability. The study used three indicators of profitability i.e. Return on Assets (ROA), Return on Equity (ROE) and Market to Book Ratio (MBR) all three showed the correct relationship with Non-performing loans.

The research done by Ekinci and Poyraz (2019) in Turkey on 26 commercial banks between 2005-2017 by using panel regression and Laryea *et al.,* (2016) on 22 banks of Ghana from 2005-2010 by using panel data models also supports the results obtained by Islam *et al.,* (2019) as it also used same indicators ROA and ROE as the profitability measure and NPL to be a measure of credit risk management and same results came out for NPL's association with ROA and ROE which was statistically significant. Hence, proving the theoretical expectation to be correct. However, the study done by Laryea *et al.,* (2016) was more focused on NPLs and shows that inflation cannot be used to find the reason for increasing NPLs but one of the reasons for increase in NPL is stated as, charging higher interest rates on loans.

In continuation with showing the consistency in results with NPLs, Annor and Obeng (2018) also made an attempt to understand the impact of credit risk management and

profitability in Ghana. The data was analyzed for 10 years (2007-2016) of 6 commercial banks in which profitability is measured by one of the main indicators i.e. Return on Equity (ROE) which is also used by Islam *et al.,* (2019). With NPL, additional indicators of credit risk are used in the study which are Loans loss provisions ratio, loan to asset ratio. But after using random effect model in panel estimation gives the results which are similar to the study conducted by Islam *et al.,* (2019) as it is portrays that there is a negative relationship between profitability and Non-performing loans. This result is in support with the study done by Mushtaq *et al.,* (2015) where NPL showed negative association with profitability which is continuing to be consistent with the theory related to NPL as the results are in the same direction as of Ekinci and Poyraz (2019); Islam *et al.,* (2019) and Laryea *et al.,* (2016). One of the studies come from a country, Ethiopia where Gizaw *et al.,* (2015) also examined the impact of credit risk management on profitability where 8 Ethiopian banks were used and the data for 12 years was considered. Using Panel data regression analysis in which one of the independent variable was NPLR showed that it is negatively associated with profitability (ROA and ROE) but it affects ROE more as compared to ROA.

However, there is a study which used Non-performing Assets instead of Non-performing loans as an indicator of credit risk management but showed that it certainly affects the performance of the bank. This can be seen in next section.

2.4: Study finding that Non-performing Assets negatively affects profitability:

This is the study which is quite different as compared to the study which is being conducted on Irish banks. The research is conducted by Sharifi *et al*., (2019) on the commercial banks in one of the largest democratic country, India. The study was done based on both primary and secondary data. The secondary data is analyzed only based on Non-performing Assets (NPA) which is used as an indicator of credit risk management and according to the authors, Non-performing Assets is further categorized as loss assets, doubtful, standard and substandard. The research also provides an evidence that Indian banks are improving the practices of their credit risk management in order to improve the performance so that it can reach to the standards which are accepted internationally. From the primary source, the information which has been taken by the risk managers regarding the credit risks basically included the components of credit risk management

which are: credit risks' perception, its identification, assessment, controlling the credit risk and its capital requirement. Really this is an area which needs to be looked upon seriously by the banks, as it is one the serious risks which banks face. It is considered as one the crucial risks because it can have an impact on bank's profit and its performance. Safari *et al*., (2016) mentions that banks and financial institutions face different type of risks which are Market Risk, Liquidity Risks, Credit risk and Operational risks. But credit risk is most crucial because it arises from the primary activity of the banks, which is lending. The study on Indian banks used multiple regression analysis as a methodology in which the two dependent variables are considered as NPA growth rate and credit risk performance while 5 independent variables are used in the study which are built from the responses received from the risk managers. The variables are credit risk capital requirements, credit risk perception, credit risk assessment, credit risk identification and credit risk control. The results from the research shows that identifying the credit risk certainly affects the performance of the credit risk. It is also concluded that Non-performing Assets are related negatively to credit risk identification. The result proves the expectation that NPA certainly effects the performance of banks. But the time period considered for the study is only 5 years (2012-2016) which doesn't give a clear picture of the changes that could have come in the economy of the country as the study is focused on the period after the global economic crises ended.

As a part of contradicting results related to NPL i.e. positive relationship between NPL and profitability, there are few studies which shows this result and it can be seen in succeeding section.

2.5: Studies finding that Non-performing Loans are positively related to profitability:

As discussed previously, there are findings where theoretical expectation with NPLs are not consistent as it shows a positive relationship with profitability. This interesting finding can be seen from study done in Bangladesh in which NPLR is positively related to profitability (ROA and ROE). But, it was found when NPLR is lagged by one period (Islam *et al.,* 2019). This is totally opposite with the theoretical expectation. High NPLs can be explained by micro and macro-economic factors (Ciukaj and Kil, 2020) but, the reason of NPL being positively related to profitability is suggested by Islam *et al*. (2019) is, due to collection of loans in current year which were given in preceding years. This can be true

as the research period included in the study of Bangladesh has both the time of financial crises and recovery so, this can be a strong reason of NPL showing positive relation with profitability of the banks. As an expectation, higher NPLs reduces banks' profit and this is supported by Ciukaj and Kil (2020) as high level of NPLs can be due to charging higher interest rates on the loans which is a similar result given in the study by Laryea *et al.,* (2016). As per Abiola and Olausi (2014) who conducted the study on 7 commercial banks from 2005-2011 where performance was measured by ROA and ROE on the other side credit risk management was measured by NPL along CAR with the panel regression model approach. The results are quite surprising as it tells that there is a positive relationship between Non-performing loans and profitability of the banks which is supported by Islam *et al.,* (2019) but the only difference is seen in the study that NPL is lagged by one period. Abiola and Olausi (2014) also states that, positive relationship means, with increase in loans, there is constant increase in Non-performing loans of the commercial banks of Nigeria. The results overall provide an evidence that, with a greater number of NPLs, the profits earned by banks keeps on increasing (Abiola and Olausi, 2014). This can be possible because banks charge high interest margin to the other customers.

Continuing with exploring the literature in this field, there are some studies which also tells that there is no relationship between credit risk management and profitability which is evident from the studies discussed in the next section.

2.6: Studies finding no relation between credit risk management and profitability:

Two studies which are done with a difference of 10 years time period are by Kithinji (2010) and Bhatti *et al.,* (2020) and a study done in the year 2015 shows no relation between credit risk management and profitability. Kithinji (2010) conducted the study on the banks in Kenya for the time period 2004-2008 has also followed the regression analysis like other authors, to know the relationship between credit risk management and profitability. Additionally, the study also focuses on credit risk management policies. For finding the results, data on Non-performing loans, credit and profits were collected for the period of 5 years (2004-2008). The measurement of credit was done by dividing loans given to customers by the total asset of the banks in Kenya. Whereas, the measurement of profit is similar to the studies done by Ali and Dhiman, (2019); Rahmadi *et al*., (2019); Islam *et al.*, (2019) which is Return on Total Assets (ROTA). ROTA is also sometimes known as

Return on Assets and it is one of the major determinants of measuring the profits of the banks. Basically, profits of the banks reduced between the time period selected for the study (2004-2008) on the other hand NPLs also saw decline in that period. From the results of the regression model, a positive relationship is seen between profitability (ROTA) and the amount of credit and a negative relationship between NPL and ROTA. Significance testing shows a clear picture, as the results indicate that all the three variables are not related with each other and author concludes that banks should focus on other factors apart from Non-performing loans in order to maintain its profit (Kithinji, 2010). Overall, from this research it is seen that there is no relation between credit risk and profitability. The result from the study done by Bayyoud and Sayyad (2015) in Palestine supports the results obtained by Kithinji (2010) as it also shows that there is no relation between credit risk management and profitability. But Bayyoud and Sayyad (2015) used ROE as an indicator of profitability and NPL for credit risk management similar to Yousuf and Felföldi (2018). And the results shows that there is no relation of credit risk management (NPL) with profitability (ROE).

Also, Bhatti *et al.,* (2020) attempted to understand the connection between risk management and profitability by using the data of 3 big commercial banks of Pakistan. The study selected the time period for 3 years from 2016-2018 which includes the time period selected by the studies done by Sharifi *et al.,* (2019); Ali and Dhiman (2019); Annor and Obeng (2017). The measurement of profitability used are, ROA and ROE which is similar to the research done by Islam *et al.,* (2019) and indicators of credit risk which are independent variables considered in the study are CAR and NPL. The results after using regression and correlation found that there is a critical relationship between NPLR and ROA but CAR and ROE doesn't show the strong relationship and it is not important (Bhatti *et al.,* 2020). From which it can be concluded that there is no direct link between credit risk management and profitability.

The major reason for the impact on bank's profitability is due to Non-performing loans as a result credit risk arises from the bank's main activity, lending. Especially at the time of global crisis, NPL grew and impacted the profitability of the banks. Abiola and Olausi (2014) also states that Non-performing loans majorly contributes to profitability. This can be seen in the below section.

2.7: Study indicating that Non-performing loan is the biggest reason for lower profitability:

Kessey (2015) conducted research in Ghana and showed that NPLs grew every year in spite of having departments which manages credit risks. Majorly from the year 2007-2011, NPL grew in Ghana and it was one of the biggest reasons for the credit risk as NPL was recorded highest at the time of global crises, 2009. Study conducted by Kessey (2015) has qualitative approach as well, where the factors contributing to bad loans were identified based on the survey filled by the staff working in the department of credit risk management. From the result it is found that inefficient credit review process, not monitoring credit and bad credit appraisal were topmost reasons contributing to high Non-performing loans. With qualitative analysis, the quantitative touch has also given to the study as descriptive statistics are used to rank the factors accounting for bad loans. Overall, it can be said that, this study account NPLs to be a biggest reason for the lower profitability of the banks.

Profitability of the banks also depends on the environment in which the financial institutions are operating. This is shown by the studies conducted by the authors, which is discussed in the next section.

2.8: Effect of operating environment and stage of economic development on banks' profitability:

The authors have made an attempt to understand the relationship between credit risk management and profitability in the countries having different types of economies. One such research came from Tanzania whose economy is less developed. Richard *et al.,* (2008) conducted the study by using both primary and secondary information. The study is focused on developing the conceptual model to understand credit risk management of the country whose economy is less developed. The study analyzed the data qualitatively and hence taken the case study approach. It is found that, to know the borrowers capacity for repaying loans, banks use various checklists. But the study also finds that credit scoring model is not used by the banks hence, it can be argued that not using quantitative scoring methods can make the credit risk management system of the bank weaker. As before providing loans to the customers, banks examine the financial condition of the customer and one the best and easy technique is through providing the scores based on the financial

condition of the borrower. This can be helpful for the banks in deciding whether the loan should be given to the customer (Samreen and Zaidi, 2012) and it is done based on the credit scoring. In this way Non-performing loans for the banks can get reduced. Results by Richard *et al.,* (2008) shows that environment in which a bank works play a major role in deciding the credit risk management system's success. In support to this, a similar finding is given by Ogboi and Unuafe (2013) in which the author states that impact of credit risk has a strong dependency on the regulatory environment in which the bank is operating. The other main finding from the study by Richard *et al.,* (2008) tells that credit risk management system of commercial banks differs in both developed and developing countries.

Till now, it is seen that the studies have used CAR and NPL for measuring credit risk but there can be different indicators for it apart from these two major ones. This is shown in the following section.

2.9: Evidence of using unique indicators:

There are other indicators of credit risk management other than CAR and NPL, which can be used to conduct the study. This is evident from the study done by Abayomi and Oyedijo (2012) from 2006 to 2010 on Nigerian banks. Out of 24 Nigerian banks, 5 banks were selected by using stratified sampling for the analysis. Regression analysis done which is also followed by Kithinji (2010) but additionally correlation technique is also used for the analysis. One interesting thing found out in this study are the parameter used. This is the only study discussed in this dissertation where Earnings per share (EPS), Dividends per share (DPS) are used along with Return on Capital Employed (ROCE) and Performing loans (PL). These are some different variables which have been introduced for the analysis. With an additional objective of finding the relationship between shareholder's wealth and credit risk management, DPS is used whereas EPS is used to determine the relation between profitability and credit risk management. The 5 years considered for the study included the time of financial crash which hit hard in Nigeria. As mentioned by Ngwube and Ogbuagu (2014), due to financial crisis Nigerian economy suffered and banking sector was most affected by it when compared to any other sectors of the country. Hence, the results from the study conducted by Abayomi and Oyedijo (2012) showed that there is significant relationship between the credit risk management, profitability and

shareholder's wealth. It can be said that good credit risk management will have positive effect on the performance. There is certainly an agreement on the statement made by the author that banks having good credit risk management policies tend to have lower Non-performing loans or bad loans and have higher profit and those banks can recover from the loss better and record its performance at the time of crisis.

From the analysis done by researchers in different studies, it is recommended that banks should focus on adopting modern credit risk management techniques and consider other factors apart from NPLs that can affect the profitability so that the recovery from any crisis can be made easily. This can be seen from the studies done by Ekinci and Poyraz (2019); Kithinji (2010). Also, it can be seen from the various studies in which it is discussed that, credit risk is considered to be an important indicator for the bank's profitability and specifically, Ogboi and Unuafe (2013) tells that banks significant profitability predictor is Capital Adequacy where as Makri *et al.,* (2014) states that NPL ratio is one of the most important indicator of credit risk.

Overall, from this section it can be seen that there is an argument in determining the impact of credit risk management on profitability. This is also noticed by Ogboi and Unuafe (2013) as few studies shows there is a relationship, some tells that they are not related so, it also draws an attention to understand the impact of credit risk management on profitability of the Irish banks. Hence, the questions arise, How NPLs impact the profitability? How CAR impacts the profitability? It is observed that research in this field has not been done widely on the banks of developed country. As a gap, it is also identified that, no study has been conducted on credit risk management of the Irish banks and the financial system so it will also contribute to a reason to make an attempt for understanding the relationship between credit risk management and profitability of the Irish banks and will be interesting to know the results.

2.10: Research Question:

Arising from the literature review, a formal research question has been developed. Since, credit risk is considered most important in the banking sector as compared to any other risks, it becomes important and creates a curiosity to find its influence on the profitability of the banks. As discussed, Ireland is considered to have a developed economy, it draws an attention to understand the impact of credit risk management on the profitability of

the Irish banks. Also, from the studies conducted by different authors in various countries as seen in the previous chapter, there are differences in results and it is identified as a gap of the research on this topic. Hence, question is developed to understand the relationship between credit risk management and profitability of the banks.

"Is there any relationship between credit risk management and profitability of the Irish banks?"

To get the answer for this Research Question, four hypotheses are developed and it will be investigated based on this. The hypotheses are:

H_{01}: There is no significant relationship between NPL and ROE

H_{a1}: There is a significant relationship between NPL and ROE

H_{02}: There is no significant relationship between CAR and ROE.

H_{a2}: There is a significant relationship between CAR and ROE

The next chapter will explain the methodology used in this research for achieving the objective of the study.

Chapter 3: Methodology:

The aim of this research is to understand if there is an impact of credit risk management on the profitability of the Irish banks. In other words, the attempt is to check if there is a relationship between the two. The time period which is taken for the analysis is from 2008 to 2018 which includes both, the period of economic recession and recovery. The global crisis hit in 2008 where Ireland was also severely impacted by it and experienced a difficult time as the financial crisis hit hard in this country as well (O'Sullivan and Kennedy, 2010). In this crisis, banking sector was also impacted. As mentioned by Fitzgerald (2014) Irish authorities had to handle the crisis in the banking sector along with handling the crisis of public finance. Hence, the effect of the crisis can be seen in the data where, the profit of the banks reduced. The previous research done by the authors Bhatti *et al.,* (2020); Sharifi *et al.,* (2019); Asllanaj and Nuhiu (2018); Yousuf and Felföldi (2018); Serwadda (2018); Gizaw *et al.,* (2015); Mushtaq *et al.,* (2015) and Kithinji (2010) used regression analysis hence, this research has also followed the same approach of regression analysis but with variations and looking from different angles as it will help in understanding the relationship between credit risk management and profitability.

In order to analyze the data from the financial ratios of 4 Irish banks from the year 2008 till 2018 and find out the answer to the research question, single and multiple regression analysis is undertaken in this study by building different models. Firstly, the question comes, what exactly is regression analysis and what it does? In simple words, regression analysis tells the form of relationship between the variables. According to Davies (2017) "*regression analysis tells how much one variable changes as another changes". This concept was first introduced by Sir Francis Galton in a study which was based on "Inheritance of stature in the human being"* (Agarwal, 2006). It deals with the nature of the relationship between the variables including the situations where there are more than two variables.

In this research, Return on Equity (ROE) is a dependent variable as it is considered to be a measure of profitability whereas Non-performing loans (NPL) and Capital Adequacy Ratio (CAR) being independent variables, which are the measures of credit risk management. The variables are measured in percentage and the example of the calculations are shown in Appendix 1. The reason for choosing Non-performing loans and Capital Adequacy Ratio

as an indicator of the credit risk management is because both the indicators has been used frequently by the authors Bhatti *et al.*, (2020); Ali and Dhiman (2019); Islam *et al*., (2019); Annor and Obeng (2018); Yousuf and Felföldi (2018); Abiola and Olausi (2014), who had conducted the research. The same goes with using ROE as it has been widely used in the studies conducted previously.

The independent variable is also called an 'explanatory variable' as it contributes to explaining the dependent variable. It is believed that the variables are associated with each other hence to check the same, first the simple linear regression is run to check the relationship between the dependent and an individual independent variable. Linear regression finds the straight line, 'line of best fit' which can tell the relationship between the two variables. The analysis is done with each of the independent variables separately and then multiple regression is run with both of the independent variables. In multiple regression, the impact of multiple independent variables on dependent variable is found out (Lind, 2020). Based on this, different models have been created in this research. In addition, there is also an attempt made to see if the model improves, by introducing a non-linear trendline.

3.1: Models:

The different models which will be tested as a part of analysis are:

Model 1, 2 and 3: These are the basic models which includes all the observations of the dependent (ROE) and independent variables (NPL and CAR). The analysis is undertaken with 43 observations across all 4 banks as Ulster Bank only has the available data from 2009-2018 while other 3 banks have data from 2008-2018. For Model 1 and 2 simple regression is run while for Model 3 multiple regression analysis is undertaken.

Model 1A, 2A and 3A: The first variation made is by removing an outlier which is an unusual value observed when compared with other values. Hence the regression is rerun with 42 observations for all the three models.

Model 1B, 2B and 3B: In these 3 models, the dependent variable is lagged by one period, therefore the total observations left for running the regression are 39.

Model 1C, 2C and 3C: These are the models which has further reduced number of observations as it has two variations i.e. lagging and an outlier removed. Therefore, the observations get reduced to 38 for running the regression analysis.

3.2: Data set:

To achieve the aim of the study, the secondary data for the analysis has been collected from the annual reports of the 4 Irish banks which are: Allied Irish Bank, Bank of Ireland, Permanent tsb and Ulster Bank. From the reports published by these banks, the financial ratios are calculated by the author from the source material (annual financial report) for each bank and an example is shown in Appendix 1 for calculating NPLR, CAR and ROE. Therefore, three ratios for these banks for 11 years give 129 pieces of information, since Ulster Bank has data for 10 years i.e. from 2009-2018. The analysis will be done based on these 129 values. The key metrics from the regression output which will be looked upon for the analysis are: R^2, adjusted R^2, regression coefficients of the independent variables (CAR and NPL), p-values of the regression coefficients, and significance of the F value as these are the important metrics of the regression analysis. Also, correlation analysis is undertaken in order to understand how strongly the variables are related to each other. This is denoted by 'r' and it will also be looked upon as a key metric of the correlation. These metrics will help in finding the answer for the research question.

Each of the metrics are explained below:

3.3: Correlation coefficient (r):

It is the correlation coefficient of the dependent and independent variable. The correlation coefficient is also referred to as Pearson correlation coefficient. It examines the strength of relationship between the dependent and independent variables and measures the linear relationship between the two. The correlation coefficient can take the values between +1 and -1 inclusive. A perfect positive correlation is indicated by +1 whereas -1 indicates a perfect negative correlation. A positive correlation coefficient indicates if one variable goes up, the other variable also generally goes up as well i.e. they are directly related whereas negative correlation coefficient tells that the variables are inversely related to each other.

Next part of the testing will be to test the significance of correlation coefficient based on the hypothesis to know if the linear relationship between the variables in sample is true at the population level. Therefore, the testing is done for each single regression model.

3.4: Testing the significance of correlation coefficient:

Here, the testing is done for the significance of the sample correlation coefficient using hypothesis testing. Here, 'r' (sample correlation coefficient) is used to test ρ (rho), which is correlation coefficient of the population. The null hypothesis will be ρ=0 which will be tested using p-value in order to make a conclusion. The formula used is: t = $\frac{r\sqrt{(n-2)}}{\sqrt{(1-r^2)}}$ where n-2 is degree of freedom, r= correlation coefficient and n = number of observations.

The calculated t value is compared with critical t value from the t table (Appendix 3) for the degrees of freedom. If the calculated t> critical t then it shows that t is significant however p-value allows to determine the confidence level that ρ will not be 0. Therefore, if p < 0.05[1] then null hypothesis is rejected, and it is concluded that there is a linear relationship between the variables X and Y and the correlation coefficient is ≠ 0 thereby, accepting the alternative hypothesis.

Additionally, the author has also undertaken an analysis for each model by own which is not a part of the Excel output. An example of the calculations for one of the models is shown in Appendix 4 and results of this test are shown for each model in the next chapter.

3.5: R squared (R^2):

R^2 is the coefficient of determination and it is a statistical measure which indicates how effectively the model fits the data. According to Davies (2017), it is useful in explaining how closely the regression equation fits the data. It can also be said that R^2 explains the percentage variation in the dependent variable that can be linked to the set of independent variables. The range of R^2 is from 0 to 1 inclusive, which is seen in percentage values from 0% to 100%. R^2 is the squared value of the correlation coefficient. It can be seen in the output of the regression analysis when it is run in Microsoft Excel. It is easy to

[1] 0.05 is the cut-off point as 5% is generally accepted level of significance in business and in the field of Finance. Whereas, in medical field, the significance level will be much lower than 5%. Hence, in this study the level of significance which is considered satisfactory is 5%.

understand as well. But the important point to note, since it is a squared number, it can never be negative (Lind, 2020).

3.6: Adjusted R^2:

If an additional independent variable is added in a multiple regression equation, the variation will increase even if the newly added independent variable explains small amount of the variation in the dependent variable. Since, the independent variables increase, R^2 increases but this doesn't give the correct result about how powerful the model is (Lind, 2020). Therefore, Adjusted R^2 is used in multiple regression and it will not increase automatically even if the new independent variables are added. Hence, it is considered to be more accurate and have more reliable results. Adjusted R^2 value will be less than R^2 and can even become negative. For this study, Adjusted R^2 will be looked upon for the multiple regression analysis undertaken in 4 different conditions (Model 3, 3A, 3B and 3C).

3.7: Regression coefficients:

The simple regression equation is represented as Y = a + b X where, the coefficients are 'a' and 'b'. Regression analysis calculates the value of 'a' and 'b' for each model and the values are substituted in the equation to find the relationship between the variables X and Y.

X is the independent variable and Y is the dependent variable. In regression line, 'a' is called an intercept and 'b' is the slope.

Coefficient 'a' is interpreted when X= 0 therefore, 'a' will be the value of Y when X becomes 0 (Lind, 2020)

Sometimes 'a' coefficient has a very little meaning in the equation.

Also, coefficient 'b' is interpreted from the equation when X changes by 1 unit then Y will change by 'b' times (Lind, 2020). Similarly, simple linear regression equation is extended to check the impact of multiple independent variables on the dependent variable and the equation is expressed as: $Y = a + b_1 X_1 + b_2 X_2 + \ldots. b_k X_k$ where, k is the number of independent variables. b's are the coefficient of X's and similar to the simple regression, Y becomes 'a' when all X's are 0. Also, when X_1 changes by 1 unit, Y changes by b_1 times

by keeping X_2 constant and Y will change by b_2 times when X_2 changes by keeping X_1 constant.

3.8: Hypothesis testing:

Hypothesis testing contains two contradicting statements which are based on the collected data from the sample. The two hypotheses are called "null hypothesis" and "alternate hypothesis", these two have the opposite views.

Null hypothesis is denoted by H_0 and it states that there is no relationship between the variables. However, the null hypothesis is not rejected unless the results are convincing that it is false (Lind, 2020). Whereas, alternate hypothesis is denoted by H_a (DeFusco *et al*., 2007) and it is accepted when the data provides evidence against the null hypothesis (Lind, 2020). The confidence level is set to 5% therefore, if p-value is less than 0.05 then null hypothesis is rejected and alternate hypothesis is accepted.

3.9: p-value:

p-value is the percentage significance level of the regression coefficient. It is the measure of significance of the relationship between the dependent and independent variable. In simple words, "*the significance is measured by p-value"* (Davies, 2017). The significance level is set to 5%, hence, the smaller the value of p, the more significant it is. Therefore, if p is less than 5% (0.05) then it provides at least 95% confidence that there is a significant relationship between the variables. While analyzing the models, p-value is checked for each variable to determine if the model is giving significant results.

3.10: F value and significance of F:

It is the probability that the regression model is unreliable. Therefore, this probability needs to be as small as possible. It is also indicating that the probability of coefficients in the output comes out to be zero. It is similar to the p-value in the regression model. However, the key difference is that, significance of F is applied and considered for overall model whereas p-value is applied to each of the coefficients in the regression model. In the case of single regression, p-value and significance of F value will have same results. In this study, the significance of F for each model is checked as the models are created based on the regression analysis which is undertaken in different conditions.

3.11: Identifying and removing an outlier:

In this research, while analyzing the models, one of the variations is to remove an outlier as it distorts the data. Linear regression is sensitive to outliers therefore, it justifies excluding the outlier from the dataset. An outlier is a data point that is quite different when it is compared with the other observations. According to Adams *et al*. (2019), outlier arises a concern in research which is aimed towards the field of Finance. The possibility of incorrect results increases when the data is analyzed with an outlier. Therefore, sometimes it is not included in the analysis. Hence, in this research it also creates a need to analyze the data in both ways i.e. including an outlier in dataset and excluding them in next step, to check the influence of an outlier on the results.

3.12: Lagging dependent variable:

The methodology also involves lagging the dependent variable. In time series, lagging is used to allow the time to show an impact. The variable can be lagged for more than one period but for this study, one period lag is used. As the annual data is considered for the analysis, one year lag shows a sufficient impact. Therefore, when one period lag is used, only one piece of information gets removed from the data set. However, in this research, the analysis is for 4 different Irish banks hence, after lagging dependent variable i.e. Return on Equity (ROE) by one period, a total 4 observations are removed i.e. one observation from each of the banks gets removed from the total. Therefore, overall 39 observations are left for the analysis. Hence, based on the lagged data set, 3 different models are created (Model 1B, 2B and 3B). However, there is also a variation made with an outlier removed from the lagged dataset in order to build 3 different set of models which are Model 1C, 2C and 3C.

From this, it helps to understand deeply about the effect of Non-performing loans and Capital Adequacy Ratio on Return on Equity. Because the analysis has been done from different angles hence, it makes it easier for comparison under four different conditions and to identify which model is the strongest and shows the significant results.

3.13: Using Qualitative independent variable, Dummy variable:

Dummy variable helps in getting the information about the data, whether it is affected by some event (political, economic etc.). It is created to incorporate qualitative variables in the regression analysis. It is called as qualitative variable because it describes a quality of

that variable (Lind, 2020). Here, because there is something happening in the market that might affect the banks performance which is not quantifiable therefore, a new qualitative variable is built for the analysis. To this qualitative variable, a quantitative value is assigned. For this study a dummy variable called "economic condition" is created. The good economic condition will be denoted by '1' whereas recession will be denoted by '0'. In context with Irish economy, it started to recover from year 2013 where the signs of banks performing better has also be seen (Whelan, 2014). Therefore, from 2008 to 2012, "0" is used and from 2013- 2018, "1" is used. From this, the impact of economic backdrop will be measured.

Here, multiple regression will be run with a dummy variable and same as before, the analysis will be done based on the metrics which are: R^2, significance of the F statistic and p-value of regression coefficient. If p-value of the regression coefficient of economic condition is significant, it will explain the impact of economic growth.

The expectation related to bank's performance is, when the economy is good the banks tend to perform better whereas in recession the banks have lower performance. This is analyzed and justified using the results which will be seen in the next chapter.

3.14: Non-linear trendline:

An attempt is made to introduce non-linear format to test if R^2 improves. It is done through scatter plot and trendline. Particularly, for this research logarithmic trendline is tested for single regression because the curve starts to rise and then reaches a point where it flattens. This is theoretically valid because in spite of improving NPL and CAR, ROE can't really continue to increase much, there can be other driving factors which will lead to increase ROE. The reason for not using exponential is, because it tells that if CAR or NPL reaches to a certain level, ROE shoots up. This is not likely in real situation hence, logarithmic trendline is used as an example of non-linear.

In the next chapter, the non-linear plots are shown for the models where R^2 improved more.

3.15: Diagnostic testing of data:

To identify the various issues in the data, diagnostic testing is undertaken by the author to check the quality of the data set, but resolution of any identified issues is beyond the scope of this research.

3.15.1: Multicollinearity:

Multicollinearity occurs when the independent variables are correlated (Lind, 2020). In other words, "*Multicollinearity exists when the regressors are related to each other"* (Sevinç and Göktaş, 2019). In order to test it, a matrix of correlation coefficient of different independent variables is created. If the correlation coefficient between the independent variables are between +0.7 and -0.7 then it is not considered to be a problem and both the variables can be used (Lind, 2020). However, if the coefficient between the two are higher than +0.7 or lower than -0.7 one of them should be removed. Multicollinearity creates the difficulty in measuring the effect of independent variable on the dependent variable. For this study, Multicollinearity will be tested for four different datasets which are: NPL and CAR, NPL and CAR with an outlier removed, NPL and CAR with lagged variable, NPL and CAR with lagged variable and an outlier removed.

Using Multicollinearity, it will be tested if the independent variables considered in this study (Non-performing loans and Capital Adequacy Ratio) are correlated in any of the condition.

3.15.2: Autocorrelation:

Autocorrelation, which is also known as serial correlation, is tested within SPSS through Durbin-Watson test. This is an important issue which needs to be examined in the time series data. If it occurs in the dataset, it can result in serious problem. Lind (2020) tells "*When successive residuals are correlated, autocorrelation occurs"*. This means the errors of regression analysis are correlated across the observations. It usually occurs when the data is gathered over a period of time.

Durbin-Watson ratio will be between 0 and 4. A score of 2 means the Autocorrelation is not present in the sample. Values from 0 to less than 2 indicates positive autocorrelation whereas score from more than 2 to 4 indicates negative autocorrelation detected in the

sample. For the research, the Autocorrelation is tested for the appropriate models and significance test is also done whose results are presented in the next chapter.

3.15.3: Heteroscedasticity:

Out of several assumptions in linear regression model, one of the assumptions is the absence of Heteroscedasticity. "*When variation around the regression equation is small for all the values of the independent variables"* (Lind, 2020), Homoscedasticity occurs and absence of this is termed as Heteroscedasticity. According to Sevinç and Göktaş (2019) Heteroscedasticity occurs when the error terms in the regression widely varies. In this study, the testing of Heteroscedasticity is also done by Breusch-Pagan test in SPSS along with building the scatter plots which provides visual information. According to DeFusco *et al.,* (2007) Breusch-Pagan test is widely used in the studies which are based on the area of Finance. Hence, author has also used this test to draw the conclusion. In this research, the testing is undertaken by the author in SPSS software.

3.16 Limitations of the research:

The author believes that it is more appropriate to discuss the limitations of the research after the conclusions. Therefore, it is discussed in Chapter 6.

3.17: Summary of Chapter 3:

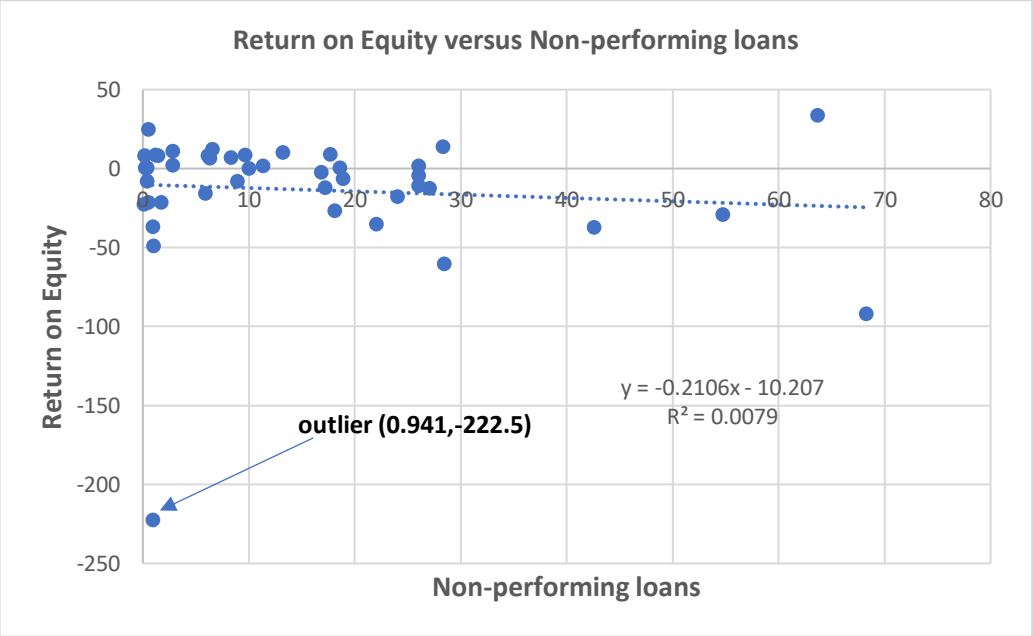
This chapter has explained different approaches which has been followed in the study and are listed below briefly: -

a) Regression analysis with original data, outliers removed, lagging with outlier and lagging without an outlier.
b) A brief look at non-linear trendline for the models showing improvement in R^2.
c) Development of the model using dummy variable.
d) Significance testing of the key results including correlation coefficient using hypothesis testing.
e) Diagnostic testing of the data and testing its significance.

Chapter 4: Results and Analysis:

This chapter includes the analysis and results of the different tests which is undertaken in this research, based on the methodology outlined in the Methodology chapter (Chapter 3). The metrics which are used in explaining the results are shown in the summary table (Table 1, 2, 3 and 4) and significance of correlation coefficient is shown in Table 5.

4.1: Model 1: Return on Equity Versus Non- performing loans



Source: Author's creation from source data using Microsoft Excel

Figure 1

In this model, Return on equity is regressed on Non-performing loan based on the 43 observations.

The regression equation is Y= a + b X, where Y = Return on Equity which is a dependent variable and X= Non-performing loans, which is an independent variable.

From the Model 1, the coefficients are a= -10.207 and b= -0.2106

Hence, the equation formed: ROE = -10.207 - 0.2106 NPL

This explains that NPL ratio effects negatively on ROE (b= -0.2106) which means that if Non-performing loans increases, the Return on Equity of banks decreases. The slope of the line is downwards, which shows a negative link between NPL and ROE. This is

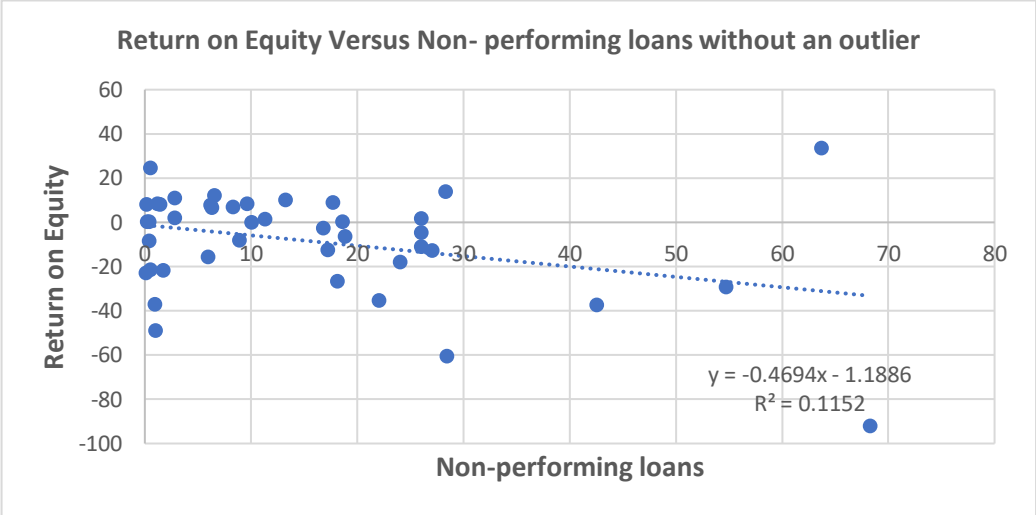
consistent with the theoretical expectation and shows the correct result. It can also be seen, if NPL goes up by 1 unit, ROE will decrease by 0.21 units. This may be because of the banks has given loans without proper security also, the other reason can be the economic slowdown as a result people were unable to repay the loans. But looking at the 'a coefficient' i.e. -10.207, it doesn't allow to draw a conclusion on Return on Equity because as per equation, if NPL = 0 which means banks has no Non-performing loans, then ROE will still be negative (-10.207). This is not giving a realistic result because in real situation if Non-performing loans of the banks are '0' then it is a favorable situation for the banks and Return on Equity should be higher. In regression, sometimes 'a coefficient' has a very little meaning, which in this case is true. The sign of the correlation coefficient, 'r' proves the theoretical expectation to be correct as it shows NPL and ROE are inversely related but it fails the significance testing as p-value > 0.05. R^2 explains the impact of independent variable on the dependent variable. Here, R^2 = 0.0079 shows 0.79% impact of NPL on ROE. The dependent variable ROE changes by less than 1% of movement which can be linked back to the independent variable NPL, which is really a small percentage.

From the sample of 43 observations, it is seen that significance of F and p-value[2] of NPL regression coefficient is 0.57 which shows that there is 57% chance that the coefficient of NPL could be 0 and other 43% of confidence that it will not be 0. Hence, the model is not reliable as it doesn't show the significant relationship between ROE and NPL because p-value of the regression coefficient is greater than 0.05.

While analyzing the data with Non-performing loans in single regression model (Model 1), it is seen that may be due to an outlier the model is not giving significant results hence, it is removed from the dataset. In Figure 1, an outlier is clearly seen (0.941, -222.5) and it is very different with the other observations as ROE was -222.5% in 2010, the reason behind this is not explained in the relationship, therefore, the next model (Model 1A) will be created by removing an outlier so that it can be checked if the model improves. Hence, the regression is done again without an outlier.

[2] In the case of single regression, Significance of F and p-value will have the same significance and they have same values, which means F test and t test will have same results. F value checks if the regression coefficients (at least 1) are not 0 whereas, t test (p-value) checks for each of the regression coefficient.

4.2: Model 1A: Return on Equity Versus Non- performing loans without an outlier



Source: Author's creation from source data using Microsoft Excel

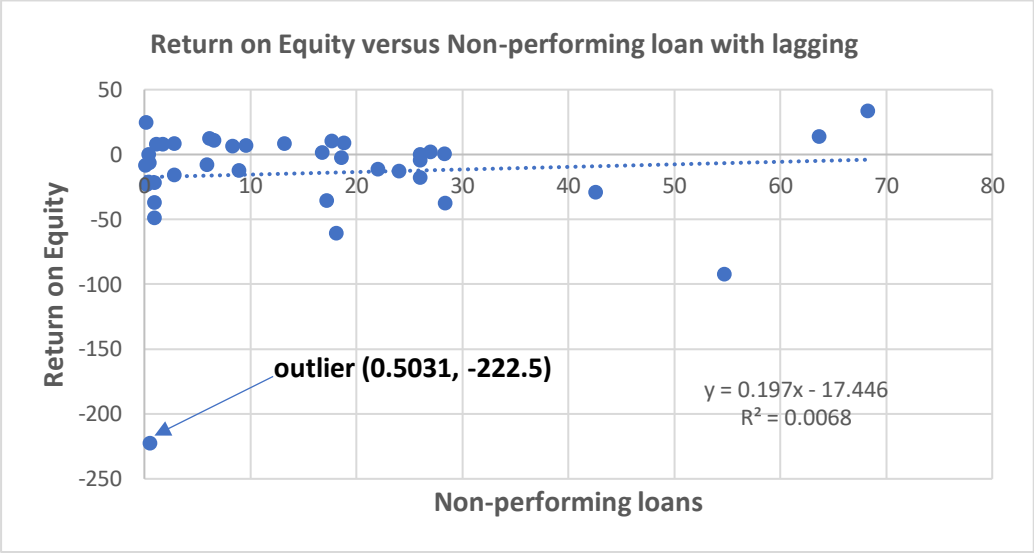
Figure 2

After removing an outlier, from the sample of 42 observations, the regression equation formed is: ROE = -1.188 - 0.469 NPL

This tells that if Non-performing loans of banks goes up by 1 unit then Return on Equity decreases. It is consistent with the theory and supported by the negative sign of 'r' showing they are inversely related and also being significant as it pass the significance testing. R^2 is improved to 0.115 which tells that there is 11.5% impact of variation of ROE which can be associated with NPL. Significance of F value of 0.0278 is telling that the probability of the model being unreliable is 2.7% which is much less. Also, p-value is good for this model (0.0278) as it is less than 5% hence, there is 97% of confidence that the coefficient of NPL is not zero and only 2.78% of uncertainty that the coefficient is zero. Therefore, the model is reliable in this case.

To further check if Non-performing loans contributes in profitability of bank, ROE is lagged by one period which will help to check the result. Therefore, Model 1B is created based on the lagged dependent variable.

4.3: Model 1B: Return on Equity versus Non-performing loan with lagging



Source: Author's creation from source data using Microsoft Excel

Figure 3

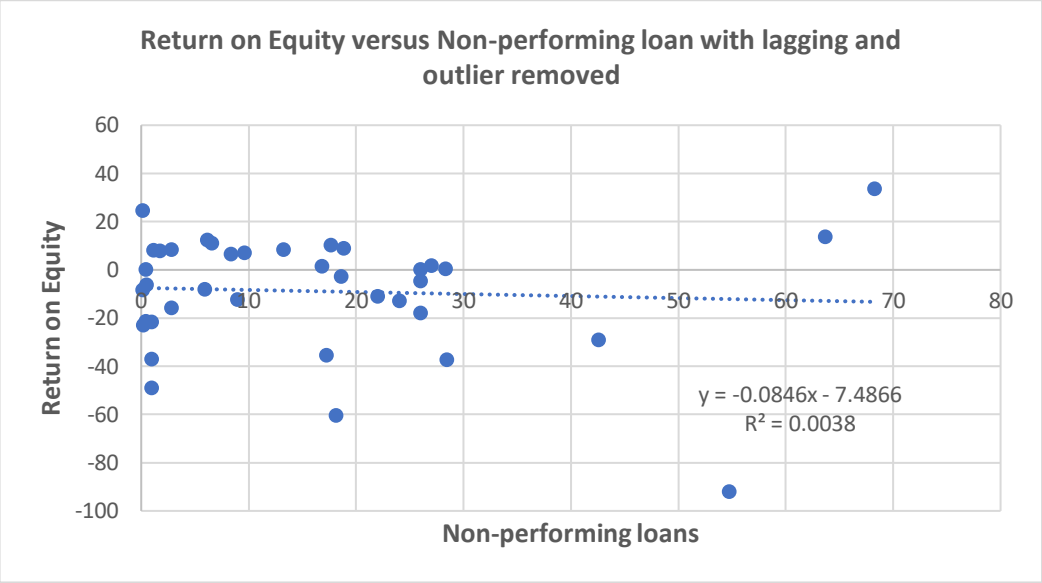
From the sample of 39 observations, the regression equation formed is:

ROE= -17.44 + 0.197 NPL

This provides a reverse result when compared with model 1 and 1A. This equation is telling that when Non-performing loan increases by 1 unit, Return on Equity for banks also increases by 0.19 times. Since r is positive, the theoretical expectation becomes false as it shows a direct relation between NPL and ROE. This is similar to the finding of Islam *et al.,* (2019) in which NPL is lagged by one period whereas in this study ROE is lagged by one period. Also, r fails the significance testing as p-value is greater than 0.05. The R^2 value has decreased to 0.0068 that shows 0.68% change in ROE when linked with Non-performing loans. This is really a small value, showing that the model is not strong. Significance of F value increased to 62% shows very high probability that the model is unreliable. p-value is much greater than 5% hence, there is 62% of chance that coefficient of NPL is zero and only 38% of certainty that coefficient will not be 0. Therefore, this model is not reliable as it is not showing the significant results.

Since this model is not giving significant results, again outlier is removed to check if the results improve.

4.4: Model 1C: Return on Equity versus Non-performing loan with lagging and outlier removed



Source: Author's creation from source data using Microsoft Excel

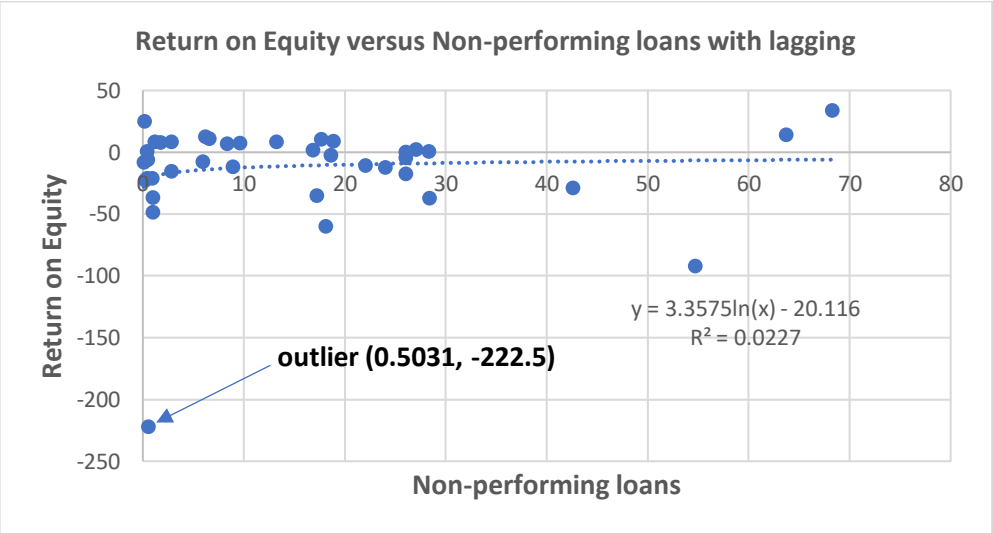
Figure 4

As outlier is removed and dependent variable is lagged, overall 38 observations are left for the regression analysis. Based on these observations, the regression equation formed: ROE = -7.48 - 0.084 NPL. From this, it can be said that if NPL increases, ROE goes down by 0.08 times. The slope tells that there is a negative relationship between the two variables. It further supports by the sign of 'r' as it tells that they are inversely related hence, proving theoretical expectation to be correct but at the same time r doesn't pass the significance testing. R^2 reduces even more when compared with Model 1 and 1B. This shows that only 0.3% of variation in ROE can be associated with NPL. The significance of the F value gets even higher with a value of 0.71 which shows a high probability (71%) of the model being unreliable. p-value is much higher than 5%, shows 71% uncertainty of the coefficient of NPL will be 0 and 29% of confidence that coefficient will not be 0. Overall, the model is not reliable as the results are not significant.

4.5: Non-linear trendline:

The plots above show linear relationship between the variables however, there is also an attempt made by introducing non-linear trendline to see if R^2 improves. For each model logarithmic trendline is examined but only for Model 1B the R^2 is improving from 0.0068

to 0.0227 but it is still on a lower end. Therefore, it can be concluded that model with lagged dependent variable, ROE has a potential to improve with non-linear regression. This can be seen in the Figure 5.



Source: Author's creation from source data using Microsoft Excel

Figure 5

Summary of Model 1, 1A, 1B and 1C

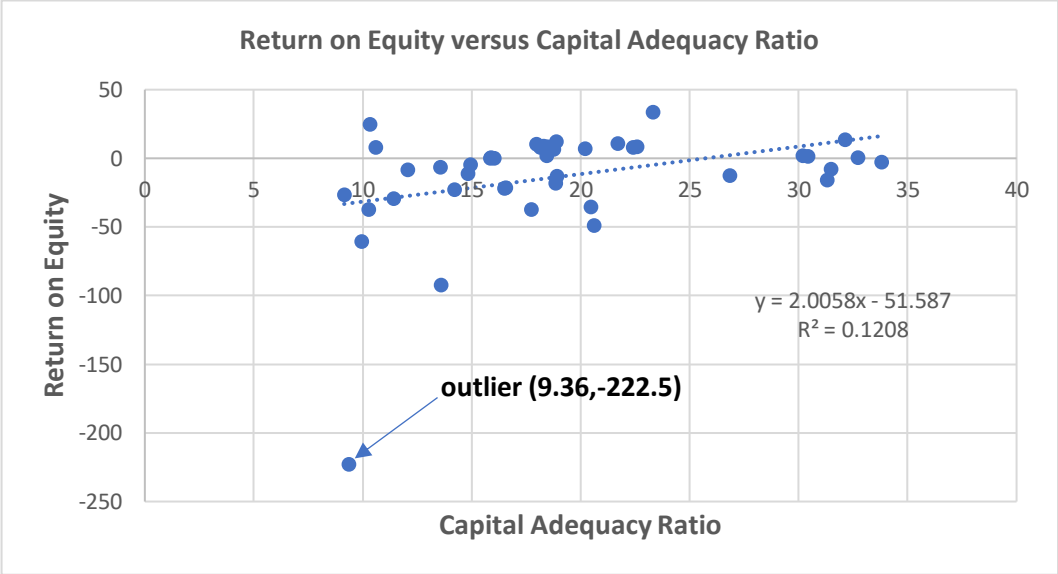
Description	Model	r	R^2	Significance of F	Coefficient of NPL	p-value	No. of observations
NPL only	Model 1	-0.088	0.0079	0.5707	-0.21	0.5707	43
NPL with outlier removed	Model 1A	-0.339	0.1152	0.0278	-0.469	0.0278	42
Lagged dependent variable with NPL	Model 1B	0.082	0.0068	0.6167	0.1969	0.6167	39
Lagged dependent variable with NPL and an outlier removed	Model 1C	-0.061	0.0038	0.7144	-0.0846	0.7144	38

Author's construct from regression output

Table 1

Based on the analysis, the highest R^2 is shown by Model 1A where the outlier is removed, and significance of F value is lowest for this. Therefore, Model 1A is considered to be the best out of these 4 Models. When non-linear trendline is introduced, Model 1B showed improvement in R^2 more as compared to other models.

4.6: Model 2: Return on Equity versus Capital Adequacy Ratio



Source: Author's creation from source data using Microsoft Excel

Figure 6

In this model, Return on Equity is regressed on Capital Adequacy Ratio.

CAR is an independent variable which is X and dependent variable remains same which is ROE.

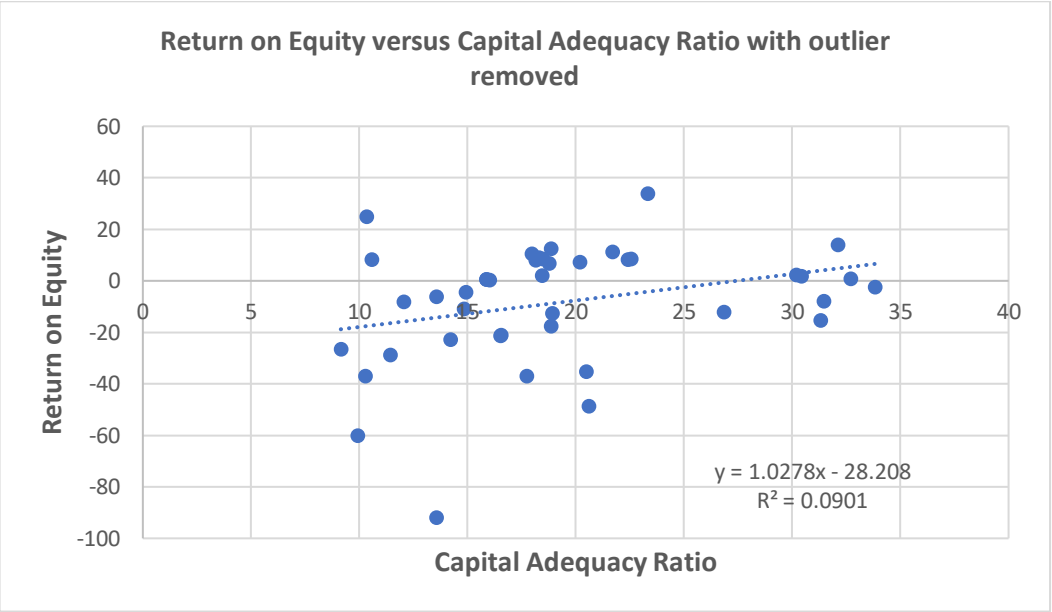
From the results, the coefficients are found as: a= -51.586 and b= 2.005

Therefore, the regression equation formed: ROE = -51.586 + 2.005 CAR

The equation explains that with every increase in CAR, Return on Equity increases. For example, if CAR increases by 1 unit, ROE increases by 2.005 times. From this it can be concluded that higher CAR reduces the risk and increases returns. Therefore, it is consistent with theoretical expectation. Correlation coefficient 'r' shows a positive sign by successfully passing the significance testing of it as it is less than 0.05. R^2 = 0.1207 shows 12.07% impact of CAR on ROE. Also, p-value = 0.022 which is less than 0.05, provides strong degree of confidence that the coefficient will be 0. Significance of F tells that there is only 2.2% of risk that the model is not reliable. Hence, significant relationship is seen between CAR and ROE. Overall the model is reliable by 98%.

Figure 6 shows an outlier, hence regression is rerun for Model 2 by excluding the outlier and named as Model 2A. The plot can be seen in Figure 7.

4.7: Model 2A: Return on Equity versus Capital Adequacy Ratio with outlier removed



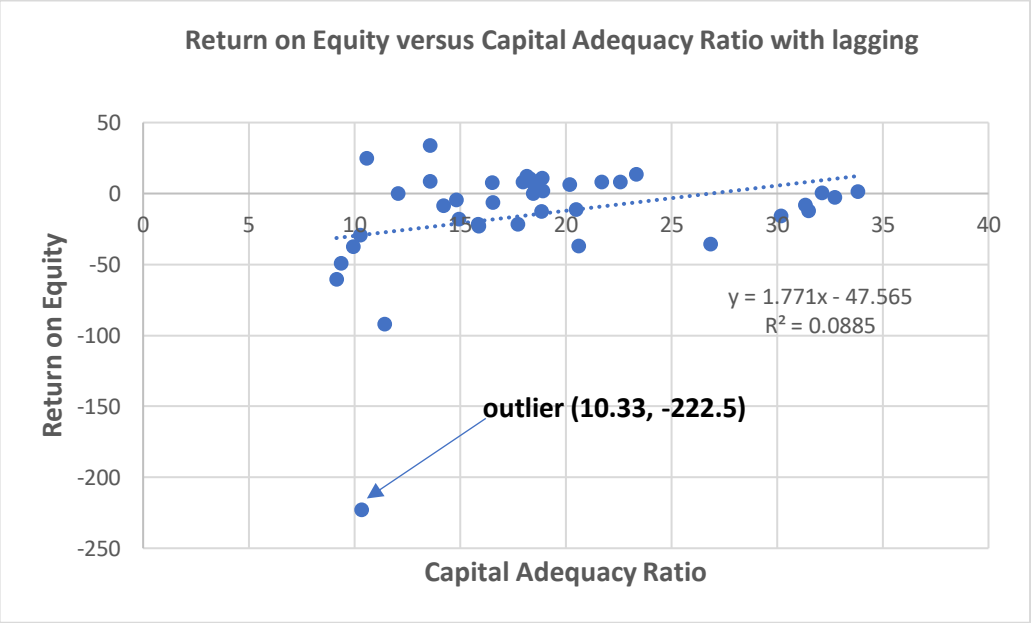
Source: Author's creation from source data using Microsoft Excel

Figure 7

After removing the most unusual value from the data set, the sample of 42 observations forms the regression equation: ROE = -28.208 + 1.02 CAR. This shows that with increase in Capital Adequacy Ratio of the banks, Return on Equity also increases 1.02 times and it is supported by the sign of 'r' which shows that it is very close to being significant. R^2 for this model changes to 0.09 i.e. 9% variation of ROE can be linked to CAR. It can be seen that there is a significant relationship between the two variables as significance of F value is small and showing that there only 5% chance of the model being unreliable. When p-value of coefficient of CAR is looked upon, it is slightly more than 5% (0.053). This exhibits that there is 94.7% certainty that coefficient of CAR will not be 0. Overall, it can be said that after removing an outlier, the model is still reliable. But, the results are weaker when compared with Model 2.

Based on the lagged dependent variable (ROE), the next model will check the impact of Capital Adequacy Ratio on Return on Equity, which is lagged by one period.

4.8: Model 2B: Return on Equity versus Capital Adequacy Ratio with lagging

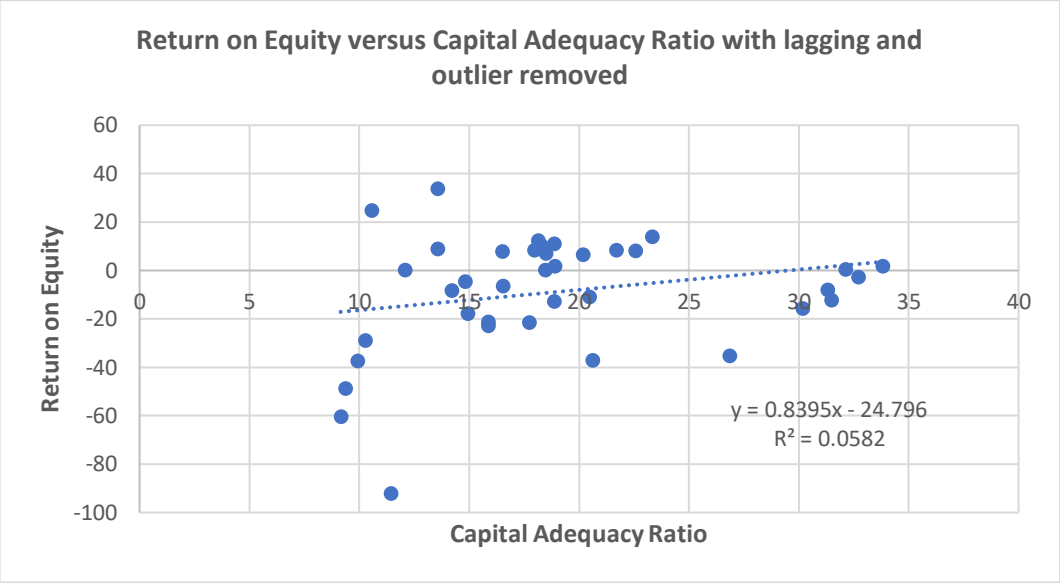


Source: Author's creation from source data using Microsoft Excel

Figure 8

In this model, the analysis is done with outlier kept in, whereas ROE is lagged by one period for each bank. Therefore, the sample of 39 observations makes the regression equation as: ROE = -47.56 + 1.77 CAR. This shows that even after lagging ROE, with increase in Capital Adequacy Ratio, the Return on Equity of the banks increases by 1.77 times. Correlation coefficient 'r' is almost significant and shows the positive sign. Also, R^2 further goes down to 0.088, which means that there is 8% impact on ROE by movement of CAR. p-value of coefficient of CAR is slightly higher than 5% (0.065) which shows that there is 6.5% chance that coefficient will be 0. Hence, the model is close to be significant as there is 6.5% probability of model being unreliable. But, overall the model is not reliable when compared with Model 2 and 2A.

4.9: Model 2C: Return on Equity versus Capital Adequacy Ratio with lagging and outlier removed



Source: Author's creation from source data using Microsoft Excel

Figure 9

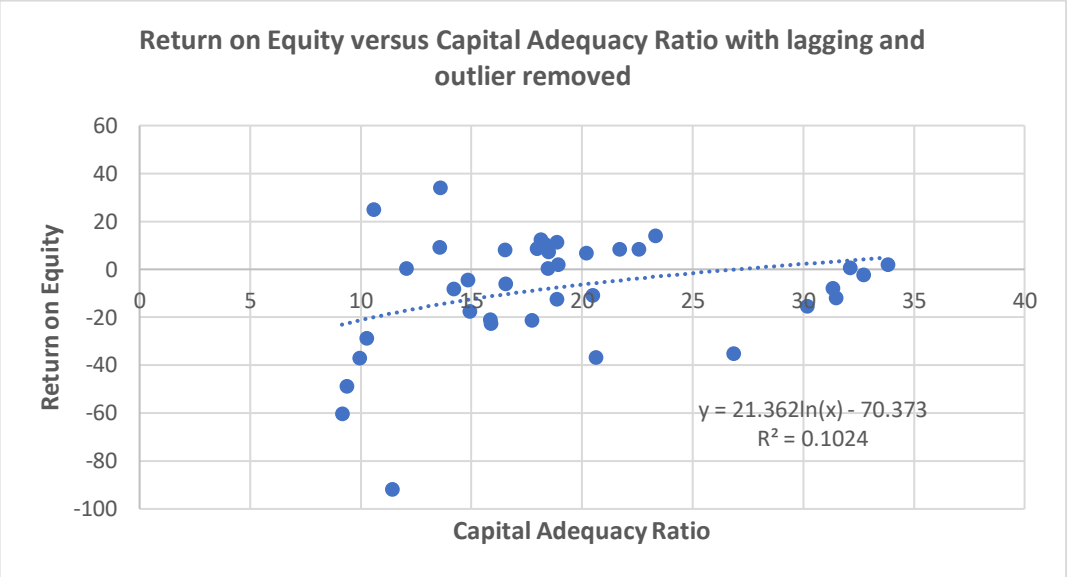
With the lagging and an outlier removed, the 38 observations from the sample makes the regression equation as: ROE = -24.79 + 0.839 CAR

It is seen that the result is consistent with the theoretical expectation as ROE is increasing with an increase in CAR. The slope is positive and r also shows positive sign but fails to pass the significant testing. R^2 doesn't improve when it is compared to Models 2, 2A and 2B as it is showing only 6% impact of CAR on ROE. Significance of the F value exhibiting that 14.4% chance of model being unreliable which is quite high. Also, $p > 0.05$ (0.144) shows 14% probability that the coefficient of CAR will be 0 and 86% confidence that coefficient will not be 0. Therefore, this model is not reliable as the results are not significant.

4.10: Non-linear trendline:

For these 4 models, the starting point was linear regression analysis, then a variation is made by changing the format of trendline to logarithmic for all these models. With this, it is found that for each case R^2 improved. However, the highest improvement seen is with

Model 2C though being not significant it has improved. This is because R^2 gets doubled from 5.8% to 10.2%, it can be seen in Figure 10.



Source: Author's creation from source data using Microsoft Excel

Figure 10

Summary of Model 2, 2A, 2B and 2C

Description	Model	r	R^2	Significance of F	Coefficient of CAR	p-value	No. of observations
CAR only	Model 2	0.347	0.1207	0.0224	2.0058	0.0224	43
CAR with an outlier removed	Model 2A	0.3	0.0901	0.0533	1.02	0.0533	42
Lagged dependent variable with CAR	Model 2B	0.297	0.0884	0.0658	1.77	0.0658	39
Lagged dependent with an outlier removed	Model 2C	0.2412	0.0581	0.1446	0.839	0.1446	38

Author's construct from regression output

Table 2

From all 4 Models, the sign of correlation coefficient stays positive hence it is consistent with the theoretical explanation as it shows the direct relationship. But out of these, the most reliable one is Model 2 with outlier kept in. Because R^2 is highest and significance of the F value being most significant thus, providing the stronger results and making it reliable. It is an interesting result because with an outlier for NPL (Model 1A), R^2 improved and showed the stronger results however it is not the case with CAR. Another interesting variation seen when logarithmic trendline doubled the R^2 of Model 2C but analyzing with all the key metrics, Model 2 is most significant.

4.11: Model 3: Return on Equity versus Non- performing loans and Capital Adequacy Ratio

Scatter plot for multiple regression in 2 dimensions cannot be plotted hence there will not be a graphical representation of it.

Here, both the independent variables are included in the analysis. ROE is regressed on NPL and CAR. From the output of the regression, the equation is formed as:

ROE= -48.828 - 0.1488 NPL + 1.978 CAR.

This equation explains, if NPL and CAR are 0 then ROE becomes negative (-48.828) which is not correct in real situation hence 'a' coefficient has no realistic meaning in this model. In other case when NPL increases by 1 unit by keeping CAR constant, ROE drops by 0.148 units. Whereas if NPL is kept constant and CAR increases by 1 unit then ROE goes up by 1.978 units. This shows the correct theoretical meaning. Also, R^2 for this model is 0.124 which means there is 12% impact of movement of ROE that can be associated with CAR and NPL. Using the adjusted R^2 which is regarded as more accurate, it loses 4%. Therefore, 8% variation in ROE is associated with NPL and CAR. It can also be seen that NPL is not contributing much to the variation as the R^2 changes from 12.07% when CAR is regressed on ROE (Model 2) to 12.47% (Model 3) when NPL is also considered in the analysis. So, there is minor change in R^2. The significance of F is 0.0696 which shows that there is 6.9% of probability that the model is unreliable but, it is near to 5%. This tells that the model is good but not reliable. p-value of X_1 (NPL) is 0.67 which is greater than 5%, that means there is 67% uncertainty that the coefficient will be 0 and only 33% of confidence that coefficient of NPL is not 0. Whereas p-value of CAR = 0.026 which is < 0.05, this shows a

reliable result because there is 97% confidence that coefficient of CAR will not be 0 and only 2.6% of uncertainty lies that the coefficient will be 0. Hence the model is not reliable due to significance of F and p-value of NPL coefficient is not significant.

4.12: Model 3A: Return on Equity versus Non- performing loans and Capital Adequacy Ratio with outlier removed

In the data set of 129 values, the outlier is clearly seen (0.941, 9.36, -222.5) (Appendix 6) therefore, in this model the multiple regression is rerun on the data set without an outlier and the equation formed with 42 observations is: ROE = -19.408 - 0.429 NPL + 0.9131 CAR. It can be seen that Return on Equity decreases when Non-performing loans increases for the banks. Whereas CAR and ROE still shows the positive relation. Because as per the equation, when CAR increases, ROE also increases 0.9 times, which was 1.97 times increase when compared with Model 3. R^2 value goes up to 0.185 by showing that there is 18.5% variation of ROE associated with both the independent variables (NPL and CAR). However, adjusted R^2 drops to 14.3% which exhibits less impact of independent variables on ROE. Significance of F value is good as it is much lower and showing that only 1.8% probability of the model being unreliable. p-value of NPL shows that there is 4% uncertainty that the coefficient will 0 and 96% of confidence that it will not be 0. Whereas p-value of CAR is close to be significant by showing 7.4% of uncertainty that the coefficient will be 0 and 93% confidence that it will not be 0. Hence the model is considered as broadly reliable.

4.13: Model 3B: Return on Equity versus Non- performing loans and Capital Adequacy Ratio with lagging

When ROE is lagged by one period, 4 observations gets removed therefore, with 39 observation the equation formed is: ROE = -52.11 + 0.242 NPL + 1.809 CAR here, theoretical expectation of NPL proved to be incorrect as the equation is showing positive relationship between the two. However, it is consistent with CAR as ROE increases by 1.8 times with increase in CAR. R^2 shows 9.8% variation of ROE that can be linked with NPL and CAR but adjusted R^2 becomes small when compared with model 3A, where it is showing only 4.8% variation of ROE that can be linked with NPL and CAR and considered to be more accurate. Significance of F value is much higher and showing 15% probability of the model being unreliable. p-value of NPL tells that there is 52.4% uncertainty that the

coefficient will be 0 and 47.6% confidence of coefficient not being 0. Whereas, p-value of CAR is close to be significant by showing 6% uncertainty of coefficient being 0 and 94% confidence that it will not be 0. But overall, the model is not good when compared with Model 3 as the results are not significant.

4.14: Model 3C: Return on Equity versus Non- performing loans and Capital Adequacy Ratio with lagging and outlier removed

This model has 38 observations as it includes both the removal of an outlier (0.5031, 10.33, -222.5) along with lagged variable. Therefore, the equation comes out to be: ROE = -23.683 - 0.05 NPL + 0.826 CAR. The equation is still consistent theoretically for the relation of ROE with NPL and CAR. R^2 becomes really low but it pulls down even further when it is adjusted (0.0059). It shows only 0.59% impact on ROE by movement of NPL and CAR which is really a small value. Significance of F becomes double as compared to Model 3B. It is showing 34% probability of the model being unreliable which is high and doesn't considered as a significant result. p-values of NPL and CAR are more than 5% which is not a reliable result. There is 81% chance of the coefficient of NPL being 0 and only 19% confidence that the coefficient will not be 0. Also, there is 16% confidence that the coefficient of CAR will be 0 and 84% chance that the coefficient will not be 0. Hence the model doesn't seem to give a reliable result.

Summary of Model 3, 3A, 3B and 3C

Description	Model	R^2	Adjusted R^2	Significance of F	Coefficient of NPL and CAR	p-value of NPL and CAR	No. of observations
NPL and CAR	Model 3	0.1247	0.08	0.0696	-0.1488 and 1.978	0.6741 and 0.0261	43
NPL and CAR with outlier removed	Model 3A	0.185	0.143	0.01828	-0.4295 and 0.9131	0.038 and 0.0741	42
Lagging with NPL and CAR	Model 3B	0.098	0.048	0.1536	0.2427 and 1.8093	0.524 and 0.0631	39
Lagged variable with NPL and CAR with an outlier removed	Model 3C	0.059	0.0059	0.34	-0.05 and 0.826	0.814 and 0.158	38

Author's construct from regression output

Table 3

From all 4 models, it is seen that Model 3A is providing the significant result as R^2 being the highest and shows good significance of F value.

4.15: Development of the model:

By using a dummy variable called "economic condition", the model is developed further to see if it improves. Here, Model 3A, which is best out of above 4 multiple regression models has been selected to test with the dummy variable. This new Model is named as "Model 3a". Hence, after running the multiple regression with three independent variables which includes a dummy variable, the model gives more significant results.

The regression equation formed ROE = -21.44 -0.561 NPL + 0.55 CAR + 19.16 economic condition

From this it can be seen that there is a positive link between economic condition and performance of the Irish banks. Because from the equation it can be said that, if economy goes up, ROE also goes up and when economy becomes negative, it pulls ROE down. Hence, there is a direct relation between these two. However, with CAR and NPL the expectation remains consistent. R^2 increases to 33.5% but it loses 5.3% when it is adjusted. Hence, it shows the correct value that explains the variability of ROE associated with NPL, CAR and economic condition, which is high as compared to Model 3A. Significance of F is excellent as it shows only 0.1% probability of the model being unreliable. Also, p-value of NPL and economic condition is significant however it is not the case with p-value of CAR because it shows 25% probability that the coefficient of CAR will be 0, which is not acceptable. Overall, it can be concluded that model gets stronger by using dummy variable. Theoretically it tells that the economic condition plays major role in bank's performance and with specific to Irish banks, economic condition is having direct relation to their performance.

Summary of Model 3a

Description	Model	R^2	Adjusted R^2	Significance of F	Coefficient of NPL, CAR and economic condition	p-value of NPL, CAR and economic condition	No. of observations
Model 3A with dummy variable introduced	Model 3a	0.335	0.282	0.0013	-0.56, 0.55 and 19.16	0.005, 0.246 and 0.005	42

Author's construct from regression output

Table 4

4.16: Testing significance of correlation coefficient:

The correlation coefficient for each model is calculated above however it is important to test if it is significant. Here, the testing is done for each of the single regression models. The F-test is the appropriate test for multiple regression models. Based on the hypothesis it will be concluded that correlation coefficient of population ρ (rho) is different to zero if the p-value is < 0.05. Therefore, the hypotheses will be:

H_0: The correlation coefficient $\rho = 0$

H_a: The correlation coefficient $\rho \neq 0$

Models	t value of correlation coefficient	p-value of correlation coefficient	Significance Yes/No
1	0.57148	0.5707	No
1A	2.281	0.0278	Yes
1B	0.6167	0.504	No
1C	0.7144	0.368	No
2	2.373	0.0224	Yes
2A	1.99	0.0533	Almost Yes
2B	1.895	0.065	Almost Yes
2C	1.491	0.144	No

Author's construct using Microsoft Excel

Table 5: Significance testing of correlation coefficient

From table 5 it can be seen that p-value is < 0.05 in model 1A, 2, and slightly more than 5% in 2A and 2B. In Model 1A, t value of correlation coefficient 2.281 > 2.021 (critical t value at df = 40) and there is 97.2% of confidence that ρ (population correlation coefficient) is not 0. Hence, there is a linear relationship between NPL and ROE thereby rejecting the null hypothesis. For Model 2, t > 2.02 (critical t value at df= 41) and p-value shows that there is 97.7% confidence that r is significant. This shows that there is significant linear relationship between CAR and ROE. But for Model 2A and 2B it is close to being significant as t values are slightly less than critical t values at df = 40 and 37.

Hence, relation between CAR and ROE is close to being significant. Therefore, in all these case H_a will be accepted and null hypothesis H_0 is rejected.

4.17: Diagnostic testing:

The results which are coming with Non- performing loans are low because R^2 value is coming out to be lower in each of the model hence, author has done the diagnostic testing to check the quality of the dataset.

4.17.1: Multicollinearity:

The examination is done for the correlation between the independent variables (NPL and CAR) under 4 different conditions to check if Non-performing loans and Capital Adequacy Ratio are correlated. However, from the results, it is seen that none of them are high. The values are coming out to be very low for all the 4 conditions. Hence, it can be concluded that the independent variables i.e. Non-performing Loans and Capital Adequacy Ratio are not correlated, which means Multicollinearity is not present between the variables. Therefore, Multicollinearity is not a problem for this study and hence, resolution is not required in this case.

Multicollinearity test		
Conditions	Data set	Correlation between NPL and CAR
1	Original data with NPL and CAR	-0.076
2	NPL and CAR with outlier removed	-0.107
3	NPL and CAR with lagged variable	-0.063
4	NPL and CAR with lagging and outlier removed	-0.094

Author's construct using Microsoft Excel

Table 6: Multicollinearity test

4.17.2: Autocorrelation:

Autocorrelation is tested by the author for the models which are appropriate[3] for the test. It is done by using Durbin-Watson test in SPSS software and results are shown in Table 7, but there is a need to check the significance of the obtained Durbin-Watson score hence, Durbin-Watson significance table (Appendix 5) comes in picture. The significance testing is done based on hypothesis (Lind, 2020) which are:

H_0 = No autocorrelation

H_a= Positive autocorrelation

From the results it is seen that Durbin-Watson score is between 1.5 and 2 and after doing the significance testing against the Durbin-Watson table[4], it is seen that the obtained d value is greater than upper limit (d_u) hence, it can be concluded that there is a failure in rejection of null hypothesis and there is no evidence of Autocorrelation being present for the data. Autocorrelation is not a problem for this study hence, resolution is not required in this case.

[3] Durbin-Watson test is not applicable when the model includes lagged dependent variable. Hence in this study, models with "lagged variable" and model with both "lagging and outlier removed" are not considered for the testing.

[4] d_l and d_u are created by the author for n= 42 and 43 as Durbin-Watson table provides the upper and lower limit for n= 40 and directly jumps to n= 45.

Model	D-W score	Lower limit (d_l) and upper limit (d_u) for n=43 and 42	conclusion
1	1.857	1.414 and 1.612 (n=43)	No Autocorrelation
1A	1.7	1.406 and 1.608 (n=42)	No Autocorrelation
1B	1.828	Not appropriate	N/A
1C	1.659	Not appropriate	N/A
2	1.788	1.414 and 1.612(n=43)	No Autocorrelation
2A	1.653	1.406 and 1.608(n=42)	No Autocorrelation
2B	2.033	Not appropriate	N/A
2C	1.708	Not appropriate	N/A
3	1.869	1.414 and 1.612(n=43)	No Autocorrelation
3A	1.865	1.406 and 1.608(n=42)	No Autocorrelation
3B	2.035	Not appropriate	N/A
3C	1.727	Not appropriate	N/A

Author's construct using Microsoft Excel

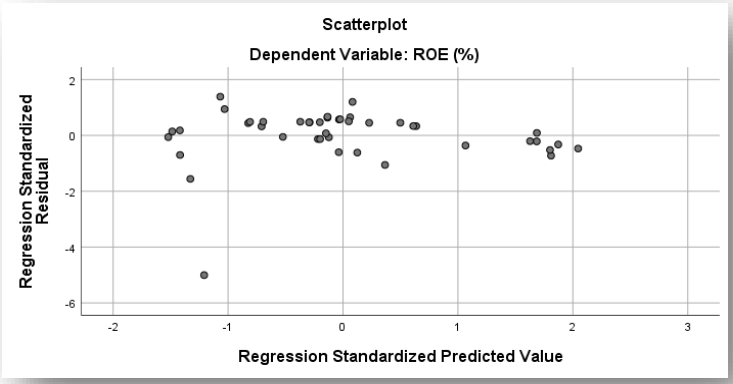
Table 7: Significance testing of Autocorrelation

4.17.3: Heteroscedasticity:

Using the scatter plots in SPSS, an attempt is made to check for the presence of Heteroscedasticity in multiple regression for different conditions. Below are the scatter plots for 4 different conditions which has been considered in the study, in which standardized residual value is regressed on standardized predictive value.

The examination is done through scatter plots primarily, in which it will be observed if there is any pattern visible. Also, it will be examined if the residual values or errors are increasing with increase in predictive value. The testing of heteroscedasticity is done through scatter plot in this study.

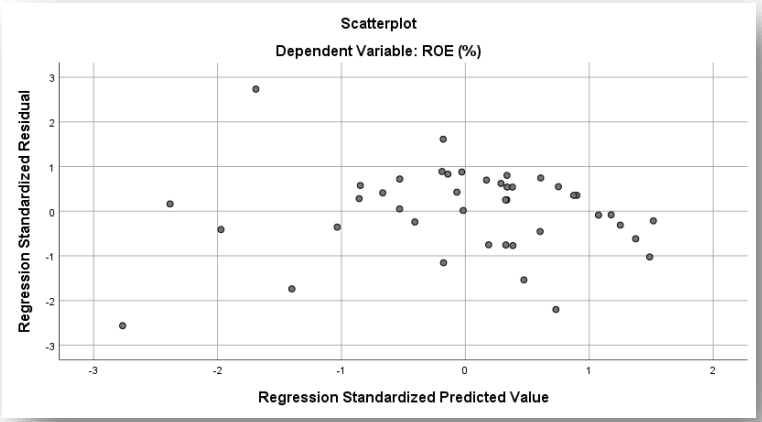
1) **Raw data:** For original data set with 43 observations, in middle there are few numbers which are closer in the scatter plot but overall, the model doesn't have any specific pattern visible which shows there is no heteroscedasticity problem.



Author's construct using SPSS

Figure 11

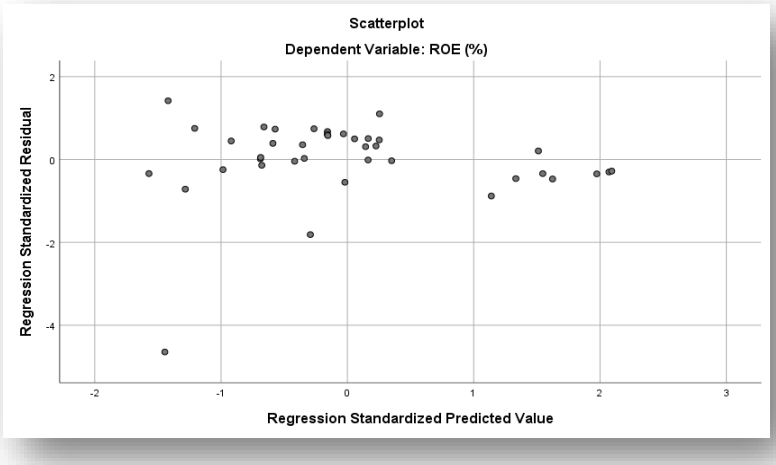
2) **Outlier removed:** After removing an outlier (0.941, 9.36, -222.5) in this case as well, the data doesn't show any pattern with 42 observations. Hence, it can be concluded that even if the outlier is removed, the data doesn't show any specific pattern. Therefore, Heteroscedasticity doesn't come out to be an issue for this condition.



Author's construct using SPSS

Figure 12

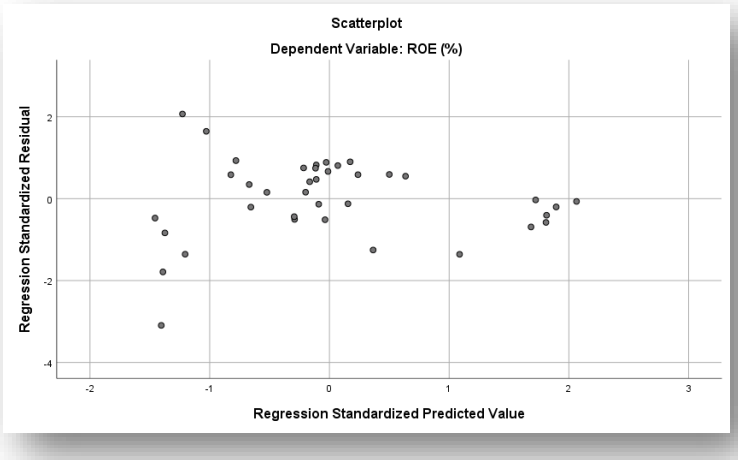
3) **<u>Lagged dependent variable:</u>** Even after lagging dependent variable ROE by one period, with 39 observations the points are closer in middle but when considering overall model, there is no pattern seen. Hence, there is no evidence that Heteroscedasticity is an issue in this case as well.



Author's construct using SPSS

Figure 13

4) **<u>Lagging and outlier removed:</u>** Based on the plot below, it can be seen that the points are scattered, and no obvious pattern is seen. Hence with 38 observations, Heteroscedasticity is not an issue for this condition as well.



Author's construct using SPSS

Figure 14

However, from the visuals it gives an idea that Heteroscedasticity is not present in the data. But to be sure, its significance is tested in SPSS using Breusch-Pagan test and conclusion is made based on the hypothesis.

H_0 = The data has Homoscedasticity

H_a = The data has Heteroscedasticity

The author has tested the Heteroscedasticity for all the four conditions by using this test in SPSS where the squared residuals are regressed on the independent variables. And p-value is looked upon for making the conclusion. Therefore, if p-value > 0.05 then null hypothesis is not rejected. Appendix 6 shows the output from the SPSS after regressing squares of residual with the independent variables for the raw data, as an example and Table 8 has the results from the test.

Condition	Dataset	p-value	Conclusion	Heteroscedasticity present (Yes/ No)
1	Raw data	0.238	Fail to reject H_0	No
2	Outlier removed	0.005	Reject H_0	Yes
3	Lagged dependent variable	0.258	Fail to reject H_0	No
4	Lagging and outlier removed	0.002	Reject H_0	Yes

Author's construct using SPSS

Table 8: Significance testing for presence of Heteroscedasticity

From Table 8, it is seen that p-value < 0.05 for two conditions i.e. 'outlier removed' and 'lagging and outlier removed' from the dataset. Hence, null hypothesis H_0 is rejected as data shows that there is Heteroscedasticity present in the data. Whereas, for other two conditions, there is no evidence seen for Heteroscedasticity. But, addressing the identified issue of heteroscedasticity will be beyond the scope of this research.

Chapter 5: Discussion:

In this dissertation the objective was to check if there is a significant relationship between credit risk management and profitability of the Irish banks. The hypotheses is tested from different angles. The diagnostic testing undertaken and explained in Chapter 4 indicates that the models which are derived are robust and the conclusions are reliable.

It is seen from the regression results that models which are showing statistically significant relationship between NPL and ROE are Model 1A (ROE versus NPL with outlier removed) and 3A (ROE versus NPL and CAR with outlier removed). This is similar to the results obtained by Ekinci and Poyraz (2019); Islam *et al.,* (2019); Serwadda (2018); Annor and Obeng (2018); Laryea *et al.,* (2016); and Gizaw *et al.,* (2015). Also, when dummy variable is added to the model (Model 3a: ROE versus NPL, CAR and economic condition), it still provides the significant result with NPL. Hence, accepting the hypothesis H_{a1}: There is a significant relationship between NPL and ROE and rejecting the null hypothesis H_{01} as the results from the best models provides the evidence to accept it. This is because p-value of NPL coefficient is less than 0.05 in the models. Also, correlation coefficient 'r' for model 1A is negative and passing the significance test (Table 5) thus, providing the strong evidence that there is negative association between NPL and ROE. From this it can be concluded that NPLs contributes in profitability of the banks. As a result, high number of NPLs in Irish banks will have negative effect on profitability therefore, banks should focus on doing background checks and concentrating on credit scoring before giving loans to the customers.

When it comes to understanding the relation between CAR and ROE, it is expected to have a positive association and this study on Irish banks is consistent with the expectation. It can be seen from Model 2 that there is a significant relationship between the two variables. The result is in support with Ali and Dhiman (2019); Islam *et al*., (2019); Annor and Obeng (2018); Asllanaj and Nuhiu (2018); Gizaw *et al.,* (2015); Mushtaq *et al.,* (2015); Ogboi and Unuafe (2013); Poudel (2012). Thereby, null hypothesis H_{02} is rejected and alternate hypothesis H_{a2}: There is a significant relationship between CAR and ROE, is accepted. This is because p-value is less than 0.05. Also, Model 3A shows the result with CAR, close to be significant as p-value is slightly more than 5%. Correlation coefficient 'r' pass the significant testing for Model 2 hence, making the stronger conclusion. From this

it can be said that Capital Adequacy positively impacts the profitability of the banks. Therefore, if Irish banks improves the Capital Adequacy Ratio, the profitability will show a rise.

Overall, it can be said that, both NPL and CAR as measures of credit risk management are important drivers of profitability. But as an additional finding, it can be seen that economic condition also plays a major role in bank's profitability as it can be seen from Model 3a that there is also a positive relationship between the two. Based on the results of the research analysis it is clear that if Irish banks controls NPLs by having efficient credit risk management which can include credit assessment and using credit scoring models, profitability will improve. Similarly, the findings related to CAR tells that better Capital Adequacy will certainly improves the financial stability and security of the Irish banks as it helps in avoiding the unlikely situations which can arise in the form of financial losses. Thereby enhancing the profitability of the Irish banks.

While the results are significant, R^2 values are still on the lower end. Therefore, other variables would impact on profitability and this is discussed in bit more detail in Chapter 6.

Chapter 6: Conclusions, Limitations and Recommendations:

6.1: Conclusions:

The objective of this research was to examine if there is an impact of credit risk management on the profitability of the Irish banks. The sample of 4 Irish banks were used in this study with 2 indicators of credit risk management (NPL and CAR) and a single indicator of profitability (ROE), which were used in the previous study done by Yousuf and Felföldi (2018). The time period considered is of 11 years from 2008-2018. After developing the models under different conditions and undertaking diagnostic testing of the dataset, findings shows that Non-performing loans are associated negatively with the profitability. In other words, it can be said that Non-performing loans and profitability shows an inverse relation. This is in support with the theory related to Non-performing loans as profitability will decrease with high number of NPLs. A reason is given by Ciukaj and Kil (2020) for high number of NPLs are, charging of higher interest rate on the loans which are newly granted to customers. But, having efficient credit policy will certainly help the banks for reducing Non-performing Loans. Hence, it is important for the commercial banks to have a sound credit risk management system.

With increase in sources of income of the banks, the ability to provide more loans increases but at the same time the risk of keeping funds with them, in order to be sustainable at the time of loss also increases. Hence, Basel Committee has announced to keep the minimum level of Capital Adequacy Ratio and increased the level of the requirements under Basel I, II and III (Li *et al*., 2016). The findings related to Capital Adequacy Ratio from this study showed that it is positively related to the profitability of the Irish banks, which is also consistent with the theory. This is directly related to the profitability as higher Capital Adequacy Ratio means banks have the sufficient funds in order to recover from any crisis also, have better financial state as the funds which banks will have are more than the minimum amount which has to be held in order to reduce the risk of being insolvent. Yousuf and Felföldi (2018) also states that as Capital Adequacy Ratio increases, banks' financial security and stability also goes up. Therefore, it is better to have high CAR in banks as it will help in absorbing the loss related to credit thereby recording greater profitability. With the best models identified in the study related to CAR (Model 2), the regression coefficient showed that if CAR increase by 1 unit, profitability

goes up by 2 units. This is a good result relating to Irish banks as high level of CAR will positively affect ROE of the banks.

Additionally, findings related to the dummy variable indicated that economic condition plays a major role in profitability of the banks. Though variable is not real and measureable, it showed a significant result and proved to be a stronger reason for increase or decrease in profitability of the banks.

Hence, it is always advisable for banks not only just for Ireland but for any country, to have a good credit risk management system.

6.2: Limitations of the research:

1) This study has used only 2 indicators of credit risk management. However, the other indicators e.g. Non-performing Assets (NPA), Liquidity (L) and Asset Quality Ratio (AQ), as used by other authors could also be used along with NPL and CAR to possibly get more accurate results for the effect of credit risk management on profitability.
2) As a single profitability measure is used in this study, using more than one measure may give stronger results, eg. Return on Assets (ROA) which has been used by other authors.
3) In order to introduce dummy variable, the year of crisis and recovery is decided based on the general knowledge and understanding. It was not done based on any specific metric. Hence, different ways of measuring economic condition could be examined, such as level of unemployment.
4) Some models show an evidence of the presence of Heteroscedasticity but the resolution of it is not done in this study. However, the analysis could be done further by trying to remove Heteroscedasticity.

6.3: Recommendations for the further development of the research:

Based on the findings from this study, there are a few suggestions made by the author, which can be used in developing further research in this area.

1) **Different country:** One way of developing this study, is by considering a different country which has a developed economy for the same time period which is considered in this research. It would be interesting to see if the results are consistent with theoretical expectations and with the results for Ireland or contradicts with these.
2) **Non-linear regression:** As a suggestion for the methodology for the development of the research, non-linear regression could be used for developing the models. The study has examined using non-linear trendline for the single regression models and has presented this for the models which are showing highest improvement in R^2. Hence, it can be recommended for the further development of the study to use non-linear regression for developing the models. Basically, a logarithmic regression can be used in further studies as logarithmic trendline has improved the R^2 in this research for single regression from 5% to 10%, which is done with ROE and CAR. Therefore, from this it is seen that there is a potential to improve the models and further research could be developed in this direction.
3) **Dummy variable:** Another recommendation can be to develop the research models using dummy variable. Since, this research has considered the time of crisis and recovery both in Ireland, it was logical to use a dummy variable called "economic condition" to investigate the relationship of it with the profitability of the Irish banks. Hence, an attempt is made to use dummy variable for one of the best models of multiple regression analysis (Model 3A) to check if the model is improving. The results are interesting as it shows a strong relationship with profitability therefore, it would be interesting to find the suitable qualitative variable for the further studies which are using different time periods and use that dummy variable to develop the models. This could be an interesting expansion of the research.
4) **Other explanatory variables:** In this study, the R^2 values are relatively low, the research can also be widened out to examine other explanatory variables which

drive the profitability. It would be worth searching for the other factors apart from credit risk management that can affect profitability and hence, the focus of the research could be changed from credit risk management to other driving factors of profitability.

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Appendix:

1) Calculation of Ratios:

NPLR = $\frac{Total\ loans\ charge\ off/written\ off}{Total\ loans\ and\ receivables\ to\ customers}$ x 100 = $\frac{1133.6\ m€}{65741\ m€}$ x 100 = 1.724%

Source: Allied Irish Bank Annual report 2013

CAR = $\frac{Tier\ 1\ capital + Tier\ 2\ capital}{Risk\ Weighted\ Assets}$ x 100 = $\frac{8926\ m€ + 1410\ m€}{62395\ m€}$ x 100 = 16.5%

Source: Allied Irish Bank Annual report 2013

ROE = $\frac{Net\ income}{Shareholder's\ equity}$ = $\frac{786\ m€}{8747\ m€}$ x 100 = 8.98%

Source: Bank of Ireland Annual report 2014

Full set of calculations are available on the request from author.

2) Excel workings of Multicollinearity:

With all the observations		
	X1	*X2*
X1	1	
X2	-0.076	1

NPL and CAR with outlier removed		
	X1	*X2*
X1	1	
X2	-0.10782	1

NPL and CAR with lagged variable		
	X1	*X2*
X1	1	
X2	-0.06325	1

NPL and CAR with lagged variable and an outlier removed		
	X1	*X2*
X1	1	
X2	-0.094407265	1

Where X1 = NPL and X2= CAR

3) t distribution table:

df	Confidence intervals					
	80%	90%	95%	98%	99%	99.90%
	Level of significance for One-Tailed Test					
	0.1	0.05	0.025	0.01	0.005	0.0005
	Level of significance for Two-Tailed Test					
	0.2	0.1	0.05	0.02	0.01	0.001
36	1.306	1.688	2.028	2.434	2.719	3.582
37	1.305	1.687	2.026	2.431	2.715	3.574
38	1.304	1.686	2.024	2.429	2.712	3.566
39	1.304	1.685	2.023	2.426	2.708	3.558
40	1.302	1.684	2.021	2.423	2.704	3.551
41	1.302	1.683	2.02	2.421	2.701	3.544
42	1.302	1.682	2.018	2.418	2.698	3.538
43	1.302	1.681	2.017	2.416	2.695	3.532

Source: Lind, D. A. (2020) Statistical Techniques in Business and Economics. 18th edn

4) Example of testing significance of correlation coefficient (for Model 3):

t = $\frac{r\sqrt{(n-2)}}{\sqrt{(1-r^2)}}$ where r= 0.353131042, n=43

t= $\frac{2.261141933}{0.935573871}$ = 2.41685024

p value of 2.41685024 = 0.020190376

Source: Author's calculations

5) Critical Values for the Durbin-Watson statistic ($\alpha = 0.5$)

	K=2	
n	d_l	d_u
39	1.38	1.60
40	1.39	1.60
42	1.406	1.608
43	1.414	1.612
45	1.43	1.62

n= sample size

K= number of independent variables

Source: *Lind, D. A. (2020) Statistical Techniques in Business and Economics. 18th edn*

6) Output from the Breusch-Pagan test for Raw data:

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	90918839.182	2	45459419.591	1.486	.238[b]
	Residual	1223272290.144	40	30581807.254		
	Total	1314191129.326	42			

a. Dependent Variable: sqres

b. Predictors: (Constant), CAR (%), NPL (%)

7) Original Data set:

Year	Bank	ROE (%)	NPLR (%)	CAR (%)
2008	Allied Irish Bank	8.2	0.12827	10.57
2009	Allied Irish Bank	24.8	0.5031	10.33
2010	Allied Irish Bank	-222.5	0.941	9.36
2011	Allied Irish Bank	-48.8	0.957	20.61
2012	Allied Irish Bank	-37	0.917	17.73
2013	Allied Irish Bank	-21.51	1.724	16.5
2014	Allied Irish Bank	8	6.138	18.14
2015	Allied Irish Bank	12.4	6.54	18.86
2016	Allied Irish Bank	11.1	2.8	21.7
2017	Allied Irish Bank	8.4	1.13	22.56
2018	Allied Irish Bank	8.17	1.378	22.4
2008	Permanent tsb	2.25	2.8	30.18
2009	Permanent tsb	-15.6	5.9	31.31
2010	Permanent tsb	-7.92	8.9	31.47
2011	Permanent tsb	-12.16	17.2	26.84
2012	Permanent tsb	-35.25	22	20.47
2013	Permanent tsb	-10.95	26	14.82
2014	Permanent tsb	-4.47	26	14.92
2015	Permanent tsb	-17.74	24	18.85
2016	Permanent tsb	-12.66	27	18.9
2017	Permanent tsb	1.89	26	18.44
2018	Permanent tsb	0.15	10	16.02
2009	Ulster	-26.58	18.11	9.145

Outlier

2010	Ulster	-60.33	28.389	9.93
2011	Ulster	-37.22	42.54	10.26
2012	Ulster	-28.95	54.68	11.42
2013	Ulster	-92	68.25	13.57
2014	Ulster	33.86	63.66	23.309
2015	Ulster	13.91	28.29	32.11
2016	Ulster	0.57	18.59	32.709
2017	Ulster	-2.53	16.79	33.81
2018	Ulster	1.733	11.3	30.41
2008	Bank Of Ireland	0.491	0.182	15.86
2009	Bank Of Ireland	-22.82	0.0937	14.197
2010	Bank Of Ireland	-8.22	0.388	12.06
2011	Bank Of Ireland	0.39	0.386	15.85
2012	Bank Of Ireland	-21.25	0.48	16.539
2013	Bank Of Ireland	-6.23	18.85	13.56
2014	Bank Of Ireland	8.98	17.65	18.29
2015	Bank Of Ireland	10.39	13.2	17.96
2016	Bank Of Ireland	8.43	9.6	18.47
2017	Bank Of Ireland	7.158	8.3	20.18
2018	Bank Of Ireland	6.71	6.3	18.76

Author's calculations

8) <u>Data set with dummy variable:</u>

Year	Bank	ROE (%)	NPLR (%)	CAR (%)	economic condition
2008	Allied Irish Bank	8.2	0.12827	10.57	0
2009	Allied Irish Bank	24.8	0.5031	10.33	0
2010	Allied Irish Bank	-222.5	0.941	9.36	0
2011	Allied Irish Bank	-48.8	0.957	20.61	0
2012	Allied Irish Bank	-37	0.917	17.73	0
2013	Allied Irish Bank	-21.51	1.724	16.5	1
2014	Allied Irish Bank	8	6.138	18.14	1
2015	Allied Irish Bank	12.4	6.54	18.86	1
2016	Allied Irish Bank	11.1	2.8	21.7	1
2017	Allied Irish Bank	8.4	1.13	22.56	1
2018	Allied Irish Bank	8.17	1.378	22.4	1
2008	Permanent tsb	2.25	2.8	30.18	0
2009	Permanent tsb	-15.6	5.9	31.31	0
2010	Permanent tsb	-7.92	8.9	31.47	0
2011	Permanent tsb	-12.16	17.2	26.84	0
2012	Permanent tsb	-35.25	22	20.47	0

2013	Permanent tsb	-10.95	26	14.82	1
2014	Permanent tsb	-4.47	26	14.92	1
2015	Permanent tsb	-17.74	24	18.85	1
2016	Permanent tsb	-12.66	27	18.9	1
2017	Permanent tsb	1.89	26	18.44	1
2018	Permanent tsb	0.15	10	16.02	1
2009	Ulster	-26.58	18.11	9.145	0
2010	Ulster	-60.33	28.389	9.93	0
2011	Ulster	-37.22	42.54	10.26	0
2012	Ulster	-28.95	54.68	11.42	0
2013	Ulster	-92	68.25	13.57	1
2014	Ulster	33.86	63.66	23.309	1
2015	Ulster	13.91	28.29	32.11	1
2016	Ulster	0.57	18.59	32.709	1
2017	Ulster	-2.53	16.79	33.81	1
2018	Ulster	1.733	11.3	30.41	1
2008	Bank Of Ireland	0.491	0.182	15.86	0
2009	Bank Of Ireland	-22.82	0.0937	14.197	0
2010	Bank Of Ireland	-8.22	0.388	12.06	0
2011	Bank Of Ireland	0.39	0.386	15.85	0
2012	Bank Of Ireland	-21.25	0.48	16.539	0
2013	Bank Of Ireland	-6.23	18.85	13.56	1
2014	Bank Of Ireland	8.98	17.65	18.29	1
2015	Bank Of Ireland	10.39	13.2	17.96	1
2016	Bank Of Ireland	8.43	9.6	18.47	1
2017	Bank Of Ireland	7.158	8.3	20.18	1
2018	Bank Of Ireland	6.71	6.3	18.76	1

Author's calculations